Environmental and individual influences on smoking in young people

Findings from the international HBSC study

Anne Hublet

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"An ounce of prevention is worth a pound of cure"

Henry de Bracton – English jurist and author of De Legibus et Consuetudinibus Angliae
(ca. 1210 – 1268)

"It is now proved beyond doubt that smoking is one of the leading causes of statistics."

Fletcher Knebel – American author (1911 – 1993)

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Smoking and smoking in adolescence has been a priority in public health for decades (US Department of Health, Education and Welfare, 1964; Wynder, 1988). Although the topic is well researched and all Western countries have policies in place, smoking prevalence in young people is still high in many countries and even rising in other countries (Mackay & Eriksen, 2002; Schepsis & Rao, 2005). The international Health Behaviour in School-aged Children-study (HBSC) offers opportunities to study this public health issue in large representative samples of adolescent populations in many countries in Europe and North America. The international perspective has the advantage that countries in all phases of the smoking epidemic (as measured in an adult population) are included and the large international representative samples of adolescent populations offer opportunities to study smoking in specific target populations for smoking prevention. After describing several aspects of the tobacco problem, a social ecological framework for tobacco control is presented. This framework is used not only to describe what can be done at the different levels of intervention but also to structure the information on the determinants of smoking that can be tackled at the different levels. In the chapter on the individual level, we are also concentrating on a specific risk population for smoking, namely adolescents with respiratory problems. After summarising the objectives of the thesis, the methodology on which the thesis is based on, is explained.

1. Tobacco, a public health threat

Cigarettes are still the core of the mass production of tobacco products that are being smoked globally, and today no other tobacco product on the market causes more harm (Prokhorov et al, 2006). Tobacco smoke contains about 4000 chemical substances such as acetone, ammonia, arsenic, butane, DDT, cadmium, carbon monoxide, methanol, hydrogen cyanide, naphthalene, toluene, and vinyl chloride (Mackay & Eriksen, 2002). Smoking-related deaths are mainly due to lung cancers, heart disease, chronic lung disease of emphysema, bronchitis, and chronic airway obstruction (Centers for Disease Control and Prevention, 2005). This makes tobacco a leading preventable cause of death in the world (WHO, 2002b). Smoking is currently responsible for the death of one in ten adults worldwide (about five million deaths each year) (Ezzati & Lopez, 2003). If the

current smoking patterns continue, the total of tobacco-attributable deaths will rise to 6.4 millions in 2015 and 8.3 millions in 2030 (Mathers & Loncar, 2006).

Of course, these are all long-term effects of smoking seldom affecting young people. Short-term effects of smoking occurring in adolescence are: being less physically active, having more respiratory illnesses, and a faster lung function decline (US Department of Health and Human Services, 2004). Also impaired lung growth, chronic coughing and wheezing are observed in adolescent smokers (US Department of Health and Human Services, 2004). The short-term hazards mentioned by adolescents are: having breathing difficulties, being less physical active, irritating eyes and coughing (de Vries et al, 1990).

Most smoking (90%) is established in adolescence (Jarvis, 2004; Lamkin & Houston, 1998; Warren et al, 2000). Within a year of smoking, children inhale the same amount of nicotine per cigarette as adults and experience the same craving symptoms (Jarvis, 2004). Therefore, tobacco dependence is sometimes described as a paediatric disease (Prokhorov et al, 2006).

The majority of smokers (75%) try to stop smoking during adolescence, but only few (10%) succeed (Lamkin & Houston, 1998). In a study of Stanton et al (1996), 13.6% of adolescents quit smoking for at least a month, the same rate as in adults, while only 21% of the adolescents were not considering to quit smoking. In the experimental phase of smoking, a lot of movement in and out smoking status occurs with 50% of quitters (Sargent et al, 1998). In daily smokers, only 6.8% quit smoking. Sargent et al (1998) found no characteristics in daily smoking that predict future cessation. They conclude that addiction plays the largest role in the failure to quit smoking in daily smokers. After reaching the brain, nicotine binds to nicotine receptors which stimulate the release of dopamine, a neurotransmitter associated with addiction. Adolescents' developing brains tend to be highly susceptible to nicotine addiction. Therefore the duration of smoking and the number of cigarettes required to establish nicotine addiction are lower in adolescents than in adults (Prokhorov et al, 2006). Just a few weeks of use are sufficient to develop a nicotine addiction (DiFranza et al, 2002).

Tobacco and poverty are inextricably linked. In 2002 in the EU, 54% of the unemployed and 51% of the manual workers were smokers, compared to an overall average of 39% smokers in the EU (WHO, 2004). Also between countries,

the socio-economical gradient is observed in the last 30-40 years with low-income countries having a higher smoking prevalence than high-income countries (WHO, 2004). Smoking is seen as the largest single cause of socio-economical inequalities in morbidity and premature mortality (Kunst et al, 2004). In men, smoking contributed for about 20% to educational inequalities in all-cause mortality (Kunst, 2007).

Not only smoking, but also the exposure to tobacco smoke has been associated with a multitude of health problems. More than 50 carcinogens are identified in the midstream and in second-hand smoke (US Department of Health and Human Services, 2006). Therefore, second-hand smoke causes premature death and disease in children and in adults who do not smoke. Especially among children of school age, a causal relation exists between second-hand smoke (like parental smoking) and cough, phlegm, wheeze, breathlessness, wheeze illnesses and asthma (US Department of Health and Human Services, 2006). Thereby, scientific evidence indicates that there is no risk-free level of exposure to second-hand smoke (US Department of Health and Human Services, 2006).

Tobacco control has four principal objectives. The final goal is to avoid the burden of tobacco-related disease, disability and mortality (Centers for Disease Control and Prevention, 2007). These objectives are:
1. preventing the initiation of tobacco use by young people
2. helping adult smokers to quit
3. protecting non-smokers from the risk posed by second-hand smoke
4. identifying and eliminating the disparities related to tobacco use and its effects among different population groups.

2. A social ecological framework for tobacco control

2.1 The social ecological model for tobacco control

Most of the early smoking prevention interventions focus on individual behaviour change, but have shown to have limited success. Richard et al (2002) described three generations of tobacco control interventions: 1) cessation of smoking using a clinical approach (smoking is an individual and behavioural issue), 2) the

smoking problem as a community and environmental issue with the focus on the population as well as high-risk groups with interventions from the clinic to the community (e.g. in schools), and 3) comprehensive tobacco control programs by putting a greater emphasis on macro-environmental factors and by initiating actions to influence public and private policies and regulations (such as taxes and restricting youth access).

In the last decades, the health promotion shifted to approaches that respond to the reciprocity between biology, health behaviours and environment (Green, 2006). The decades of research on risk factors and protective factors of smoking in adolescents show a broad picture of factors on different levels of adolescents' life. As with other behaviour, smoking does not occur within a vacuum but is influenced by its physical environment and relationships to people.

Concepts of ecological approaches are already found in the 1800s when poverty and social class were linked with health and diseases (i.e. the typhus epidemic) (McLaren & Hawe, 2005). Also in psychology, psychologists such as Skinner, Lewin, Barker and Brofenbrenner recognised that antecedents, consequences, and the environment, indirectly or directly influence behaviour (Sallis & Owen, 2002). In health promotion, the social ecological approach was introduced by Rudolphe Moos (1980) who specified four sets of environmental factors relevant to health: physical setting, organizational setting, human aggregate and social climate. Stokols (1992) introduced the concept of Health Promotive Environment in which interventions must address environmental resources.

An ecological model of health behaviour identifies multiple levels of influence and suggests relationships between and among them (Cook, 2003; Kothari et al, 2007; McLeroy et al, 1988). McLeroy et al (1988) propose five levels of influence; namely intrapersonal factors, interpersonal processes, institutional factors, community factors and public policy. This model is especially applicable to tobacco control. Extensive multilevel interventions targeting individuals, social norms, policy and regulatory initiatives, and environmental change by reducing availability of cigarettes can influence smoking prevalence (Warner, 2000). Therefore, key interventions for tobacco control are at the personal, interpersonal, community and policy level.

Risk factors of and protective factors for smoking and smoking interventions in adolescents will be discussed within the different levels of a social ecological framework. Keeping in mind that a socio-ecological model suggests complex interconnections among factors by influencing or modifying each other, discussion is possible where to describe certain factors (such as school connectedness which is an individual characteristic that can be influenced by the school climate and culture). Smoking interventions are described on the level they are conducted, although they include components using individual level factors (such as school interventions based on social influence models).

2.2 Country level

2.2.1 The smoking epidemic

The epidemic of smoking as defined by Lopez et al. (1994) describes smoking in relation to the welfare of a country and is based on sociological models. Characteristics of this four-stage trajectory are the smoking prevalence, the smoking consumption (the amount of cigarettes smoked) and smoking-related mortality in a country.

Stage 1 (10-20 years):

Smoking prevalence is low and mainly a male habit (less than 15% of men smoke, while less than 5% in females). Also the consumption of cigarettes is low (less than 500 cigarettes/adult per year) and smoking-related diseases and deaths are rare. According to the Diffusion of Innovations theory of Rogers (Rogers, 1995), this new habit will be first adopted by males in the higher socio-economical classes.

Stage 2 (20-30 years):

This stage is characterised by a rapid rise of male smoking to 50-80%. The amount of ex-smokers is low. Also smoking prevalence in women increases, but is still lower than the smoking prevalence in men. Especially the higher socio-economical classes are smokers, but also the lower classes start smoking. The consumption of cigarettes increases (1000-3000 cigarettes/adult per year), mostly due to an increased consumption of cigarettes in men. About 10% of mortality in men is due to tobacco-related diseases. In women, tobacco-related mortality is still low.

Stage 3 (30 years):

The male smoking prevalence declines to 40-60%. Women smoking prevalence remains stable and even starts to decline at the end of this stage (35-45%). The peak of women smoking will be lower than in men due to prevention campaigns started in this phase. These tobacco control policies are aimed to reduce the overall smoking rate, but the decreases of smoking are found in high-educated adults (Ogilvie & Petticrew, 2004). Consumption of cigarettes is still increasing or remains stable, indicating that smokers smoke more cigarettes. This stage is especially characterised by a rapid increase of smoking-attributable mortality to 25-30% in males. In women, mortality due to smoking stays relatively low (5%) but is increasing.

Stage 4:

Smoking is still declining but now at a slower rate. The prevalence of male smoking is between 33-35% while prevalence in female smoking is about 30%. There is a peak in male smoking-attributable mortality of 30-35% and mortality in females increases rapidly to 20-25%. In this stage the social differences in smoking persist and are even widening. Socio-economical inequalities in smoking are established.

Although smoking seems to follow a 'natural' course or a course induced by the tobacco industry by targeting specific subpopulations (Lopez et al, 1994; Pierce & Gilpin, 1995), tobacco control policies can influence this course. Countries can take several price and non-price measurements to protect non-smokers from secondhand smoke and to discourage smoking.

2.2.2. Tobacco control policy

In 1999, the World Bank launched a report on the most effective tobacco control policies (Jha & Chaloupka, 1999). In the report, for several tobacco control policies, a thorough review of the literature was made together with the study of a database compiled from various sources (Jha & Chaloupka, 2000). Evidence for cost-effectiveness is based on the effect in the general population and takes into account the three aims of tobacco control (smoking prevention, smoking cessation and protecting non-smokers from the risk posed by second hand smoke). Cost-effective tobacco control initiatives include increasing tobacco price

and taxes, bans or restrictions of smoking in public places, giving consumer information by campaigns, bans on smoking advertisement, obliging health warnings on cigarette packages, and investing in treatment for smoking cessation. It is still unclear what is effective in youth protection. In the following, the literature regarding the effect of the six tobacco control policies in adolescents will be reviewed.

Most research in the field of smoking policy strategy focuses on the effect of the *price of cigarettes* on smoking prevalence. Price increases have been found to have a specific effect on young people (Levy et al, 2004; Lewit et al, 1997; Liang et al, 2003). Higher cigarette prices prevent the onset of smoking and also result in smokers quitting or smoking less (Guidon et al, 2002). Guindon et al (2002) cite three main reasons for this. First, younger individuals may not be as addicted to nicotine as long-term users and may therefore be more able to curb their consumption. Second, as a result of fewer peers smoking, the normative belief that almost all young people are smokers may be reduced and a multiplying effect of the price control can be expected. Third, youth are more responsive to price changes because of their relatively smaller disposable incomes. Chaloupka (1999) calculated that an increase of 10% in cigarette price will result in a decrease of 3-5% in smoking prevalence in the general population. But, in adolescents, studies show that the effect on smoking prevalence is much bigger: from 8% up to a decrease of 17% in smoking prevalence has been reported (Chaloupka, 1999; Powell et al, 2005; Tauras et al, 2005). In Canada, the taxes on cigarettes decreased under pressure from the tobacco industry. The assumption of the industry and the government was that smuggling tobacco will increase when taxes are high (Zhang et al, 2006). Zhang et al (2006) found that the greater the price reduction, the higher the rates of smoking initiation, even after controlling for individual characteristics (such as age, gender, educational attainment, income, marital status) and other tobacco control policies (such as smoke-free laws in restaurants, enforcements, signage, tobacco control expenditures). Similarly, cigarette promotions that result in effective price reductions (such as discounts on larger packages) have been found to facilitate the movement from initiation to regular smoking among young people (Slater et al, 2007).

Bans or restrictions of smoking in public places are known to have less effect in young people (Levy et al, 2004; Wakefield et al, 2000). Lewit et al (1997) found no relation between the restriction on smoking in public places and the reduction of smoking prevalence in young people. Recent longitudinal research showed that local smoke-free restaurant laws decreases the transition from experimentation to established smoking (Siegel et al, 2008).

Information campaigns in the media may also have smaller effects on youth than on other population groups (Chaloupka, 1999; Levy et al, 2004). Sowden et al (1998) found no strong evidence that mass media campaigns have an effect on youth smoking prevalence. Wakefield et al (2006) studied prevention campaigns sponsored by the tobacco industry. No beneficial outcomes were observed for the campaigns targeted to youth. In contrast, the parent-targeted advertising ('talk to your children about not smoking') may have harmful effects on youth as after they have seen the campaign, adolescents develop stronger intentions to smoke in the future (Wakefield et al, 2006).

Bans of tobacco advertisements have elicited mixed results in relation to their effects on smoking prevalence. Media and advertisements shape the social norm around smoking (Kunst et al, 2004). Advertisements glamorise smoking and fit in the struggle of adolescents to become adults and to rebel (Jarvis, 2004). Lewit et al (1997) found limited support for the effectiveness of an advertisement ban for young people, but also highlighted that additional research is needed. However, there is evidence that youth tend to recall ads that are pro-smoking (Levy et al, 2004), and that exposure to tobacco advertisements and promotions are associated with the likelihood that adolescents will initiate smoking behaviour (Lovato et al, 2003). Especially the point of sale advertisements encourages youth to smoke (Slater et al, 2007). Adolescent smokers are more likely to smoke the most advertised brands (Turner et al, 2004). During the 1960s, tobacco advertisement campaigns targeted women, resulting in a major increase in smoking among (especially) young women (Pierce et al, 1994). Only total bans on tobacco advertising may be effective (Jha & Chaloupka, 2000). Thereby, it has been argued that restrictions or bans on advertisements may only be effective as part of a more comprehensive strategy involving a range of complementary approaches (Chaloupka, 1999).

Health warnings on packages of cigarettes have not been documented as being particularly effective in reducing smoking behaviours. The evaluation finds are weak and mixed (Orleans & Cummings 1999; Levy et al, 2004). This policy may help to alter cultural norms towards smoking. Warnings on plain white packages may be more effective than warnings on regular packages (Goldberg, 1999). Also misleading messages such as 'mild', 'light', 'low tar' and 'low nicotine' can confuse consumers and make them think that these brands are safer, while the health effects are similar (Joossens & Sasco, 1999). As smoking initiation often begins with borrowing or getting cigarettes from others, this policy may not be effective to prevent smoking (Orleans & Cummings, 1995).

One of the policy measures recommended in the report of the World Bank is investing in *smoking cessation treatment*. Elements that can be included are well funded national quitlines, reimbursement of treatment (through a smoking cessation network) and reimbursement of pharmaceutical treatment products. Research shows that this tobacco control policy only has results after a few years (Levy et al, 2004). Mixed results are found in youth. In adults, counselling, nicotine replacement therapies (NRT) and bupropion are used to help smokers to quit. Nicotine replacement therapy is safe and well tolerated for use in adolescents but additional research is needed (Prokhorov et al, 2006). Recent research shows that bupropion, an antidepressant, in combination with behavioural counselling, has short-term efficacy in smoking cessation in adolescents (Muramota et al, 2007). In the long term, the abstinence rates are much lower than in adults. In their review, Grimshaw and Stanton (2006) conclude that NRT and bupropion had no effect in adolescents. Behavioural counselling may be effective, but more well-designed research is needed before drawing any final conclusions (Grimshaw and Stanton, 2006).

There is some evidence that *restrictions or bans on the sale of cigarettes to minors* reduce smoking and cigarette consumption in youth (Chaloupka and Pacula, 1999; Chen and Forster, 2006; Jason et al, 2006; Luke et al, 2000; Sundh & Hagquist, 2006). Lewit et al (1997) found a reduction in cigarette consumption when legal purchase of cigarettes was raised to 18 years. However, it appears that policy has a relatively limited impact due to weak enforcement

and the widespread availability of cigarette vending machines. Interventions dealing with this problem are described in the chapter on community level.

2.2.3. The Framework Convention on Tobacco Control

The Framework Convention on Tobacco Control (FCTC) is an international treaty that was adopted by the World Health Assembly on May 21, 2003 (Prokhorov et al, 2006). The treaty offers tools that countries can use to build tobacco control legislation. The WHO Framework Convention on Tobacco Control (WHO FCTC) is the first treaty negotiated under the auspices of the World Health Organization (WHO, 2003). Already 168 countries have signed it and 154 countries have ratified the framework (www.who.int/tobacco/framework/en downloaded on 26/05/2008).

The goals of the framework are:

- To enact comprehensive bans on tobacco advertising, promotion and sponsorship within five years.
- To obligate the placement of rotating health warnings on tobacco packaging that cover at least 30% of the principal display areas and may include pictures or pictograms.
- To prohibit misleading and deceptive terms such as 'light' and 'mild', together with an urge to strict regulation of tobacco product contents.
- To protect citizens from exposure to tobacco smoke in work places, public transport and indoor public places.
- To combat smuggling, including the placing of final destination markings on packs.
- To increase tobacco taxes.

Also, a strong commitment to create strategies that are gender-specific is part of the framework (Prokhorov et al, 2006; World Bank, 2003).

2.3. Community level

2.3.1 Determinants of smoking on a community level

Several sociological models explain development of behaviour (like smoking) in relation to the community. Wilcox (2003) described a community as a geographical space (although geographical boundaries can be imprecise and variable) in which individuals, their proximal contexts (families and peer groups), and their physical structures (stores, schools, churches, playgrounds...) are embedded. This results in a larger, more distal context that has aggregate social and cultural characteristics of its own. These individuals share common resources and have a sense of common identity, whether or not those individuals actually know one another. In contagion models, for example, people within a community adopt similar patterns of behaviour, primarily through peer influence. This behaviour often stems from an adherence to underlying values (Wilcox, 2003). Institutional models pose that organizational effectiveness of institutions within a neighbourhood greatly affects the rates of risky/harmful behaviour (Duncan & Raudenbush, 1999).

Community interventions must involve community members making decisions about the implementation of various activities within the program, often building on existing structures (Sowden & Stead, 2003). The assumption behind community interventions for smoking is that smoking behaviour is influenced by values, social norms and behaviour of those in the wider environment. Individuals connected to a group or social organisation with strong prescriptions against tobacco have lower rates of cancer-related deaths and respiratory related deaths (Jarvis & Northcott, 1987). As an example, self-reported religiosity is a protective factor for smoking initiation in adolescents (Schepsis & Rao, 2005).

The neighbourhood of the adolescent becomes more and more important in research. The hypothesis behind these studies is that people would be healthier in communities characterized by high levels of social capital despite individual deprivation. Social capital has been found to influence both physical and emotional health in adults and children (Kawachi et al, 1997; Kawachi &

Kennedy, 1999). However, few studies have investigated the relationship between social capital and adolescent health (e.g. Drukker et al, 2005). The role of social capital in substance use is understudied. Low neighbourhood attachment, community disorganization, community norms favouring drug use, and the lack of community opportunities for prosocial involvement, are associated with regular smoking in adolescents (Beyers et al, 2004). A second explorative study indicates that social capital is correlated with the probability of smoking (Lundborg, 2005).

Tobacco control interventions on the community level (other than school interventions) specifically targeting adolescents are scarce. Most interventions have a school-based component, including local media, parent involvement, and community action (e.g. youth clubs).

Some interventions focus on the education of retailers about the state law regarding the sale of tobacco to minors, followed by police sting operations (Richard et al, 2002; Wilcox, 2003). These interventions can influence young adolescents not to initiate smoking, but are not successful in older adolescents. Pokorny et al (2006) found that the restriction of selling tobacco to adolescents is less important than the community attitudes towards supporting this law. Giving retailers information on the legal status or policy of youth tobacco sales has been found to be less effective than the active enforcement in reducing illegal sales (Stead & Lancaster, 2005). However, no strategy appears to guarantee complete compliance with the law.

In their review of community level interventions for adolescents, Sowden and Stead (2003) found no statistical differences between community-wide interventions and school-based interventions only. Also, no significant difference in smoking prevalence was found when community intervention programs with a school-based component are compared with those without a school-based component. Although, smoking prevalence decreased in both groups. They conclude that overall, some limited support is found for the effectiveness of community interventions in preventing the uptake of smoking in young people (Sowden & Stead, 2003).

2.3.2 School as intervention channel

Most research on community level influences on smoking in young people is on school-based interventions (Richard et al, 2006). The advantage of school-based interventions is that almost all children can be reached. Schools are social and learning environments that are accessible and relatively stable, especially in the adolescence, a period of change of relationships with family and peers.

Different characteristics of the school are related to smoking behaviour in pupils such as school size, school culture, type of school (traditional and high school versus continuation schools), sex ratio of students and of the staff, curriculum (such as health classes and smoking education), school ethos, and school smoking policy (Aveyard et al, 2004; Wilcox, 2003). In Maes and Lievens (2003), also the workload of the teachers was related to regular smoking.

One aspect of a school smoking policy is a smoking ban for pupils, staff and visitors. A school smoking ban should be applicable to all these actors. Schools permitting older students, staff and/or third parties (such as parents, suppliers and other visitors) to smoke, or schools where the rules are not clear, provide students with mixed messages and therefore may result in more smoking in pupils (Murnaghan et al, 2007; Piontek et al, 2007; Reid et al, 1995). Studies on the effect of school policies conclude that a smoking ban in the school enforced by punishment reduces tobacco use in adolescents (Aveyard et al, 2004; Wakefield et al, 2000). Piontek et al (2007) found that especially in younger adolescents, the existence of a smoking ban shows significant results. Adolescents in schools without regulations were more at risk of becoming a smoker. In older students (16 to 21-year-olds) no significant results were found. For older students, exposure to teachers smoking outdoors on the school grounds was related to an increased risk of smoking (Piontek et al, 2007). A complete ban on teachers smoking in Scottish schools was related to more smoking outside the schools and more smoking visible for pupils (Griesbach et al, 2002). Poulsen et al (2002) found that teachers smoking in the direct school environment (but not in the school) influence the smoking behaviour of pupils.

Personal factors related to the school are school connectedness and academic achievement and will be discussed in the next chapter.

School-based smoking interventions can, besides smoking bans, consist of different components (Thomas & Perera, 2006).

In *an information giving curriculum*, information is given about health risk, prevalence and incidence of smoking (Lantz et al, 2000). In a review, a significant effect in one high-quality intervention was found (Thomas & Perera, 2006). Compared to other interventions, just giving information had no or less effect. Giving information increases the pupils' knowledge, but has little effect on behaviour (Lantz et al, 2000; Reid et al, 1995).

A social competence curriculum is based on the social learning theory (Bandura, 1977). Based on this theory, smoking is established by social models. Poor personal and social skills make adolescents smoke. Activities included are goal setting, problem solving, decision making, enhancing self-esteem, learning to cope with stress and anxiety and increasing assertiveness. Some positive non-significant effect was observed (Lantz et al, 2000; Thomas & Perera, 2006).

Most effect is found in intervention programs with *a social influence approach* based on normative education methods and anti-tobacco resistance skills training (Lantz et al, 2000; Reid et al, 1995; Thomas & Perera, 2006). Methods used in these programs are correcting the overestimation of smoking prevalence, recognizing high-risk situations, increasing awareness of media and other influences, teaching refusal skills, using older peers to teach younger adolescents, and making a public commitment not to smoke. Most interventions at school are based on this model (Thomas & Perera, 2006). When data in the review of Thomas and Perera (2006) are pooled, beneficial effects (but not significant) are found on the short term, but negative (not significant) effects on the long term. When taking only the high-quality interventions into account, a negative non-significant effect was found on the short term and a positive non-significant effect was found on the long term. Combining the social influence model with other components such as community interventions and generic social competence may improve effectiveness (Backinger et al, 2003; Thomas & Perera, 2006).

A criticism of this kind of intervention studies is that these are conducted under artificial conditions. In real-life situations, these programs were relatively ineffective (Reid et al. 1995; Thomas & Perera, 2006). Comprehensive programs (focusing on broader issues such as personal relationships and substance use in

general) were found to have a modest effect on smoking prevalence and were (in the USA) more likely to be adopted by the school (Reid et al, 1995).

2.4. Intra- and interpersonal level

2.4.1 Determinants of smoking on an individual level

Several **socio-demographic factors** are directly related to smoking, but can also indirectly influence smoking behaviour.

Age of onset is important as adolescents who try cigarettes at younger ages are more likely to continue smoking and to be more dependent on nicotine (Breslau & Peterson, 1996; Riali et al, 2004). Age is also a moderator of other effects such as the psychological developmental stage.

The education level (sometimes seen as the socio-economic indicator in adolescents) influences smoking behaviour. Vocational pupils are more likely to smoke than high school pupils (de Vries et al, 1990). When smoking cessation is studied in adults, each year of own education increases the chance of smoking cessation (Gilman et al, 2003; Kunst et al, 2004).

Gender is also an important determinant of smoking. As described in the chapter on country level influences, gender has a different influence on smoking prevalence depending on the period and the country characteristics (Lopez et al, 1994). The motives for smoking are also gender-specific. In girls, smoking is associated with body image and eating issues, while in boys smoking is associated with aggression and conduct disorders (Turner et al, 2004). Indirectly, gender influences smoking because girls are more likely to have depressive feelings and boys are more likely to engage in delinquency, both associated with smoking (Prokhorov et al, 2006).

While the reasons for smoking are similar across *racial or ethnic groups* (such as stress management, image and social belonging) reasons for not smoking differ substantially across ethnics (Prokhorov et al, 2006; Schepsis & Rao, 2005; Turner et al, 2004). For example, African-American girls perceive smoking as unladylike and unrespectful towards their parents while white children perceive anti-smoking messages from parents as lacking in credibility (Mermelstein & the Tobacco Control Network Writing Group, 1999).

Family structure is also associated with smoking. Intact two-parent families are protective against smoking (Griesbach et al, 2002; Tyas & Pederson, 1998).

A low *parental socio-economic status* and *socio-economic stress* in general is related to higher smoking prevalence in youth (Prokhorov et al, 2006; Schepsis & Rao, 2005). In a review of socio-economic status and health behaviours in adolescence, 68% of the papers found that low SES was associated with smoking in adolescence (Hanson & Chen, 2007). Investigating which indicators are most important in which phase, Gilman et al (2003) found that for smoking initiation low parental occupation and childhood household poverty are most important. Low maternal education predicts a tendency towards regular smoking while household poverty during childhood predicts continuing smoking in adulthood (Gilman et al, 2003).

Also **personal and behavioural** factors can influence smoking.

Twin studies have shown a substantial *genetic* contribution to smoking behaviour. Up to 56% of the variance in smoking initiation was genetically predisposed and even 70% of the variance in nicotine dependence was genetically determined (Sullivan & Kendler, 1999). Also the individual *physiological reaction* (such as dizziness) that adolescents experience when smoking their first cigarette has an impact on continuing smoking (Turner et al, 2004).

According to the Theory of Planned Behaviour (Ajzen & Fishbein, 1980), behaviour is initiated by an intention to perform the behaviour. This intention is a result of attitudes, social influence (see next paragraph) and self-efficacy. Adolescents who see *positive personal advantages* of smoking, such as the believe that smoking relieves boredom and tension, can help to relax, or has a good taste, were more likely to initiate smoking (de Vries et al, 1990). Non-smokers perceive more health-related disadvantages (such as breathing problems, problems for others, cancer, heart attack) and more personal disadvantages (like unwise behaviour, unpleasant smell) (de Vries, 1995). Female regular smokers are more likely to believe that smoking controls weight (Cavallo et al, 2006). In fact, the report of the Surgeon General states that in adults, current smokers tend to weigh less than non-smokers (USDHHS, 2001). In adolescents, this relation is less clear. A review of Potter et al (2004) on body weight and smoking conclude that the evidence for the relation between smoking

and body weight was inconsistent. More important, in female adolescents a clear relation exists between smoking and weight concerns such as perceived weight, general weight concerns, dieting behaviours, and disordered eating (Potter et al, 2004; Cawley et al, 2004; Cavallo et al, 2006; Kendzor et al, 2007).

Concerning *self-efficacy*, all adolescents find it hard to refuse cigarettes from friends (de Vries, 1995).

Furthermore, *psychological and psychiatric factors* make it difficult to resist smoking. Less smoking is observed in adolescents with an optimistic mood, a strong engagement and perceived control (Kunst et al, 2004; Schepsis & Rao, 2005). More smoking is seen in adolescents with a major depression, anxiety, ADHD, conduct disorders, disruptive behaviour, a low self-esteem and adolescents who are rebellious (Killen et al, 1997; Kunst et al, 2004; Turner et al, 2004; Schepsis & Rao, 2005; Prokhorov et al, 2006).

Different *stress factors* (besides socio-economic stress) such as abuse, job loss of the parents, conflict with parents, poor performance at school, are all related to smoking initiation and continuation (Tyas & Pederson, 1998; Ellickson et al, 2001; Schepsis & Rao, 2005; Prokhorov et al, 2006). Piontek et al (2007) found that *school performance* was significantly related to current smoking in 16 to 21-year-olds, but not in 10 to 15-year-olds. Low *school connectedness* in early secondary school is related to substance use (including smoking) in the later years of schooling (Bond et al, 2007).

One of the more consistent determinants of smoking is the influence of the **direct environment** of the adolescent. Smoking is a behaviour that can be modelled by caregivers during childhood in a way that places children on trajectories that remain stable through adolescence and adulthood (Gilman et al, 2003; Hanson & Chen, 2007). Smoking behaviour of significant others such as parents, siblings and peers is related to smoking behaviour in adolescents (Flay et al, 1999; Killen et al, 1997; Tyas & Pederson, 1998; Kobus, 2003; Turner, 2004; Prokhorov et al, 2006). Parental smoking is a predictor for smoking experimentation in adolescence (Geckova et al, 2005; Schepsis & Rao, 2005) while peer smoking is more consistent related to regular smoking (Prokhorov et al, 2006).

Not only *parental smoking* is important. Parents also influence their children by their *messages and rules* about smoking and their general *parenting style*.

Parental expectations of good behaviour and of drug avoidance works as a protective factor against smoking (Schepsis & Rao, 2005). Rules (such as smoking bans at the house) and anti-smoking messages are protective against smoking, even if the parent is a smoker (Tyas & Pederson, 1998; Wakefield et al, 2000; Turner et al, 2004; Kim & Clark, 2006). Thereby, it is the adolescents' perception of social control and social norms (perception of disappointment and punishment) that plays a role rather than the actual behaviour of the parent (Turner et al, 2004). Adolescents with parents having an authoritative parental style are less likely to smoke (Tyas & Pederson, 1998). Also high family autonomy and intimacy are protective, while low cohesion, low family connectedness, and poor family functioning are risk factors for smoking (Tyas & Pederson, 1998; Beyers et al, 2004; Tilson et al, 2004; Turner et al, 2004).

Peer smoking is more prevalent in smokers than in non-smokers (Turner et al, 2004). Smoking is a social behaviour and a way to achieve social belonging. Smokers also have the perception that smoking is prevalent in their group, although research has found that this perception is often exaggerated (Tyas & Pederson, 1998; Turner et al, 2004). There is rarely a direct pressure from peers, though a more subtle pressure as a sense of belonging and acceptance exists (Kobus, 2003). All children face the problem of establishing credentials for a self that can be interpolated in an adolescent status or power structure (Plumridge et al, 2002). Being a non-smoker is considered as being average, in the middle. Especially girls are at risk because boys can establish alternatives through physical activity. Girls with a higher sociability score are more likely to initiate smoking (Killen et al, 1997). They are more motivated to participate in social events and to comply. In a longitudinal research, Bond et al (2007) found that students, who were socially connected first, before being school-connected, were more likely to become regular smokers.

Past research has focused on the social pressure hypothesis: smoking onset is caused by peer smoking and the incapability of youngsters to resist (Simons-Morton et al, 2001). An alternative hypothesis is that adolescent smokers select peers that have similar smoking behaviour (de Vries et al, 2006). De Vries et al (2006) found that peer smoking at 12-13 year was no significant predictor of adolescent smoking one year later in most studied countries. In young adolescents in Finland, Denmark, the Netherlands and the UK, the evidence for selection processes in influencing smoking initiation were stronger than influence

processes. In this hypothesis, parents can be seen as gatekeepers in the sense that parents' smoking behaviour can influence children to choose friends partly based on their friends' smoking status (Turner et al, 2004; de Vries et al, 2006). Research that differentiates between social selection and social influence found that both hypotheses influence smoking in adolescents (Arett, 2007; Hall & Valente, 2007; Mercken et al, 2007).

2.4.2 Specific target population: adolescents with respiratory problems

Respiratory morbidity imposes an enormous burden on society, and is among the leading causes of death worldwide (WHO, 2002a). Tobacco use and ageing of the population are expected to increase the burden of chronic respiratory diseases, including asthma, chronic obstructive pulmonary disease (COPD) and lung cancer.

Asthma is a disorder defined by its clinical, physiological and pathological characteristics. The predominant feature of the clinical history is episodic shortness of breath, particularly at night, often accompanied by cough (GINA, 2007).

In 1993, the Global Initiative for Asthma was founded aiming to produce recommendations for asthma management based on the best scientific information available (GINA, 2007). Their definition of asthma is as follows:

"Asthma is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role. The chronic inflammation is associated with airway hyper-responsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread, but variable, airflow obstruction within the lung that is often reversible either spontaneously or with treatment."

Asthma cannot be cured, but appropriate management can control the disease and enable people to enjoy a good quality of life (Lara et al, 2002).

Large variations between countries in prevalence of asthma in childhood can be observed (ISAAC, 1998). In the last century, studies showed that asthma prevalence and wheezing in children and adolescents was increasing worldwide

(Sears, 1997; Woolcock & Peat, 1997). The recent results of the International Study of Asthma and Allergies (ISAAC) indicate that asthma symptoms in 13 and 14-year-olds in Western countries have decreased or stabilised (Pearce et al, 2007). In countries where asthma symptoms were low in the last century (Africa, Latin America and parts of Asia), the prevalence of asthma symptoms is increasing. The prevalence of asthma diagnosis (self-reported by the children) increased significantly, probably indicating a greater awareness of the disease.

Multiple determinants increase the burden of asthma. Active as well as passive smoking were found to be factors that induce asthma exacerbations and cause asthma symptoms as well as influence the susceptibility to the development of asthma in predisposed individuals (GINA, 2007). Although, the evidence that smoking causes asthma is still not elucidated (Piipari et al, 2004; Sandström & Lundbäck, 2004), asthmatic patients who smoke are more symptomatic (Zbikowski et al, 2002). Asthmatic smokers have a more rapid decline in pulmonary function and higher rates of hospitalisation (Eisner et al, 2001; GINA, 2007). Thereby, smoking makes asthma more difficult to control (Thomson et al, 2004; GINA, 2007).

Various guidelines for the management of asthma are clear in relation to smoking. They explicitly state that asthmatic patients should be strongly advised not to start smoking, to stop smoking and to avoid passive smoking (NIH, 1997; Scottish Intercollegiate Guidelines Network et al, 2003; WHO, 2002a; GINA, 2007).

Despite these guidelines, research showed that adolescents having asthma are equally or more likely to smoke compared with non-asthmatic adolescents (Forero et al, 1996; Precht et al, 2003; Tercyak, 2003; Annesi-Maesano, et al, 2004; Tercyak, 2006).

Studies on the determinants of smoking in adolescents with asthma are scarce. Forero et al (1996) found that, besides smoking, depressive symptoms and low school performance (which are risk factors of smoking) were more prevalent in asthmatic than in non-asthmatic adolescents. Previous studies in samples of American adolescents (Zbikowski et al, 2002; Tercyak, 2003) found similar risk factors for smoking in adolescents with and without asthma. Zbikowski et al (2002) hypothesised that having asthma may stigmatise adolescents because of treatments during school hours, a limitation to certain activities and absenteeism due to asthma. According to the social influence theory, these asthmatic

adolescents may feel an additional pressure to fit in with their peers and therefore engage in smoking behaviour. Another hypothesis poses that adolescents having asthma experience greater levels of psychological distress and behavioural problems, making them more vulnerable for smoking (McQuaid et al, 2001; Tercyak, 2003; Halterman et al, 2006).

3. Objectives of the thesis

The HBSC database, which was used for this thesis, offers the opportunity to study the effects of country level interventions on adolescent smoking in general as well as to further explore determinants of smoking in specific risk groups for which specific studies are lacking at the moment.

Objectives for the thesis were formulated as follows:

Part 1:

- describing gender-specific trends in smoking among adolescents in Europe and Canada (article 1) and
- assessing the effect of country level policies on adolescent smoking (article 2)

Part 2:

- developing an instrument to measure smoking in adolescents with respiratory symptoms suitable for a large-scale multi-topic community study (article 3)
- measuring the prevalence of asthma and respiratory symptoms in adolescents (article 4)
- measuring the prevalence of smoking and the determinants of smoking in adolescents with respiratory symptoms (article 5).

4. Methodology

4.1. The HBSC study

Monitoring of health behaviours in adolescence is the basis to study health in adolescents. This thesis is based on the Health Behaviour in School-aged Children (HBSC) study, one of the first international surveys of adolescent health in Europe (Roberts et al, 2007). The first data were collected in 1983/1984 in

three countries and the study continued growing up to 41 countries or regions in the 7th survey of 2005/2006. Flanders is a member of the HBSC study since 1990. The study runs in collaboration with the WHO Regional office for Europe. The HBSC study has a coordinating centre located at the Child and Adolescent Health Research Unit at the University of Edinburgh.

Since the beginning of the study, the aim of HBSC was to gain new insight into and increase understanding of adolescent health behaviours, health and well being in their social context (Roberts et al, 2007). Collected data can be used to study trends within and between countries and to analyze the relationships between behaviour, health and the factors affecting them. This information can help to improve health policy and practice nationally and internationally.

To achieve this aim, cross-national high-quality data is collected every four years. A self-completion questionnaire is administered in the class-room consisting of questions on health indicators, health-related behaviours and life circumstances (Roberts et al, 2007). Questionnaires are developed by the members of the international HBSC network who are organized in focus groups around specific topics. Questionnaires are translated and back-translated to secure internationally comparable questions.

HBSC focuses on the age groups 11, 13 and 15 years. The 11-year-olds are seen as the onset of adolescence; the 13-year-olds present a period of challenges of physical and emotional changes; the 15-year-olds are the middle years when important life and career decisions are starting to be made (Roberts et al, 2007).

Cluster sampling is used to recruit the students with the class or the school as unit. The aim is to obtain 1500 students within each age category. That way, a 95% confidence interval of approximately 3% is assumed around a portion of 50% and a design factor of 1.2 (Roberts et al, 2007). Data is cleaned centrally by the international databank manager at the University of Bergen.

4.2. Measuring smoking behaviour

To measure smoking behaviour in adolescents, HBSC uses self-reports. The question on smoking in the HBSC questionnaire is:

How often do you smoke tobacco at present?

1. every day
2. at least once a week, but not every day
3. less than once a week

4. I do not smoke

This question has been present and remained unchanged in the HBSC questionnaire since the beginning of the survey in 1983/1984 (Hublet & Godeau, 2005).

Self-reports on smoking are found to be a good indicator of the actual smoking status compared with biochemical validated smoking prevalence (Patrick et al, 1994; Dolcini et al., 1996; Newell et al, 1999). More recent research pose questions on biochemical validation of smoking status as these are found to be influenced by inhalation patterns (Dolcini et al, 2003). Also, biochemical validation can be used for recent use (daily smokers) but less for occasional smokers. Thereby, self-reports are simple and inexpensive. Factors influencing self-reports of smoking are the level of demand, age and gender (Velicer et al, 1992; Bowlin et al, 1993; Newell et al, 1999). The level of demand is low in HBSC as the questionnaire is filled in anonymously and the aim of the research is monitoring instead of intervention testing. Adolescents tend to answer more socially desirable, indicating that the prevalence rates found can be an underestimation. Boys or men tend to report less accurately than girls do. One way to improve smoking self-reports is to use a bogus pipeline (mention in the classroom that smoking status can be biochemical tested) (Pechacek et al, 1984). This method is not used due to practical reasons.

4.3. Measuring respiratory symptoms in adolescents

Measuring asthma and wheezing symptoms in children and adolescents is difficult due to several reasons. First, there is no standard definition of asthma applicable to all cases (Burr, 1992; Sears, 1997). Second, no simple biological marker or simple clinical test exists to diagnose asthma (Pearce et al, 1993; Sears, 1997). Third, the symptoms resemble a normal cold and should be chronic, which can not be measured by a test (Sears, 1997). In other large scale studies, questionnaires are used to detect asthma because they are cost-effective and independent of immediate circumstances.

For this thesis, an asthma scale was developed and validated. The scale can be found in box 1. The validation work is described in article 2.1 of the thesis. The Asthma scale was proposed at one of the HBSC meetings. Six countries or regions were prepared to include the asthma scale in their national HBSC survey of 2001/2002: Belgium (Flanders), Canada, Denmark, Finland, France and the

Netherlands. Every following HBSC meeting, a working meeting with the involved countries was organized to discuss the international results. In the analyses concerning asthma and smoking, the answer on the question 'were you ever diagnosed with asthma by a doctor' was used. These 15-year-olds know (or think) they have asthma and should/ could act accordingly.

Box 1: HBSC Asthma Scale

1. Has the doctor ever told you that you have asthma?

2. Have you had wheezing or whistling in the chest in the last 12 months?

3. In the last 12 months, has your chest sounded wheezy during or after exercise?

4. In the last 12 months, have you had a dry cough at night, apart from a cough associated with a cold or a chest infection?

5. In the last 12 months, have you been to a doctor, an emergency room, or a hospital for wheezing?

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ORIGINAL RESEARCH

Part 1: country level

Chapter 1.1:

Smoking trends among adolescents from 1990 to 2002 in ten European countries and Canada.

Hublet A, De Bacquer D, Valimaa R, Godeau E, Schmid H, Rahav G, Maes L.

BMC Public Health

Research article

Smoking trends among adolescents from 1990 to 2002 in ten European countries and Canada

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Abstract

Background: Daily smoking adolescents are a public health problem as they are more likely to become adult smokers and to develop smoking-related health problems later on in their lives.

Methods: The study is part of the four-yearly, cross-national Health Behaviour in School-aged Children study, a school-based survey on a nationally representative sample using a standardised methodology. Data of 4 survey periods are available (1990–2002). Gender-specific daily smoking trends among 14–15 year olds are examined using logistic regressions. Sex ratios are calculated for each survey period and country. Interaction effects between period and gender are examined.

Results: Daily smoking prevalence in boys in 2002 ranges from 5.5% in Sweden to 20.0% in Latvia. Among girls, the daily smoking prevalence in 2002 ranges from 8.9% in Poland to 24.7% in Austria. Three daily smoking trend groups are identified: countries with a declining or stagnating trend, countries with an increasing trend followed by a decreasing trend, and countries with an increasing trend. These trend groups show a geographical pattern, but are not linked to smoking prevalence. Over the 4 surveys, the sex ratio has changed in Belgium, Switzerland, and Latvia.

Conclusion: Among adolescents in Europe, three groups of countries in a different stage of the smoking epidemic curve can be identified, with girls being in an earlier stage than boys. In 2002, large differences in smoking prevalence between the countries have been observed. This predicts a high mortality due to smoking over 20–30 years for some countries, if no policy interventions are taken.

Background

Daily smoking among adolescents is a significant public health problem. Smoking-related health problems are a function of the duration (years of smoking) and the intensity of use (number of cigarettes smoked) [1]. Most adult smokers began to smoke or were already addicted to nic-

otine before the age of 18 [2,3]. Besides, a lot of adolescents want to quit smoking, but only a small number of them really succeed [1,2]. Tobacco control policies varied widely in European countries in the last 20 years [4]. The smoking prevalence among adolescents is important for policy makers to monitor their current policy and to make decisions for future policies. Information on recent smoking trends within a country and comparison of trends between countries is therefore urgently needed. This information is important to have a benchmark, in order for countries to see how large their smoking problem is compared with other countries. These data can also help to explain the observed differences and trends in smoking prevalence, by relating it to potentially relevant circumstances in the different countries. Relating smoking trends to country-specific policies regarding smoking, can help policy-makers to determine which actions to take in order to reduce smoking. Studies gathering this information according to a standardised research protocol are rare.

According to the WHO European report on Tobacco Control Policy [5], gender differences in smoking prevalence among young people in Europe are smaller than those for adults. Similarities and differences in smoking trends among boys and girls need consideration for future developments. Here, we present the results of a large international study concentrating on the evolution of daily smoking prevalence among boys and girls between 1990 and 2002. The study targeted 14 and 15 year olds in 10 European countries and Canada.

Methods

The present paper is based on observations made in the Health Behaviour in School-aged Children study (HBSC). This is a four-yearly cross-national research study conducted in collaboration with the WHO Regional Office for Europe [6]. The data of the 4 last surveys are used (1989–1990, 1993–1994, 1997–1998, and 2001–2002). The HBSC-study is carried out in a growing number of countries (from 16 countries in 1989 to 36 countries in 2001). Only countries participating in the 4 survey periods were included in the analyses: Austria, Belgium, Canada, Finland, Hungary, Latvia, Norway, Poland, United Kingdom (Scotland and Wales), Sweden, and Switzerland. The HBSC study aims to gain insight into young people's health and well-being, health behaviours and their social context. The target population of the study is young people 11, 13 and 15 years old attending school. Cluster sampling (school or classes) is used as sampling method in the study. The survey is carried out on a nationally representative sample in each participating country. The sample consists of more than 1200 students in each year, country and age-category. In this paper, 14-year-old and 15-year-old students were selected (n = 75 745), as daily smoking is still rather rare in younger age groups. More

details can be found in the international HBSC protocol [6]. The survey is approved by the Ethics Committee of the University Hospital of Ghent, project 2001/304.

Detailed information on non-response in all countries and all survey years is not available. Non-response at school-level varies between countries and survey years and a decreasing trend can be observed. However, non-response at pupil-level (for this study most important) is more constant between countries and survey years and remains high.

The self-administered questionnaire is completed in the classroom and consists of a standard questionnaire developed by the HBSC international research network. Besides questions on smoking and other health-risk behaviours, there were also questions on health outcomes, individual and social resources... The question used in this paper that remained unchanged over the 4 survey periods, is:

'How often do you smoke tobacco at present?' 'Every day'; 'at least once a week, but not every day'; 'less than once a week'; 'I do not smoke'.

Statistical analyses

Over the 4 survey periods, prevalence for daily smoking among boys and girls are presented separately. Trends are examined using separate logistic regressions for gender and country. Daily smoking is used as a dependent variable and the survey period as an independent variable, controlling for age. The odds ratios and their 99% confidence interval are computed with reference category 'survey 1990' at one hand (presented in table), and 'survey 2002' on the other hand. An additional analysis focuses on the daily smoking sex ratio (female prevalence of daily smoking/male prevalence of daily smoking), calculated for each survey period and country. Significant differences in this sex ratio are analysed using logistic regressions per country and per survey period, with daily smoking as a dependent variable and gender as an independent variable, controlling for age. The interaction between survey period and gender was also studied using logistic regressions by country and controlling for age. In case it was relevant, the data were weighted with the weights provided by the HBSC national teams [6]. The analyses were done using SPSS 11.0 [7].

Results

Daily smoking prevalence in boys

Table 1 shows the daily smoking prevalence classified by survey year and country, for boys and girls separately. The countries are ranked by smoking prevalence in 2002. Among boys, the lowest prevalence in 2002 is found in Sweden, followed by the other participating Western countries, the Eastern European countries and Austria.

Looking at the trend from 1990 to 2002, we identified three groups (table 2). Group A includes countries with a significant decline (Finland and Sweden) or stagnation (Norway, Austria and Hungary) in daily smoking over the 4 periods. In group B, Belgium, Canada and the UK show an increase in smoking prevalence in 1994 and 1998, followed by a significant decrease in the last survey of 2002. In Canada and the UK, smoking prevalence in 2002 is not significantly different from the smoking prevalence in 1990. In Belgium however, smoking prevalence in 2002 is still significantly higher than in 1990. Group C includes the Eastern European countries (Poland, Latvia) and Switzerland. Here, smoking prevalence has increased since 1990, followed by a stabilisation in the last survey. The smoking odds between 1990 and 2002 have even been doubled in Latvia and Switzerland.

Daily smoking prevalence among girls
Among girls, a different pattern concerning smoking prevalence has been observed (table 1). The highest preva-

lence in 2002 in daily smoking can be found in Austria, Norway and Belgium. The group of countries with the lowest daily smoking prevalence in 2002 includes Eastern European countries (Poland and Latvia) as well as Sweden and Canada. However, in 1990, a clearer geographical pattern is found with the Eastern European countries in the lowest prevalence group, and the Nordic countries in the highest smoking prevalence group. Among girls, the composition of the trend groups is slightly different than among boys. Group A includes Finland, Norway and Sweden where daily smoking prevalence in girls remained constant from 1990 to 2002. In Finland, stabilisation occurred after a decline in 1994 and 1998 compared with 1990. Group B includes the same countries as among boys. But it is remarkable to notice that Canada is the only country in this study where girls have a significantly lower smoking prevalence in 2002 compared with 1990. In group C, daily smoking prevalence increased in 1994 and/ or 1998, with a stabilisation between 1998 and 2002 (not in table – odds ratio 1998–2002 (reference): Austria OR =

Table 1: Sample characteristics

Country	1990		1994		1998		2002	
	n	% daily smoking	n	% daily smoking	n	% daily smoking	n	% daily smoking
Boys								
Sweden	582	9.5	596	9.7	605	8.6	614	5.5
UK	1739	9.1	1251	13.4	1536	14.5	1249	10.2
Canada	924	9.4	1066	15.0	1177	16.1	592	10.5
Switzerland	629	6.3	658	9.5	930	15.8	754	12.9
Norway	790	17.1	829	15.8	838	17.8	793	15.4
Finland	485	22.7	845	17.3	743	15.7	858	16.4
Belgium	496	10.1	1314	17.8	1089	21.9	1657	16.8
Poland	789	12.7	698	13.8	855	18.5	1010	18.0
Hungary	996	10.7	876	12.7	491	12.8	507	19.1
Austria	546	14.1	1151	20.1	618	20.1	641	19.5
Latvia	346	9.8	501	16.6	573	18.0	530	20.0
Total	**8322**	**11.4**	**9785**	**15.3**	**9455**	**16.5**	**9205**	**14.9**
Girls								
Poland	692	4.3	705	6.1	782	9.8	1072	8.9
Canada	1016	13.2	1139	19.8	1309	20.4	743	9.0
Switzerland	608	2.1	736	12.3	924	15.8	751	13.0
Latvia	668	1.8	788	5.7	774	9.9	655	13.1
Sweden	541	13.7	562	13.0	541	16.1	606	13.7
UK	1830	11.4	1437	17.5	1604	21.6	1228	16.7
Hungary	1178	7.3	972	9.4	524	6.5	799	16.9
Finland	449	20.3	823	13.9	772	15.7	870	18.0
Belgium	445	13.4	1716	13.9	1113	22.3	1757	19.0
Norway	846	15.7	793	14.9	811	20.5	818	19.9
Austria	478	8.7	717	19.9	755	26.0	631	24.7
Total	**8751**	**10.1**	**10388**	**13.8**	**9909**	**17.8**	**9930**	**15.9**

Number of participants and prevalence of daily smoking among 14 and 15 year olds, listed by country and survey period, separately for boys and girls. Countries are listed from lowest daily smoking prevalence to highest daily smoking prevalence in 2002.

Table 2: Daily smoking odds ratios (99% confidence interval), 1990 as reference category.

Country	1990	1994	1998	2002	Trend group
			Boys		
Finland	I	0.72 (0.50–1.04)	0.63 (0.43–0.92)	0.66 (0.46–0.96)*	Group A
Sweden	I	1.00 (0.60–1.66)	0.87 (0.51–1.46)	0.54 (0.30–0.97)*	
Norway	I	0.88 (0.62–1.25)	1.02 (0.73–1.43)	0.85 (0.60–1.22)	
Austria	I	1.54 (0.96–2.47)	1.55 (0.94–2.56)	1.66 (0.99–2.78)	
Hungary	I	0.99 (0.69–1.43)	1.46 (0.93–2.29)	1.37 (0.92–2.06)	
Belgium	I	2.01 (1.31–3.08)**	2.49 (1.61–3.83)**	1.79 (1.18–2.73)**	Group B
Canada	I	1.54 (1.07–2.23)*	1.63 (1.14–2.34)**	1.08 (0.69–1.71)	
UK	I	1.37 (1.00–1.86)	1.51 (1.12–2.02)**	1.06 (0.76–1.47)	
Switzerland	I	1.42 (0.80–2.55)	2.90 (1.76–4.77)**	2.36 (1.40–3.98)**	Group C
Latvia	I	1.78 (1.02–3.13)*	2.11 (1.22–3.65)**	2.20 (1.27–3.79)**	
Poland	I	1.09 (0.73–1.62)	1.58 (1.11–2.27)*	1.55 (1.09–2.20)*	
Total	**I**	**1.21 (1.08–1.37)****	**1.41 (1.26–1.59)****	**1.22 (1.08–1.38)****	
			Girls		
Finland	I	0.67 (0.45–1.01)	0.73 (0.49–1.10)	0.87 (0.60–1.28)	Group A
Sweden	I	0.93 (0.59–1.47)	1.19 (0.76–1.85)	0.99 (0.63–1.54)	
Norway	I	0.93 (0.65–1.37)	1.37 (0.98–1.91)	1.32 (0.95–1.85)	
Belgium	I	1.13 (0.75–1.70)	1.94 (1.28–2.93)**	1.57 (1.05–2.35)	Group B
Canada	I	1.46 (1.07–1.99)*	1.49 (1.10–2.02)*	0.62 (0.41–0.93)*	
UK	I	1.55 (1.19–2.02)**	2.03 (1.58–2.60)**	1.56 (1.18–2.06)**	
Austria	I	2.46 (1.31–4.64)**	3.50 (1.87–6.52)**	4.15 (2.18–7.89)**	Group C
Switzerland	I	5.72 (2.51–13.05)**	8.71 (3.95–19.21)**	7.38 (3.30–16.54)**	
Latvia	I	3.47 (1.48–8.11)**	6.62 (2.93–14.93)**	8.60 (3.83–19.33)**	
Poland	I	1.50 (0.80–2.83)	2.61 (1.47–4.64)**	2.16 (1.24–3.78)**	
Hungary	I	1.14 (0.76–1.73)	1.02 (0.59–1.78)	2.07 (1.41–3.04)**	
Total	**I**	**1.29 (1.14–1.46)****	**1.76 (1.56–1.98)****	**1.61 (1.43–1.82)****	

Analyses for boys and girls separately and countries listed by same trend.
Group A: declining or stabilising trend; **Group B**: increasing trend followed by decreasing trend; **Group C**: increasing trend with or without stabilisation in last surveys.
* p < 0.01; ** p < 0.001

.84; Switzerland OR = 1.18; Latvia OR = 0.77; Poland OR = 1.21, all not significant). An exception is Hungary, where smoking prevalence remained stable till 1998 followed by an increase in 2002. The highest increases in girls' daily smoking prevalence between 1990 and 2002 are found in Latvia (OR 1990 versus 2002 = 8.59) and Switzerland (OR 1990 versus 2002 = 7.38).

Sex differences in daily smoking prevalence

The sex ratios over the 4 survey periods are presented in table 3. The countries are ranked by sex ratio in 2002. In Sweden and the UK, significantly more girls than boys are smoking daily in 2002. The opposite is true for Latvia and Poland. In the other countries, no significant differences are observed between boys and girls. By studying the significance of the interaction between period and gender, a significant change in sex ratio was observed in 3 countries. In all countries, female smokers caught up with male smokers.

Discussion

In countries of the European Union with membership before 2004, a converging trend among adult smokers has been observed [8]. However, this trend was not observed in daily smoking among adolescents. Taking into account also some new member states, in 2002 the smoking prevalence among boys varied from 5.5% to 20.0%. Among girls, it varied from 8.9% to 24.7%. It is far from easy to explain this important variation between countries. Policy differences as well as differences in youth cultures can play a role.

Interestingly enough, smoking prevalence within countries is not linked with the observed smoking trends between 1990 and 2002. Among boys as well as girls, three different trends were observed showing the same geographical pattern. Among boys, the Nordic countries show a declining or stabilising smoking trend; in the Western countries an initial increase is followed by a

Table 3: Sex ratio of daily smoking.

Country	1990	1994	1998	2002	Sex X period (p-value)
Sweden	1.44	1.34	1.87**	2.49**	.073
UK	1.25	1.30*	1.49**	1.64**	.086
Norway	0.92	0.94	1.15	1.29	.080
Austria	0.62	0.99	1.29	1.27	.016
Belgium	1.33	0.78*	1.02	1.13	.004
Finland	0.89	0.80	1.00	1.10	.263
Switzerland	0.33*	1.29	1.00	1.01	.005
Hungary	0.68*	0.74*	0.51**	0.88	.023
Canada	1.40*	1.32*	1.27*	0.86	.083
Latvia	0.18**	0.34**	0.55**	0.65*	.001
Poland	0.34**	0.44**	0.53**	0.49**	.325
Total	**0.88***	**0.90***	**1.08**	**1.07**	**<.001**

Sex ratio (daily smoking prevalence girls/daily smoking prevalence boys) in the 4 survey periods, gender significance per period and country, controlling for age. P-value of interaction of sex with period, separately for country and controlling for age.
* p < 0.01; ** p < 0.001 (p-value indicating significant differences between boys and girls or to what extent the ratio differs from 1)

decrease in daily smoking; and in the Eastern European countries an increase is followed by a stabilisation in smoking prevalence between 1998 and 2002. Among girls, similar daily smoking trends can be found, with only a few exceptions. First, no country in this study shows a continuous decline in daily smoking prevalence among girls. Second, Austria and Hungary show an increasing smoking trend in girls, while in boys a stabilisation is observed. Third, Hungary is the only country in this study where smoking prevalence among girls has increased since the last two surveys.

Pirkins et al. [9] state that cross-national data of adolescent substance use should be interpreted cautiously. When comparing data from cross-national surveys, the list of problems includes differences in population focus, differences in sampling method, a different survey context and question wording. The HBSC study attempts to control these problems by adapting standardised methods [6]. Literature on smoking trends using the same methods over different periods and in different countries is very scarce [8].

A weakness in large scale school-based studies is the self-report of substance use. In general, self-reported smoking prevalence has been considered as a good indicator of the actual smoking status, compared with biochemical validated smoking prevalence [10,11], especially in epidemiology. But it may still give an underestimation of the problem in adolescents [11]. Although the questionnaire had to be completed anonymously, cultural differences in answering questions (especially questions with a social stigma) can be a problem (like tobacco use in some countries and certain periods for girls and/or boys). Validation studies in this respect are mostly done in Western countries. It would be interesting to repeat such validation studies in countries with a different cultural background.

Another limitation of this school-based study is the fact that school drop outs, which may be a high-risk group for smoking, are not included in the survey (at least in some countries). And finally, information referring to smokeless tobacco is lacking. For instance in Sweden, smokeless tobacco is much used among youngsters, especially boys (14.5% used snuff weekly in 2002) [12]. Hence, in some of the participating countries, the daily smoking prevalence can be an underestimation of the tobacco-related problem in reality.

This paper concentrates only on daily smoking among adolescents, which may give a misleading picture of the whole smoking epidemic. When daily smoking is declining, this behaviour can be overtaken by occasional smoking. According to McNeil [13], smoking among adolescents may well show important fluctuations in regularity, from weekly to daily smoking. However, since daily smoking is defined as an important part of nicotine dependence [14], we decided to use this indicator in order to get a clear picture of the current and future burden of smoking on the public health. Daily smoking adolescents are more likely to smoke in the future and to develop smoking-related health problems leading to premature deaths.

This is a descriptive epidemiological study. To help policy makers, analytical epidemiological studies explaining differences in smoking prevalence and trends are needed. Further analyses are needed on different levels of information (individual, population and country characteristics).

Among adults and, as observed in this study, also among adolescents, gender and country differences in smoking trends follow the four stage model of the smoking epidemic [15], and 'Diffusion of Innovations' theory proposed by Rogers [16]. In the first stage of the smoking

epidemic model, smoking begins as a male habit; after men have adopted smoking, females begin to smoke in the second stage; in the third stage, male prevalence begins to decline, while female smoking prevalence remains stable; the fourth phase is characterised by a decline in both genders. It may well be that different countries are facing different stages. However, if this theory holds, most of the countries studied here are found in stage three. This should be further examined. Following Rogers' theory, innovations, such as smoking, are taken up first by communities marked out by their relative advantage in terms of educational level, socioeconomic status and upward social mobility [16]. The observed geographical pattern in smoking trends reflects this theory.

However, these theories do not explain the large differences in smoking prevalence between the countries. As documented in the 2004 ENSP report (European Network for Smoking Prevention), effective tobacco control efforts targeting adolescents are not taken in all countries [4]. Among adolescents, most effects are obtained by increasing taxes and prices, restricting advertising, sponsoring media campaigns and subsidising cessation treatment [4]. Although the whole smoking prevalence pattern cannot be explained by the implementation of these measurements, it is noteworthy that countries scoring high on these components (like the UK, Sweden and Norway) have also a relatively low smoking prevalence, especially among boys. Countries scoring low on these components (like Latvia and Austria) have relatively high smoking prevalence, again especially among boys.

Conclusion
From this paper, we can conclude that among European adolescents, three groups of countries in a different stage of the smoking epidemic curve can be identified, with girls being in an earlier stage than boys.

As smoking-attributable mortality is most closely related to smoking patterns from thirty or more years earlier and not to the current smoking prevalence [15], the results in this paper predict a huge burden on the health care systems of Eastern European countries over the next 20–30 years. Policy makers in these countries must be encouraged to initiate cost-effective strategies for tobacco control as proposed by the World Bank [17]. But equally important, countries with a declining or stabilising daily smoking trend among adolescents must remain alert. Policy makers there should face the challenge to keep the smoking prevalence declining or at least stable. This can be done by developing initiatives that are innovative and suitable for both boys and girls.

Competing interests
The author(s) declare that they have no competing interests.

Authors' contributions
AH: performed the statistical analyses and drafted the manuscript. DDB: gave statistical advice and helped in the interpretation of the results. RV: was involved in revising the manuscript critically. EG: was involved in the international coordination of the study (risk behaviour focus group) and revised the manuscript critically. HS: revised the manuscript critically. GR: revised the manuscript critically. LM: was involved in the design of the study, in drafting the manuscript and revising it critically. All authors have read and approved the final manuscript.

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Chapter 1.2:

Association between tobacco control policies and smoking behaviour among adolescents in 29 European countries.

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Abstract

Objective

To investigate the associations between well known cost-effective tobacco control policies at country level and smoking prevalence among 15-year-old adolescents.

Design

Multilevel modelling based on the 2005-2006 Health Behaviour in School-aged Children Study (HBSC), a cross national study at individual (pupil) level, and with country level variables from the Tobacco Control Scale and published country-level databases.

Setting

29 European countries.

Participants

A total of 25 599 boys and 26 509 girls, aged 15 years.

Main outcome measures

Self-reported regular smoking defined as at least weekly smoking, daily smoking included (dichotomous).

Results

Interaction effects between gender and smoking policies were found, so boys and girls were analysed separately. Large cross-national differences in smoking prevalence were identified. In boys, an intraclass correlation (ICC) was found of 0.038, while in girls ICC was 0.035. In the final multilevel model in boys, besides the significance of the individual variables such as family affluence, affluence of the country and legality of vending machines were significantly related to regular smoking (b(affluence country) = -0.010; b(partial restriction vending machines) = -0.366, $p <$ .05). Price policy had a borderline significant result (b(price policy) = -0.026, $p =$ 0.050). All relations were in the expected direction. In girls, the model was less well fit and only the legality of vending machines has a borderline significant result in the final model (b(total ban vending machines)= -0.372, $p =$ .060).

Conclusions

For boys, some of the current recommended tobacco control policies may help decrease the smoking prevalence. In girls, the model was less suitable, indicating that gender differences in the susceptibility of smoking policies exist. Future research should address this issue.

Introduction

Tobacco use is one of the largest threats to public health and a leading preventable cause of death in the world (about 5 million deaths each year) (Ezzati & Lopez, 2003; WHO, 2002). If the current smoking patterns continue, it has been estimated that total tobacco-attributable deaths will rise to 6.4 million in 2015 and 8.3 million in 2030 (Mathers & Loncar, 2006). The onset and development of cigarette smoking occurs primarily in adolescence (Chassin et al, 1996; Lamkin & Houston, 1998), with approximately 80% of all smokers beginning before age 18 (US Department of Health and Human Services, 1994). About one half of the smokers who start smoking cigarettes in their teens will sooner or later die of a tobacco-related disease if they continue to smoke (US Department of Health and Human Services, 2004). The younger they start, the greater their risk of habitual smoking (Lando et al, 2000; Riali et al, 2004).

In Europe in 15-year-olds, daily smoking prevalence rates ranged in 2002 from 5.5% (Sweden) to 20.0% (Latvia) in boys and from 8.9% (Poland) to 24.7% (Austria) in girls (Hublet et al, 2006). Gender differences and geographical patterns in smoking rates in young people in Europe follow the smoking epidemic curve with three different trends between 1990 and 2002. For boys, in the Nordic countries a decline or stabilising smoking trend is observed. In the Western European countries an initial increase has been followed by a decrease in smoking rates. In Eastern European countries, an increase was followed by a stabilisation. For girls, no decline was observed between 1990 and 2002 in either part of Europe (Hublet et al, 2006).

In 1999, the World Bank launched a report on the most effective tobacco control policies (Jha & Chaloupka, 1999). Cost-effective tobacco control initiatives include tobacco price increases, bans or restrictions of smoking in public places, consumer information, tobacco advertisement bans, health warnings on packages and treatment to quit. Most research in the field of smoking policy strategy is focused on the effect of *price of cigarettes* on smoking prevalence. Price increases have been found to have a specific effect on young people (Levy et al, 2004; Lewit et al, 1997 ; Liang et al, 2003). Higher cigarette prices appear to prevent the onset of smoking, but also result in smokers quitting or smoking less (Guidon et al, 2002). *Bans of*

tobacco advertisements have elicited mixed results in relation to their effects on smoking prevalence, and there is evidence that youth tend to recall ads that are pro-smoking (Levy et al, 2004). *Bans or restrictions on smoking in public places* are known to have a greater effect among older people (Levy et al, 2004). Lewit et al (1997) found no relation between restriction on smoking in public places and reduction of smoking prevalence in young people. Similarly, it has been suggested that *information campaigns in the media* may have smaller or no effects on youth compared with other population subgroups (Chaloupka, 1999; Levy et al, 2004; Sowden & Arblaster, 1998). *Health warnings* on packages of cigarettes have not been documented as particularly effective in reducing smoking behaviours, however, warnings on plain white packages may be more effective than warnings on regular packages (Goldberg, 1999). *Cessation treatment* concerns quitlines, cessation support networks, reimbursement of treatment expenses and medications to stop smoking (Joossens & Raw, 2006). These activities merely target at highly dependent smokers, hence are hardly designed for young people. Finally, there is some evidence that *restrictions or bans on the sale of cigarettes to minors* reduce smoking and cigarette consumption in youth (Chaloupka & Pacula, 1999; Chen & Forster, 2006).

Youth protection against tobacco is part of the World Health Organization's (WHO) Framework Convention on Tobacco Control (FCTC) (WHO, 2005). Effective legislative, executive, administrative or other measures should be undertaken by countries having signed the convention. A recent report from the World Health Organisation described that only around 5% of the total world population is covered by any one of the above described key interventions (WHO, 2008). However, it is still unclear what is effective in youth protection in Europe. The present study aims to investigate the smoking policies in 29 European countries in relation to the national smoking prevalence among young people. Our study focuses on 15-year-olds because early adolescence is a critical time for acquiring new patterns of behaviour that could track into adulthood. This is especially true in the field of smoking.

Method

Sample

The 2006 Health Behaviour in School-Aged Children Study (HBSC) is a study of nationally representative samples of adolescents in 41 countries or regions (Roberts et al, 2007). In each country, a hierarchical design was used with the school or class being the sampling unit. Schools and classes within schools were selected to be representative by age level. Three age groups of young people were sampled but only the 15-year-olds were used in the current analyses. Recommended sample sizes for each country were 1536 students per age group. Sample sizes assured a 95% confidence interval of +/- 3% for prevalence estimates, with a design effect of no more than 1.2 in any country (Roberts, et al. 2007).

For the present analysis, male and female students aged 15 years from 29 European countries were selected: Austria, Belgium, Bulgaria, Czech republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Rep. of Ireland, Romania, Slovak republic, Slovenia, Spain, Sweden, Switzerland.

Measures

Data were collected on two levels. The individual level data included the students' self-reports of their smoking behaviour as well as their gender, age and the Family Affluence Scale (FAS) (Currie et al, 2007) as an indicator of socioeconomic status (SES). The question on smoking was formulated as follows: how often do you smoke tobacco at present, with answer possibilities: every day, at least once a week but not every day, less than once a week and I do not smoke. In the analyses, regular smoking was first studied (at least weekly smoking, daily smoking included). The analyses were subsequently repeated with daily smoking only.

The FAS comprises 4 questions about car possession of the family, having an own bedroom, going on holidays with the family and having a computer (Currie et al, 2007). Validation studies have shown that FAS can be used as a cross-national indicator of child material affluence and as predictor of health outcomes (Currie et al, 2008). The score of the scale was divided into tertiles per country (low, medium and high FAS-score). These categories indicate the relative material affluence of the

student within the country.

Second level data comprised information on the participating countries gathered by Joossens et al (2006) for the Tobacco Control Scale, from the European Network for Smoking Prevention (ENSP) country files 2006 (selling to minors and penalties, legality of vending machines) and the Tobacco Atlas (smoking prevalence of adults). Joossens et al (2006) developed a Tobacco Control Scale for European countries to measure the grade of implementation of the six most effective policies described by the World Bank (Jha & Chaloupka, 1999). The scale was developed by means of a questionnaire that was sent to the ENSP correspondents in the different countries. The questionnaires were sent in 2005 and contained several questions on the six different policies (Joossens & Raw, 2006). Every subscale is weighted based on its effectiveness. For the present analysis, a selection was made based on the literature and relevance for an adolescent population. The subscales "price" (from minimum 0 to maximum 30), "smoking bans in public places" (from 0 to 22) and "bans on advertisements" (from 0 to 13) of the Tobacco Control Scale were included. The subscale on "information campaigns" and "cessation treatment" were excluded as no information was available on tailoring of the campaigns or treatments towards young people and thus they were of uncertain relevance. The subscale "health warnings" was excluded because little variation was identified between countries.

A combination of laws about selling to minors and penalties for such selling (ENSP, 2006), resulted in a new variable "selling to minors" with three categories: 'legal to sell to minors', 'illegal to sell to minors but without penalties' and 'illegal to sell to minors with penalties'. A second new variable was constructed for the analyses, namely "legality of vending machines" with answer categories: 'legal', 'legal on specific places' and 'illegal' (ENSP, 2006). The affluence of the country (here calculated as the Gross Domestic Product (GDP) of a country in Euros divided by the population of a country) (Eurostat, 2005) and the smoking prevalence of adults (Mackay & Eriksen, 2002) were also included.

Statistics

As the data are hierarchically structured (adolescents within countries), a multilevel regression model (Hox, 2002) was applied with regular smoking at the individual level

as outcome and predictor variables at both the individual level (age and FAS) and the country level (subscales "price", "smoking bans in public places", "bans on smoking advertising", "selling to minors", "legality of vending machines", smoking prevalence of adults and affluence of the country).

Several consecutive models were tested: first the null model (or intercept-only model) where no predictor variables were included. The next model tested only the individual level predictors as fixed effects (model 1). In addition, several models were tested with the individual level predictors and a country level predictor added as fixed effect sequentially. To end with, a model with individual level predictors and all country level predictors with significance levels of < 0.20 in the previous models was tested; this was the final multilevel model. Analyses were conducted separately for boys and girls since significant interactions exist between gender and the country level variables.

The SAS release 9.1 software was used for the analyses (The SAS system). The Glimmix procedure was applied as it fits generalized linear mixed models where the response variable is not necessarily normally distributed. The Kenward-Roger method was used to compute the degrees of freedom for the tests of fixed effects.

Results

Regular smoking prevalence of boys and girls can be found in table 1. In total 25599 boys and 26509 girls are included in the analyses. Large cross-national differences in smoking prevalence were identified: from 8.6% regular smokers in Sweden to 32.1% regular smokers in Bulgaria. Large gender differences were found between countries (table 1). Table 2 shows the country level variables used in this paper. Multilevel modelling was performed. In the null model, the country level variance (the variance estimate of the country level residual errors) was 0.1305 (s.e. 0.038) for boys and 0.1195 (s.e. 0.034) for girls. Based on these country level variances, an intraclass correlation (ICC) of 0.0382 was calculated for regular smoking in boys, which indicates that 3.8% of regular smoking in boys can be explained by the country structure. In girls, this percentage was 3.5%. Model 1, with only the individual variables, show similar results for boys and girls. Pupils with a low FAS score were

significantly more likely to smoke regularly compared with high FAS score (p=0.001). In girls, those with a low and medium FAS score were more likely to smoke regularly than girls with a high FAS score (low-high: p <0.01; medium-high: p = 0.011).

In further models, country level variables were included one by one. Only the country variables with a p value < .20 were included in the final model. These are for boys: "price" (p = .009), "bans on advertisements" (p =.112), "legality of vending machines" (p = .128), adult smoking prevalence (p = .035) and affluence of the country (p = .005). For girls, only "smoking bans in public bans" (p = .131) and "legality of vending machines" (p = .114) met the criteria to be included in the final model

Table 1 - description of the population: numbers of boys, girls and total, prevalence of regular smoking in boys, girls and total by country.

	Number of adolescents			Regular smoking		
	Boy	Girl	Total	boys	girls	Total
Austria	693	801	1494	24.1	29.7	27.1
Belgium	1562	1468	3030	16.3	17.3	16.8
Bulgaria	804	884	1688	27.5	36.2	32.1
Czech Republic	842	823	1665	19.7	23.4	21.6
Denmark	762	790	1552	15.2	14.8	15.0
Estonia	801	786	1587	26.5	18.6	22.6
Finland	790	895	1685	23.0	21.0	21.9
France	1139	1083	2222	16.5	20.6	18.5
Germany	1271	1281	2552	16.8	22.4	19.6
Great Britain	2492	2507	4999	13.4	21.3	17.3
Greece	650	766	1416	17.0	16.1	16.5
Hungary	550	637	1187	22.2	21.4	21.8
Iceland	947	936	1883	13.7	13.1	13.4
Ireland	914	771	1685	18.5	19.7	19.1
Italy	678	657	1335	20.0	19.6	19.8
Latvia	628	702	1330	29.9	22.7	26.1
Lithuania	940	921	1861	25.8	17.6	21.8
Luxembourg	776	731	1507	16.8	21.3	19.0
Malta	184	170	354	19.3	23.7	21.4
Netherlands	672	691	1363	15.7	20.6	18.2
Norway	818	716	1534	9.3	12.5	10.8
Poland	1092	1195	2287	18.5	14.2	16.3
Portugal	613	770	1383	9.3	12.0	10.8
Romania	606	999	1605	20.2	11.7	14.9
Slovakia	591	661	1252	18.4	15.2	16.7
Slovenia	780	781	1561	19.7	16.4	18.1
Spain	1519	1546	3065	14.3	21.1	17.7
Sweden	752	774	1526	7.8	9.4	8.6
Switzerland	733	767	1500	15.3	15.2	15.3

.

Table 2 - Country level variables

	Price[1]	public bans[1]	advertising bans[1]	penalties selling minors[2]	vending machines[2]	Adult smoking[3]	affluence (GDP / population)[4]
Austria	14	4	4	No sales, no penalties	No restriction	24,5	28,88
Belgium	16	8	12	No sales, no penalties	partial restriction	28	27,29
Bulgaria	19	6	9	No sales, and penalties	No restriction	36,5	2,49
Czech Republic	12	6	9	No sales, and penalties	partial restriction	29	8,45
Denmark	17	3	10	No sales, no penalties	No restriction	30,5	36,02
Estonia	14	9	11	No sales, and penalties	Total ban	32	6,58
Finland	18	12	13	No sales, and penalties	Partial restriction	23,5	28,69
France	23	6	11	No sales, and penalties	Total ban	34,5	27,52
Germany	20	2	4	No sales, and penalties	Partial restriction	35	26,74
Great Britain	30	1	11	No sales, and penalties	partial restriction	26,5	28,65
Greece	17	7	4	No sales, and penalties	Total ban	38	14,97
Hungary	17	6	10	No sales, and penalties	Total ban	35,5	7,94
Iceland	25	11	13	No sales, and penalties	Total ban	24	33,87
Ireland	23	21	12	No sales, and penalties	partial restriction	31,5	36,30
Italy	16	17	10	Sales to minors	Partial restriction	24,9	23,34
Latvia	9	6	6	No sales, no penalties	Total ban	31	4,77
Lithuania	11	6	9	No sales, and penalties	Total ban	33,4	5,2
Luxembourg	7	4	5	No sales, and penalties	partial restriction	33	56,78
Malta	19	17	9	No sales, and penalties	partial restriction	23,9	10,83
Netherlands	16	9	12	No sales, and penalties	partial restriction	33	28,68
Norway	26	17	13	No sales, and penalties	Total ban	31,5	44
Poland	16	10	12	No sales, and penalties	Total ban	34,5	5,11
Portugal	17	5	10	No sales, no penalties	partial restriction	18,7	12,89
Romania	13	6	0	No sales, and penalties	Total ban	43,5	2,72
Slovakia	18	8	11	No sales, and penalties	partial restriction	42,6	6,16
Slovenia	13	6	7	No sales, and penalties	Total ban	25,2	12,97
Spain	12	3	3	No sales, and penalties	partial restriction	33,4	19,78
Sweden	19	15	13	No sales, and penalties	partial restriction	19	31,08
Switzerland	15	5	4	Sales to minors	No restriction	33,5	39,09

[1] from Joossens & Raw, 2006; [2] from ENSP, 2006; [3] from Mackay & Eriksen, 2002; [4] from Eurostat, 2005

Table 3 - parameter estimates of the final multilevel model with regular smoking as dependant variable, separately for boys and girls

	Regression coefficient (s.e.)	df	F value	P value
Boys				
Age	0.396 (0.050)	1	63.49	**<0.001**
FAS score		2	9.11	**<0.001**
Low	0.125 (0.040)			**0.0019**
Medium	-0.058 (0.043)			0.172
High	-			-
Price	-0.026 (0.013)	1	4.33	0.050
Advertise bans	0.009 (0.019)	1	0.21	0.651
Affluence country	-0.010 (0.004)	1	5.55	**0.028**
Adult smoking	0.016 (0.010)	1	2.49	0.128
Vending machines		2	3.09	0.067
Total ban	-0.310 (0.161)			0.069
Partial restriction	-0.366 (0.149)			**0.023**
No restriction	-			-
Girls				
Age	0.349 (0.048)	1	51.97	**<0.001**
FAS score		2	34.14	**<0.001**
Low	0.309 (0.038)			**<0.001**
Medium	0.106 (0.042)			**0.012**
High	-			-
Public bans	-0.018 (0.013)	1	1.82	0.189
Vending machines		2	2.05	0.151
Total ban	-0.372 (0.189)			0.060
Partial restriction	-0.199 (0.186)			0.294
No restriction	-			-

The results of the parameter estimates of the final multilevel models are reported in table 3. In boys, besides the significance of the individual variables, affluence of the country and legality of vending machines were significantly related to regular smoking (p < .05). The association between affluence of the country and smoking was negative: the higher the affluence of the country the less regular smoking (Figure 1). Also, less regular smoking was observed when partial restriction of vending machines exists compared to no restriction. Borderline significance was found for a total restriction of vending machines when compared to no restriction. Price policy had a borderline significant result (p = .051) indicating a trend where fewer boys are regular smokers when countries have efficient price policy compared to a poor price policy (Figure 2).

Figure 1: Relation between affluence of the country and weekly smoking in boys in 29 countries.
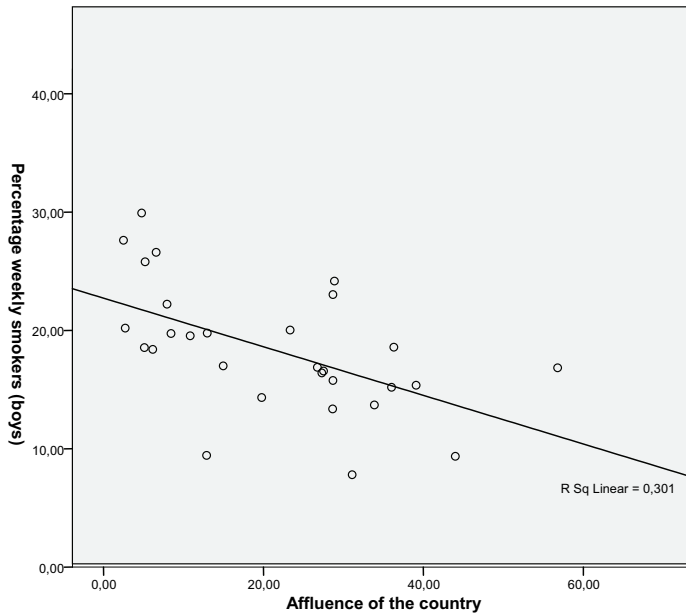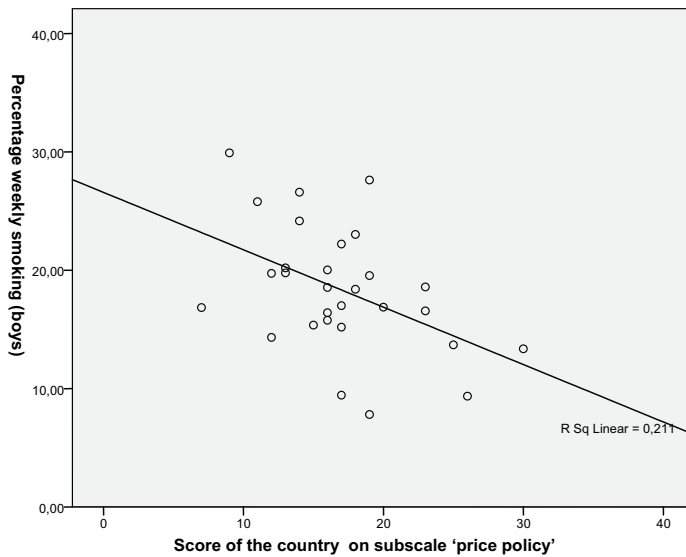

Figure 2: Relation between price policy scores and weekly smoking in boys in 29 countries.

In the final multilevel model in boys, country level variance decreased substantially compared to the null model (from 0.130 to 0.069 with a s.e. of 0.024). Thus, a considerable degree of the country level variance can be explained by the five country level variables.

In contrast, the final multilevel model in girls only showed a modest decrease of the country level variance (from 0.119 to 0.111 with a s.e. of 0.034).

In girls, the model was less well fit and only the legality of vending machines has a borderline significant result in the final model (p = .060).

The analyses were repeated for daily smoking. Similar results were retrieved: the same policy variables were related to daily smoking. Two exceptions were found: in boys daily smoking was significant related to adult smoking rates (p = 0.020), while affluence of the country became borderline significant related to daily smoking (p = 0.082)

Discussion

The analyses presented showed that 3.8% of the regular smoking variance in boys and 3.5% of the regular smoking variance in girls could be attributed to the country structure or the residence of an adolescent in a certain country. In boys, a substantial part of the country level variance could be explained by the selected country level variables. This was much less the case for girls.

We find that an efficient price policy is associated with less regular smoking in boys but not in girls. Guindon et al (2002) cite three main reasons why price can be effective deterrent in youth. Younger individuals may not be as addicted to nicotine as long-term users and may therefore be more able to curb their consumption. Second, as a result of fewer peers smoking, the normative belief that almost all young people are smokers may be reduced and a multiplying effect of the price control can be expected. Third, youth are more responsive to price changes because of their relatively smaller disposable incomes. Previous

research found that in adolescents, an increase of 10% in cigarette price can result in a decrease of up to 17% in smoking prevalence (Chaloupka, 1999; Powell et al, 2005). In Canada, where the taxes on cigarettes decreased, Zhang et al. (2006) found that the greater the price reduction, the higher the rates of smoking initiation. Even when the results are controlled for individual characteristics (such as age, gender, educational attainment, income, marital status) and other local tobacco control policies (such as smoke-free laws in restaurants, enforcements, signage, tobacco control expenditures), the association between cigarette price reduction and smoking initiation was still significant.

However, our results indicate that price policy is only related to lower smoking prevalence for boys, not for girls. This may be at least partially explained by gender differences in how adolescents obtain their cigarettes. Previous research found that females were more likely to obtain cigarettes from non-commercial sources, such as family and (older) friends (Castrucci et al, 2002; Gratias et al, 1999; Harrison et al, 2000). In contrast, males are more likely than females to buy cigarettes in a store or from vending machines (Gratias et al, 1999) and are therefore more susceptible for price increases.

We find that a policy on vending machines is significantly related to less regular smoking in boys and in girls but in girls the results are of borderline significance in the final model. Both Pokorny et al (2006) and Stead & Lancaster (2005) point out the importance of the availability of vending machines. It may be that a policy concerning legal purchase of cigarettes for above 18 year olds had a relatively limited impact because of the widespread availability of cigarette vending machines.

In contrast, the other studied tobacco control policies are not related to regular smoking in young people. Previous research has found that restrictions or bans for cigarettes sales to minors are not that effective due to weak enforcement of the law (Pokorny et al, 2006; Stead & Lancaster, 2005). Catrucci et al (2002) and Harrison et al (2000) found that younger adolescents get their cigarettes from non-commercial or social resources, while commercial resources come into the picture when regular use is established. They conclude that this policy

is not preventive for smoking initiation and experimental smoking.

Bans of smoking in public places and on advertisements were not related to less regular smoking in our study. It might be that these policies are more effective in the long term as they create a non-smoking social norm. During the 1960's, tobacco advertisement campaigns targeted women, resulting in a major increase in smoking among (especially) young women (Pierce et al, 1994). It is also known that exposure to tobacco advertisements and promotions are associated with the likelihood that adolescents will initiate smoking behaviour (Lovato et al, 2003) and that point of sale advertisements encourage youth to smoke (Slater et al, 2007). Other channels of cigarette promotion do not fall under federal legislation, such as smoking in movies. Sargent et al (2005) showed that the risk of smoking initiation is more than doubled in young people who are highly exposed to movie smoking.

Another part of the social norm are smoking adults. In our study in boys, adult smoking was associated with regular smoking in the way that where less adults are smoking, also less adolescents boys are smoking.

We find that the affluence of a country is related to regular smoking in boys but not in girls. Boys living in a country where the affluence is high, were less likely to smoke. This result is in line with the smoking epidemic model of Lopez et al (1994) and it can be concluded that boys in Europe are in the final stage of the Lopez model of the smoking epidemic. However, affluence of a country was not related to regular smoking in girls indicating a converging trend in girls in rich and poor countries. Thus, it appears that girls are therefore in an earlier phase of the smoking epidemic (Lopez et al, 1994). The observation that smoking in adolescents follows this model, has implications for tobacco prevention. In poor and rich countries, the high risk population is different with regard to gender. Prevention actions should take this into account. On individual level, pupils with a low socio-economic status in their country were more likely to smoke regularly.

There are some limitations to our study. First, causal relations between policy and smoking prevalence cannot be studied in cross-sectional research. It could be that higher taxes and stronger policies will be implemented in countries

where the anti-smoking sentiment is already high and smoking prevalence is low. It could also be that fewer policies will be implemented in countries were smoking is not (yet) a large problem. Only longitudinal research can address this. Second, only smoking prevalence (regular and daily smoking) is studied and not smoking behaviour as amount of cigarettes, inhalation methods, and type of cigarettes. As price policy has an influence on smoking prevalence in boys, we have to be careful for compensating behaviour. In high tax states, young adults smoke longer cigarettes and smoke cigarettes higher in tar and nicotine compared with young adults in low tax states (Chaloupka, 1999).

To conclude, if adolescents can be kept tobacco-free, most of them will never start using tobacco as adults. Given the detrimental health effects of smoking, prevention of smoking initiation and escalation in early adolescence through effective health promotion as well as through effective policy initiatives is needed. Our study shows that for boys, some of the current recommended tobacco control policies may help decrease the smoking prevalence. But interestingly, the results also show that gender differences in how policy influence young people's smoking behaviour exists. In girls, the model was less suitable. Future research should address this issue in more detail. Our study is the first to investigate the associations between smoking policy and smoking prevalence in adolescents across such a large range of European countries.

What is already known:

- The World Bank has listed 6 cost-effective tobacco control policies.

- Research of effectiveness of these strategies is merely done in adults and in one or a few countries.

What this study adds:

- This is the first study to investigate smoking policies in a large number (29) of European countries in relation to the smoking prevalence of 15-year-old adolescents.

- An effective price policy and a policy on vending machines are significantly related with less regular smoking in boys.

- The model was less suitable for girls, indicating that gender differences in the susceptibility of smoking policies exist.

Acknowledgment

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ORIGINAL RESEARCH

Part 2: individual level

Chapter 2.1:

Value of a shortened questionnaire in the description of asthma in 10-12-year-old pupils.

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**PEDIATRIC ALLERGY AND
IMMUNOLOGY**

Value of a shortened questionnaire in the description of asthma in 10–12-year-old pupils

Hublet A, De Bacquer D, Vereecken C, Maes L. Value of a shortened questionnaire in the description of asthma in 10–12-year-old pupils. Pediatr Allergy Immunol 2004: 15: 247–252. © 2004 Blackwell Munksgaard

Asthma is a common and severe chronic disease in children influencing their quality of life and functioning at school. A 5-item asthma-screening instrument was developed and tested in 1052 children aged 10–12 years. Questionnaires were completed by parents and children separately and data were compared. Children reported less to be diagnosed by a medical doctor as having asthma compared with their parents, although children reported more to have certain asthma symptoms. No difference in prevalence of asthma was found between children and parents' answers. The absolute agreement for the scale was 92% and a good kappa agreement was found. Recoding the 'don't know'-answers in 'no'-answers resulted in a 4% misclassification. The short 5-item asthma screening tool can be valuable in the categorization of a subgroup of children likely to suffer from asthma in a survey. Recoding 'don't know'-answers to 'no'-answers is justified in large samples.

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Key words: childhood asthma; screening; asthma symptoms; parents' report; child's report

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Asthma is a common and severe chronic disease in children and adolescents influencing their quality of life. Difficulties while playing with peers, doing sports, contacts with pets, sleeping disturbances but also negative emotions-like anxiety and worry can occur when having asthma (1–3). Asthma can interfere with normal school activities and cause problems with concentration, sport courses and absenteeism (4–6).

Asthma is also a growing problem as international studies indicate that the prevalence of asthma and symptoms of asthma in children is increasing (7). Reasons for the increase can be found in viral infections, aeroallergen exposures, weather and temperature changes, living conditions and parasitic infestations, but also in the Western lifestyle (8). Other studies indicate that the prevalence of diagnosed asthma may be slowed down or stabilized in the last 10 years after a large increase till 1990 (9). All studies show an increase of asthmatic symptoms (wheezing, night waking) (9, 10) but this increase may be restricted to mild symptoms (no increase in frequency of attacks) (7, 10).

The diagnosis of asthma in children and adults is difficult to make. First, there is no standard definition of asthma applicable to all cases (11, 12). Secondly, no simple biological marker or simple clinical test exists to diagnose asthma (12, 13). Thirdly, the symptoms of asthma resemble the symptoms of a 'normal' cold. Fourthly, the chronic character of the diagnosis cannot be administered by a single clinical test (12). There is, in other words, no golden standard to diagnose asthma.

Questionnaires for detecting asthma are widely used because of their cost-effectiveness and because they are reasonably independent of immediate circumstances like time of the year, temperature, infections, treatment (11). Most asthma questionnaires are probing for diagnosis and asthma-related symptoms. Only asking for diagnosed asthma gives an underestimation of the prevalence of asthma because many children (and adults) are unaware of having asthma.

This study was conducted to develop a short questionnaire to assess asthma that could be included in the Health Behaviour in School-aged Children (HBSC)-survey (14). The HBSC-survey is a four yearly cross-national research study rooted in a lifestyle approach. Eleven, 13- and 15-year-old students are questioned about health

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behaviours, body image, perception of the school, relations with parents and peers, and other psychosocial variables. By including a short asthma questionnaire in the survey, reasons for and consequences of asthma in young people can be studied.

In this paper, two questions are examined: (i) Can a short asthma questionnaire detect children with asthma in a survey? and (ii) Is it justified to recode 'don't know'-answers to the questions into 'no'-answers?

Methods

Questionnaire

The questionnaire used is based on two asthma screening instruments for children found in the literature, namely the Brief Paediatric Asthma Screen (BPAS) (15) and the International Study of Asthma and Allergies in Childhood (ISAAC)-questionnaire (16). The BPAS is a short questionnaire (five questions) with a good relative validity (a sensitivity of 74% and a specificity of 82% with as standard used a combination of self-reported history, physical examination and spirometry). This screening tool was developed to be filled in by the parents. The HBSC-study is, however, a self-reported questionnaire for children and adolescents, without guidance from parents or teachers.

The BPAS is based upon items from the ISAAC-questionnaire (16). This questionnaire can be used from the age of 13 (in 7–8-year-old children, the questionnaire is completed by the parents). The full questionnaire is too long to be included in the HBSC-study (15 questions).

The two questionnaires were combined in a short asthma instrument of five questions (weighted) with 'yes', 'no' and 'I don't know' as possible answers (Appendix 1). The scale results in three categories: asthma, possible asthma and no asthma.

The first question of the short asthma screening instrument deals with asthma diagnosed by a doctor. If the answer is positive, the child is labelled as 'having asthma'. The three following questions deal with the most common symptoms of asthma: wheezing, wheezing after play and nocturnal cough. If the child has two of the three symptoms and has answered 'no' to the first question, the child is labelled as 'possibly having asthma'. Using only one symptom to label a child with possible asthma can lead to mistakes as, for example, coughing is not suitable as a single predictor for asthma (17). A last question refers to a consultation for wheezing in a hospital or emergency room. If the child has consulted a

doctor for wheezing and has answered 'no' to the first question, the child is labelled as 'possibly having asthma' as well.

The 'don't know'-answers were recoded in 'no' answers: if the child or adult does not know or does not understand 'wheezing' or 'asthma', he or she probably does not suffer from it. The recoded answers were seen as misclassified if parents answered positively to that question.

Study population

The questionnaire was pre-tested in 10–12-year-old children, the youngest age group of the HBSC-study. To have a substantial proportion of children with asthma in the sample (50 children), at least 833 children had to be questioned [asthma prevalence in Flanders 6% (18)]. The sample size was set on at least 1000 pupils. Therefore, a random sample of 42 schools was taken from all primary schools in east-Flanders (a region in the northern part of Belgium): 18 schools in a city, 19 schools in the country-side and five schools in an industrial zone. The coordinating authorities of the school-networks gave permission for the study. A recruitment letter with information of the study was sent to the school boards. Finally, 16 schools (38%) participated (five schools in a city, eight schools in the countryside and three schools in an industrial zone) and 1052 pupils were questioned. The telephone survey to non-participating schools revealed that especially schools in cities often are asked to participate in scientific studies. Together with the questionnaires, a letter was sent to the teachers with instructions to administer the questionnaires in the classroom. Instructions emphasized that anonymity had to be guaranteed. Filled in questionnaires had to be put in an envelope and sealed. The parents' questionnaire and informed consent form were handed out to the children and the children were orally instructed about the procedure to give the questionnaire to their parents and to get the filled in questionnaire back. If parents did not give permission to include their children in the study, the data from their child was excluded from the database. Eighteen children were excluded. There was a further lost of 102 questionnaires (73 child's questionnaires only and 29 parents' questionnaires only). Only complete data sets were included in the analyses (n = 932).

Statistics

The prevalence rates of the asthma scale and the asthmatic symptoms are calculated from the

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child's questionnaires and the parental question-
naires. Differences in prevalence rates between
children and parents are assessed by the McNemar
chi-square test.

The level of agreement between the child's and
parents' responses is evaluated using the absolute
agreement (number of positive and negative
answers to both child's and parents' question-
naire divided by total number of questionnaires)
and kappa statistics with following interpret-
ation: values between 0.0 and 0.4 indicating
relatively poor agreement, values between 0.4
and 0.6 indicating moderate agreement, between
0.6 and 0.8 indicating good agreement and values
between 0.8 and 1.0 as excellent agreement.

The 'don't know'-answers are analysed by
calculating the misclassified or discordant an-
swers ('don't know'-answers of the child com-
pared with the 'yes' responses of the parents) and
by examining the influence of this recoding on
the scale.

Results

Characteristics of the sample

About half of the sample was boys (51.2%). Only
2.5% of the children had a foreign nationality,
the others were all Belgians. Mean age of the
respondents was 11.31 years (min: 9.88, max:
13.79) with a s.d. of 0.66 years.

Prevalence rates

Prevalence rates for 'asthma', 'possible asthma'
(on the basis of two of the three asthma
symptoms or going to the doctor for wheezing)
and the asthma symptoms are given in Table 1.
The prevalence for the whole group (n = 932)
and the prevalence for the subgroup who repor-
ted both (child and parent) asthma or possible
asthma (n = 64) are described. The prevalence
of the symptoms in the asthma group reveals
the perception of reported symptoms between
parents and children (18).

Children reported less to be diagnosed as having
asthma (5.4%) compared with their parents
(6.7%) (p = 0.04), although children reported
more to have certain asthmatic symptoms. This
resulted in a higher prevalence of 'possible asthma'
in children's reports (6.0% compared with 3.5% in
the parental questionnaire). The two categories
'asthma' and 'possible asthma' combined, resulted
in a prevalence of asthma of 11.4% according to
the children's questionnaires (n = 106) and 10.2%
according to the parental questionnaires (n = 95)
(p = 0.22).

Table 1. Prevalence rates of diagnosed asthma, possible asthma and asth-
matic symptoms

	Total sample (n = 932), N (%)		Asthma group† (n = 64), N (%)	
Scale and symptoms	Child's questionnaire	Parents' questionnaire	Child's questionnaire	Parents' questionnaire
Diagnosed asthma	50 (5.4)	62 (6.7*)	46 (71.9)	47 (73.4)
Wheeze 12 months	81 (8.7)	68 (7.3)	46 (71.9)	45 (70.3)
Wheeze after play	91 (9.8)	49 (5.3**)	38 (59.4)	36 (56.3)
Nocturnal dry cough	134 (14.4)	106 (11.4*)	30 (46.9)	42 (65.6)
To doctor for wheeze	33 (3.5)	51 (5.5*)	23 (35.9)	37 (57.8)
Possible asthma	56 (6.0)	33 (3.5)	18 (28.1)	17 (26.6)
Asthma + possible asthma	106 (11.4)	95 (10.2)	64 (100)	64 (100)

†Asthma group = children and parents report both that the child has diag-
nosed asthma or possible asthma.
*McNemar's p < 0.05 when comparing child's and parents' reports.
**McNemar's p < 0.001 when comparing child's and parents' reports.

The most pronounced difference in reported
symptoms between child and parent is wheezing
after exercise or play. A total of 9.8% of the
children reported to have suffered from wheezing
after exercise compared with only 5.3% of the
parents reporting their child having this symp-
tom (p < 0.001). Slightly more children reported
to suffer from nocturnal cough (14.4%) than
their parents (11.4%) (p = 0.03). On the con-
trary, parents reported more visiting a doctor for
wheezing (5.5% compared with 3.5% for chil-
dren) (p = 0.01). No difference in the prevalence
was found for wheezing in the last 12 months.

The most prevalent symptom in the diagnosed
and possible asthma group is wheezing in the last
12 months (71.9% for children and 70.3% for
parents). The least prevalent symptom was vis-
iting a doctor or hospital for wheezing for the
children (35.9%) and wheezing after play for the
parents (56.3%).

For the children diagnosed as having asthma
(parents' questionnaire) (n = 62), 33.3% was
diagnosed with asthma by their general practi-
tioner (GP) and 66.7% was diagnosed by a
specialist.

Level of agreement

In Table 2, the level of agreement is shown
between parents' and children's questionnaires
(Table 2).

The absolute agreement for the scale and the
asthma symptoms was generally high and ranged
from 83.5% for nocturnal cough to 97% for
diagnosed asthma. The kappa agreement was
good for diagnosed asthma (κ = 0.74) and mod-
erate for the symptoms and scale (going from

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Table 2. Level of agreement between child and parents' reports

Scale and symptoms	Child yes parent yes, N (%)	Child yes parent no, N (%)	Child no parent yes, N (%)	Child no parent no, N (%)	Absolute agreement (%)	Kappa (95% CI)
Diagnosed asthma	42 (4.5)	8 (0.9)	20 (2.1)	862 (92.5)	97.0	0.73 (0.64–0.83)
Wheeze 12 months	41 (4.4)	40 (4.3)	27 (2.9)	823 (88.4)	92.8	0.51 (0.41–0.61)
Wheeze after play	37 (4.0)	54 (5.8)	12 (1.3)	827 (88.9)	92.9	0.49 (0.39–0.60)
Nocturnal cough	43 (4.6)	90 (9.7)	63 (6.8)	735 (78.9)	83.5	0.27 (0.18–0.35)
Doctor for wheeze	19 (2.0)	14 (1.5)	32 (3.4)	867 (93.0)	95.0	0.43 (0.29–0.56)
Asthma	42 (4.5)	8 (0.8)	15 (1.6)	795 (85.3)	91.2	0.56* (0.48–0.64)
Possible asthma	13 (1.4)	43 (4.6)	16 (1.7)			
Possible + asthma	64 (6.9)	42 (4.5)	31 (3.3)	795 (85.3)	92.2	0.59 (0.51–0.68)

*Kappa for variable with three categories: asthma, possible asthma and no asthma.

Table 3. Proportion 'don't know'-answers in children and discordant answers (compared with parents' reports) after recoding

	Child answered 'don't know', N (%)*	Parent answered 'yes', N (%)†
Diagnosed asthma	96 (10.3)	8 (8.3)
Wheeze in 12 months	174 (18.7)	15 (8.6)
Wheeze after play	158 (17.0)	3 (1.9)
Nocturnal cough	196 (21.0)	20 (10.2)
Visit emergency room wheeze	36 (3.9)	4 (11.1)

*Percentage of total group (n = 932).
†Percentage of group children who answered 'don't know'.

0.43 to 0.59). Only nocturnal cough had a kappa lower than 0.40, indicating a poor agreement.

Weighted kappa for the scale was 0.64 (95% CI: 0.57–0.72) indicating a good agreement. The weighted kappa considers the categories ordered going from no asthma, over maybe or possibly having asthma to having asthma.

Analysis of `don't know`-answers

Many children (43.7%, n = 407) answered 'don't know' to one or more questions. These answers were recoded as 'no's'. Proportions of 'don't know'-answers and the misclassified-answers (='yes' answers in the parental questionnaire) are shown in Table 3.

The question on nocturnal cough seems to be the most problematic. 21.0% of the children did not know the answer to the question. Ten percentage of these answers were misclassified (when taking the parents' questionnaire as reference). Wheezing in the last 12 months is an important symptom of asthma. Nineteen percentage of the children did not know the answer to this question. 8.6% of these children had parents who indicated that their child suffered from wheezing.

The influence of this misclassification on the calculation of the asthma scale was further analysed. Twenty children or 2.1% of the total sample (n = 932) were labelled as 'having asthma'

or 'possible asthma' based on their answers, but not by their parents. Seventeen parents or 1.82% of the total sample indicated their child had 'asthma or possible asthma', but not according to the child. In total, 37 children or 3.97% of the total sample was misclassified as a result of the recoding in comparison with the parents' questionnaire.

Discussion

Only asking for diagnosed asthma in a survey can lead to an underestimation of the prevalence of asthma. In the present study, young children report more asthmatic symptoms than their parents, while parents report slightly more diagnosed asthma in their child. These results were also found in Lara et al. (20) and Braun-Fahrländer et al. (19). By including only four short questions, a better estimation of asthma prevalence can be attained (when compared with parents' reports). This short questionnaire can easily be included in large-scale surveys, like the HBSC-survey, without a lot of extra efforts. Existing questionnaires are maybe more precise in detecting asthma (15, 16), but are not always convenient to include in an existing questionnaire for 10–12-year-old children: the questionnaire may be too long (16), must be filled in by parents (15, 16) or make use of a video (13). A common problem with questionnaires is the wording as language can affect the reliability and validity of the results in a survey (20). Especially, the translation of 'wheezing' can cause problems as not every language has a word for wheezing. Phankingthongkum et al. (21) showed that bad translation could miss up to 67% of the asthma cases. In this study, the wording of the ISAAC-questionnaire is used.

The absolute agreement between parental reports and children's' reports was generally high (83.5–97%) and comparable with the results of Braun-Fahrländer et al. (19) in adolescents. The kappa agreement ranged from low to good

(0.27–0.73) and was slightly higher than the results of Braun-Fahrländer et al. (19). More important than looking at the individual symptoms, are the results of the asthma scale. The kappa agreement was moderate to good (0.59 when taking asthma and possible asthma together, 0.56 when using the three categories).

In this study, parents' reports are used as reference. The literature (20, 22) suggests that children above 10 yr may be more valid reporters than their caregivers, when comparing with pulmonary function test results. Parents may underestimate the symptoms their children experience and only report the more severe symptoms. Also, they can only report symptoms if they are present when the symptoms occur or when their child tells about the symptoms. This may explain the low absolute agreement for nocturnal cough.

When recoding the 'don't know'-answers to 'no' answers, few misclassifications of the children on the scale were found (compared with parents' answers). This recoding is found justified, especially in young children and in large-scale surveys. When not suffering from asthma or certain asthmatic symptoms, children may not know the words used to describe the disease or the symptoms [like wheezing (23)]. When recoding all these answers as missing, a large part of the sample is lost (in the present study, 44%).

A limitation of this study is the absence of a clinical test for diagnosing asthma to validate the data. A limited budget was one reason for not including the use of a golden standard. The fact that no single test can detect asthma is a second reason. To partly overcome this problem, the possibility of contacting the doctor treating the children, was considered. Of the 73 respondents with inconsistent results on the scale, only 50 parents gave permission to contact the GP. Of these 50 GP, only 41 wanted to participate in the study. It was decided that a sample of 41 was too small to draw conclusions. The reason why parents or GP's refused was not asked. GP's often indicated that they did not see the child anymore, they did not have records of the child or they had too much work. Contact with the school medical doctor revealed that parents are not keen on sharing personal, medical information with the school or other persons as this is part of their privacy.

A second limitation of the study concerned the questionnaire and the lack of testing the grade of severity of asthma and asthmatic symptoms. This may be important when looking at trends over time as the prevalence of severe asthma may stay stable, while the occurrence of mild symptoms may increase

(9). However, including questions that examine the grade of severity, makes the questionnaire too long to be included in large-scale surveys on a wide variety of health behaviours, like the HBSC-survey.

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Appendix 1. The Health Behaviour in School-aged Children (HBSC)-asthma instrument

1. Has the doctor ever told you that you have asthma?	'Yes', label: 'having asthma'
2. Have you had wheezing or whistling in the chest in the last 12 months?	'Yes' to two of the three questions and 'no' to question 1, label: 'possibly having asthma'
3. In the last 12 months, has your chest sounded wheezy during or after exercise?	
4. In the last 12 months, have you had a dry cough at night, apart from a cough associated with a cold or a chest infection?	
5. In the last 12 months, have you been to a doctor, an emergency room, or a hospital for wheezing?	'Yes' and 'no' to question 1, label: 'possibly having asthma'

Asthma and Wheezing symptoms in young people in six Western countries.

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Asthma and wheezing symptoms in young people in six Western countries

Asthme et symptômes asthmatiques chez les jeunes dans six pays occidentaux

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Background: Asthma diagnosed in children shows wide geographical variations. Large scale surveys identify children with diagnosed asthma, but neglect the group of youngsters with multiple asthmatic complaints.

Methods: A short validated asthma questionnaire was included in six national surveys of the Health Behaviour in School-Aged Children Study. Prevalence rates are presented by country, gender and age. Gender and age differences are analysed using binary and multinomial logistic regressions controlling for age and smoking.

Results: Large country differences are observed in the prevalence rates of diagnosed asthma (8.6%-20.9% in boys, 6.9%-18.5% in girls) and young people with "asthma-like symptoms" (9.6%-20.2% in boys, 9.2%-23.1% in girls). When controlling for age and smoking, significant gender differences are observed (more diagnosed asthma in boys, more asthmatic symptoms in girls). Age differences were observed in adolescents with "asthma-like symptoms", but not in diagnosed asthma.

Conclusions: Using a short asthma questionnaire, large differences in diagnosed asthma and wheezing symptoms are observed between the countries. A considerable group of youngsters with "asthma-like symptoms" is detected in all countries, and may be an unrecognised risk group in health promotion.

Asthma. Prevalence. Cross-national. Respiratory symptoms. Adolescents.

Position du problème : Chez l'enfant, les taux d'asthme diagnostiqué présentent de grandes variations entre pays. Les enquêtes de grande envergure identifient les enfants pour lesquels le diagnostic d'asthme est porté, mais négligent le groupe de ceux présentant des symptômes asthmatiques.

Méthodes : Une échelle synthétique et validée a été ajoutée au questionnaire de l'enquête Health Behaviour in School-Aged Children dans six pays participants. Les taux de prévalence sont présentés par pays, sexe et âge. Les différences selon le sexe et l'âge sont analysées à l'aide de régressions bi- et multivariées ; âge et tabagisme étant contrôlés.

Résultats : On note de grandes différences entre pays pour ce qui est des taux d'asthme diagnostiqué (8,6 %-20,9 % chez les garçons, 6,9 %-18,5 % chez les filles) mais aussi les symptômes asthmatiques (9,6 %-20,2 % chez les garçons, 9,2 %-23,1 % chez les filles). Quand l'âge et le tabagisme sont contrôlés, on observe des différences significatives selon le sexe (plus d'asthmes diagnostiqués chez les garçons, plus

de symptômes asthmatiques chez les filles). On note des différences selon l'âge pour ce qui est des symptômes asthmatiques mais pas les asthmes diagnostiqués.

Conclusions : À l'aide d'un bref questionnaire sur l'asthme, on observe de grandes différences entre pays concernant l'asthme et les symptômes asthmatiques. Dans tous les pays, un groupe considérable d'adolescents présentant des symptômes asthmatiques est mis en évidence, dont on peut penser qu'il est un groupe à risque ignoré de la promotion pour la santé.

Asthme. Prévalence. International. Symptômes respiratoires. Adolescents.

INTRODUCTION

Asthma is a common and severe chronic disease in children influencing their quality of life and functioning. Studies conducted in different countries with similar research methods show wide geographical variation in the prevalence of diagnosed asthma in children [1-3].

This may be due to genuine differences in the prevalence of asthma between the countries or to different diagnostic methods of physicians in the countries [2, 4]. A study of the prevalence of symptoms suggestive of asthma may give a more correct image of respiratory problems in adolescents [3]. The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire is the most used survey instrument in the field of asthma. It was developed for large scale cross cultural prevalence studies of asthma, and it contains 8 core items about asthma, which makes it difficult to use in large scale multi topic studies, as is the Health Behaviour in School-aged Children Study (HBSC). In the HBSC study, 11, 13 and 15 year-old adolescents attending school are questioned about their health experiences, health behaviours, school experiences, relations with friends, self-esteem and other psychosocial variables. An adapted asthma questionnaire was developed for the HBSC-study, which includes self-reported questions suitable as well for 11 year olds, a younger age group as in the ISAAC-study. The inclusion of an asthma questionnaire in the HBSC-study is of particular interest because it gives the unique opportunity to study the influence of asthma as a chronic disease on different aspects of young people's lives. In addition, the study is school based hence students from all levels of socio-economical status are recruited, which is an advantage compared to other studies having problems in recruiting students from lower social classes [5].

In this paper, prevalence rates of young people with diagnosed asthma and asthma-like symptoms are presented in the participating countries by gender and age, controlled for smoking.

METHODS

An Asthma Scale (HBSC-AS) was developed using the structure of the Brief Paediatric Asthma Screen (BPAS-asthma screening instrument completed by parents) [6] and some questions of the ISAAC questionnaire [7]. This resulted in a short five items self-reported asthma-screening instrument for young people *(Appendix 1)*. The relative validity of the HBSC-AS is published elsewhere [8] and was found to be efficient for large-scale surveys. The weighted kappa for the scale was .64 (95% confidence interval: 0.57-0.72) when compared with parents' self-reports.

The category "having asthma-like symptoms" was included because youth often do not know if they are diagnosed as having asthma but can recognise the symptoms [9]. Although the last question on having consulting a doctor for wheezing is a stronger indicator for having (possible) asthma, and is considered as such in the BPAS [6], this group was for these analyses also labelled as having "asthma-like symptoms". In the group of students with "asthma-like symptoms", students with more than one asthma-like symptom or with possible asthma are included. The questionnaire was back translated to the respective languages using the wording of the ISAAC questionnaires.

Six countries participating in the HBSC-study have included the asthma scale in their national surveys: Canada, Denmark, Finland, Belgium (Flanders), France and the Netherlands. The target population of the HBSC study is young people, attending school, aged 11, 13 and 15 years. Every country took a representative random sample of the target population aiming at minimum 1 536 students per age group. The study uses cluster sampling (schools or classes) as sampling method. All countries followed the same protocol. More details can be found in the international HBSC protocol [10].

This research project was approved by the Ethics Committee of the University Hospital of Ghent, project 2001/304.

Statistics. — Differences in missing values on the asthma-scale were analysed with Pearson chi^2 tests for gender and age. To give a global picture of the problem, prevalence rates (%) of diagnosed asthma and wheezing symptoms are presented by country and gender. To study age differences in prevalence, diagnosed asthma and having "asthma-like symptoms" are presented by country, gender and age category. Gender

and age differences in prevalence rates are analysed using binary (when the dependent variable has 2 categories) and multinomial (when the dependent variable has 3 categories: no asthma, diagnosed asthma, having "asthma-like symptoms") logistic regressions controlling for smoking and age. The analyses were done using SPSS 11.0.

RESULTS

POPULATION

At school level, response rates are 52.2% in the Netherlands, 54.7% in Flanders, 74.4% in Canada, 83.8% in France, 84.8 in Finland, and 86.1% in Denmark. At student level, response rates are 74% in France and Canada, 89% in Denmark, 92% in Finland and the Netherlands, and 95% in Flanders.

Over the six countries, 33 210 children participated of which 51.3% were girls. Mean age was 13.46 years (standard deviation (sd)=1.65 years) ranging from 10.17 to 16.75 years. In the groups 11-, 13- and 15-year-old, mean ages were respectively 11.58 years (sd=0.40 years), 13.52 years (sd=0.41) and 15.52 years (sd=0.40).

If any of the five questions was not answered, the scale was not computed hence considered as a missing. Hence between 3.7% to 7.2% missing values per country were observed (5.7% in total). Missing values were more observed in boys (6.7% *versus* 4.7% in girls, χ^2=59.2, degrees of freedom (df)=1, p<0.001) and in the younger age categories (6.7%, 5.7% and 4.5% in respectively 11, 13 and 15 year olds, χ^2=46.2, df=2, p<0.001).

PREVALENCE RATES

Table I shows the prevalence rates of children with "diagnosed asthma", "having asthma-like symptoms" (as defined in *Appendix 1*), and presenting wheezing symptoms (controlled for age and smoking). Canada shows the largest prevalence of "diagnosed asthma" (20.9% in boys and 18.5% in girls) as well as "asthma-like symptoms" (20.2% in boys and 23.1% in girls). Flanders and Finland show the lowest prevalence of "diagnosed asthma" in girls (both 6.9%) and Flanders in boys (8.6%). For "asthma-like symptoms", Finland has the lowest prevalence rates for boys and girls (4.8% and 8.2% respectively).

In all countries but Denmark, boys are more diagnosed with asthma than girls *(table I)*. Looking at the wheezing symptoms, in Denmark, Finland, France and the Netherlands, more girls than boys reported having all three symptoms. However in France, boys are more likely to consult a doctor for wheezing. In Canada, girls suffer more from wheezing after play and from nocturnal cough, while in Flanders only the prevalence rates of nocturnal cough was significantly different between boys and girls.

In *table II*, prevalence rates for asthma and having "asthma-like symptoms" can be found by country, gender and age category. No significant age differences in prevalence rates of diagnosed asthma were found. In boys, significant differences between 15 year olds and 11 or 13 year olds were found for having "asthma-like symptoms"

TABLE I. — *Prevalence rates (%) of diagnosed asthma, and asthmatic symptoms by country and gender (significance for gender differences, binary logistic regressions controlled for age and smoking).*

	Canada		Denmark		Finland		Flanders-Be		France		Netherlands	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Diagnosed asthma	20.9	18.5*	14.4	12.8	9.2	6.9**	8.6	6.9*	17	12.8***	11.5	9.3*
Wheeze 12 months	22.8	25.1	14.3	17.6**	9.9	12.0*	11.7	11.7	18	20.3**	17.0	22.5***
Wheeze after play	37.3	41.5**	27.9	31.4*	9.6	13.5***	13.9	12.7	20.2	25.3***	14.4	19.3***
Nocturnal cough	30.7	35.0**	16.0	19.5**	10.0	13.4***	23.5	26.7**	21.9	24.9**	19.1	26.1***
Doctor appointment for wheeze	12.2	12.6	6.4	6.9	3.7	3.5	5.3	5.0	9.7	8.1*	7.4	6.6
"Asthma-like symptoms" (excl. diagnosed asthma)	20.2	23.1	11.5	15.5***	4.8	8.2***	9.6	9.2	11.2	14.7***	10.3	15.3***

* p<0.05; ** p<0.01; *** p<0.001.

TABLE II. — *Prevalence (%) of asthma and "asthma-like symptoms" by country, gender and age-category (significance for age differences, multinomial logistic regressions controlled for smoking).*

Gender		Boys			Girls		
Age		11	13	15	11	13	15
Canada	Asthma	18.2	22.3	22.7	15.7	19.1	21.1
	"Asthma-like symptoms"	22.7	17.9	19.6	24.3	22.1	22.7
	OR MW	ns	ns	1	ns	ns	1
	(95% CI)[a]						
Denmark	Asthma	13.7	15.1	14.3	12.2	11.9	14.6
	"Asthma-like symptoms"	10.3	10.5	13.6	14.0	14.0	18.9
	OR MW	ns	ns	1	ns	ns	1
	(95% CI)[a]						
Finland	Asthma	9.6	8.8	9.4	6.1	7.3	7.3
	"Asthma-like symptoms"	4.8	5.2	4.7	5.4	7.3	12.0
	OR MW	ns	ns	1	0.52	0.67	1
	(95% CI)[a]				(0.35-0.77)	(0.47-0.95)	
Flanders-Belgium	Asthma	8.6	7.4	8.7	6.7	5.9	8.0
	"Asthma-like symptoms"	13.3	7.1	8.2	9.2	7.3	11.4
	OR MW	2.12	ns	1	ns	ns	1
	(95% CI)[a]	(1.53-2.94)					
France	Asthma	18.6	16.4	17.1	13.0	12.3	14.0
	"Asthma-like symptoms"	12.3	10.8	10.6	15.6	12.5	16.4
	OR MW	1.47	ns	1	ns	0.79	1
	(95% CI)[a]	(1.11-1.93)				(0.63-0.997)	
The Netherlands	Asthma	8.5	11.2	12.9	7.9	9.8	9.3
	"Asthma-like symptoms"	12.8	10.2	7.6	12.1	13.9	20.7
	OR MW	2.19	1.63	1	0.63	0.69	1
	(95% CI)[a]	(1.44-3.35)	(1.08-2.46)		(0.46-0.87)	(0.51-0.94)	

[a] OR MW: odds ratio for "asthma-like symptoms" with no asthma and controlled for smoking, 15-year-old as base; 95% CI: 95% confidence interval. All odds ratios for diagnosed asthma with no asthma were not significant.

in Flanders, France and the Netherlands, and for girls in Finland, France and the Netherlands *(table II)*. Significant differences between 11 and 13 year olds (data not showed in table; 11 year olds as base) were found in Canada (OR=0.74, 95% confidence interval (CI): 0.56-0.98) and Flanders (OR=0.46, 95% CI: 0.33-0.63) in boys and in Flanders (OR=0.67, 95% CI: 0.49-0.91) and France (OR=0.74, 95% CI: 0.59-0.93) in girls. While boys report less symptoms in the older age groups, girls report more symptoms by increasing age.

HBSC ASTHMA FINDINGS COMPARED WITH ISAAC RATE AND OTHER STUDIES

Although the 1994-1995 ISAAC survey is 7 years older than the 2001-2002 HBSC survey, the rates of diagnosed asthma, wheezing in last 12 months, wheezing after play and nocturnal cough are comparable *(table III)* [11-15]. The question "Has the doctor ever told you that you have asthma?" (HBSC) is compared with the question "Have you ever had asthma?" in the ISAAC questionnaire. The two questions are slightly different as the ISAAC question refers, although not exclusively, also to diagnosed asthma (http://isaac.auckland.ac.nz/PhaseOne/Manual/Section7).

The HBSC findings of Finland for diagnosed asthma (8.0%) are slightly higher than the ISAAC findings (between 4.6 and 7.8%), while the wheezing, wheezing after play and nocturnal cough rates in Finland are lower in the HBSC study (resp. 12.1%, 12.8% and 11.6%) than in the ISAAC study

(resp. 13.1-19.8%, 17.6-25.1% and 14.5-19.5%). The HBSC findings of France are more similar with the Southern French asthma and wheezing rates of the ISAAC study, except for nocturnal cough. In Denmark in 12-16 year olds, the Odense Adolescence Cohort study on Atopic Diseases and Dermatitis 1995-1996 [16] found 11.8% asthma (of which 97% was diagnosed by a physician) compared with 14.0% in the HBSC study. Few literatures can be found concerning prevalence rates of asthma or asthmatic symptoms in the Netherlands. A study in 1991-1992 in 13-15 year olds found prevalence rates for wheezing in the last 12 months of 6% in boys and 6% girls [17]. These rates are much lower than the 17% and 22.5% found in this study.

DISCUSSION

In our study, prevalence rates of "diagnosed asthma" range from 7.5% in Flanders to 19.8% in Canada (boys and girls together). Environmental

TABLE III. — *Comparison diagnosed asthma rates (%) between HBSC 2001-2002 13-15 year olds and ISAAC 1994-1995 13-14 year olds [11-15].*

	(Diagnosed) asthma *		Wheeze in last 12 months		Wheeze after play		Nocturnal cough	
	HBSC	ISAAC	HBSC	ISAAC	HBSC	ISAAC	HBSC	ISAAC
Canada	21.2	Hamilton: 19.2	25.5	Hamilton: 30.6	40.1	Hamilton: 36.5	32.1	Hamilton: 37.5
		Saskatoon: 12.2		Saskatoon: 24.0		Saskatoon: 30.8		Saskatoon: 34.4
Denmark	14.0	/	17.0	/	30.5	/	17.4	/
Finland	8.0	Helsinki: 7.4	12.1	Helsinki: 19.8	12.8	Helsinki: 25.1	11.6	Helsinki: 19.5
		Kuopio: 4.6		Kuopio: 13.1		Kuopio: 17.6		Kuopio: 14.5
		Lappland: 6.6		Lappland: 16.1		Lappland: 20.6		Lappland: 15.6
		Turku-Pori: 7.8		Turku-Pori: 15.0		Turku-Pori: 19.2		Turku-Pori: 16.3
Flanders-Belgium	7.5	Antwerp: 8.1	11.2	Antwerp: 12.0	12.6	Antwerp: 13.1	23.2	Antwerp: 21.2
France	14.7	Marseille: 14.4	19.1	Marseille: 14.9	23.3	Marseille: 22.8	22.0	Marseille: 26.9
		Montpellier: 4.2		Montpellier: 18.2		Montpellier: 25.4		Montpellier: 29.8
		Pessac: 15.0		Pessac: 12.8		Pessac: 19.3		Pessac: 24.3
		Strasbourg: 10.1		Strasbourg: 10.2		Strasbourg: 17.9		Strasbourg: 26.2
		West Marne: 10.7		West Marne: 13.3		West Marne: 20.1		West Marne: 25.4
The Netherlands	11.2	/	19.8	/	18.7	/	22.6	/

* In HBSC, the question asked was "Has the doctor ever told you that you have asthma?"; in ISAAC, the question asked was "Have you ever had asthma?"

hypotheses could explain these high differences (pollution rates, allergy rates, climate, etc.). However, this finding could also partly be due to national differences in the quality and accessibility of health services for young people, or to more specific diagnostic customs in physicians. The prevalence of "having asthma-like symptoms" (but without asthma diagnosis) is quite high, ranging from 6.5% in Finland to 21.8% in Canada. This finding may indicate a substantial rate of young people with undiagnosed asthma or less severe asthma, or of young people with asthmatic symptoms due to undiagnosed or "mistreated" other respiratory diseases [18]. In the United States, Yeatts *et al.* [19] have described these adolescents with undiagnosed asthma-like symptoms. Our results show that a group of youngsters with "asthma-like symptoms" can not only be found in the United States, like Yeatts *et al.* [20] noticed, but can be identified in several countries with different health care systems. In adults, this group of undiagnosed people with asthmatic symptoms was studied by Ringsberg [21], who found that these symptoms incapacitate the patients in their well being and functioning. Therefore, these young people and their family may be an unrecognised risk group in health promotion.

The prevalence rates found in this study do not differ much from prevalence rates found in the ISAAC study and other studies, although regional differences are sometimes larger than national differences (for example in Finland [13, 14]). It is of particular interest to find that a short questionnaire like the HBSC-AS reproduces the same results as larger questionnaires only focused on respiratory problems. This indicates that the HBSC-AS can be included in large-scale lifestyle surveys in children, and be used to detect children with asthma or "asthma-like symptoms" and to study the relation between the chronic condition of asthma and psychosocial aspects.

In our study, gender differences in diagnosed and "asthma-like symptoms" were found. In the literature, 12 and 15 year old boys are sometimes twice as likely to be diagnosed as having asthma than girls, while asthmatic symptoms are generally not more prevalent in boys than in girls [4]. Overall in our study, diagnosed asthma was more prevalent in boys, while girls were more likely to have "asthma-like symptoms". Different hypotheses can be found in the literature explaining the gender differences in

asthma prevalence. The physiological explanation poses that boys have smaller airways relative to their lung volume [20, 21]. In adolescence, airways in boys catch up in size with those of females. Hormonal changes in females could cause the increase of female asthma in adolescence [22]. Psychosocial variables can also cause differences between diagnosed asthma and symptom reports. These include gender-specific perceptions and reports of asthma symptoms (girls are more conscious about their body and report more symptoms) and gender-dependent differences in diagnosing patients (unintentional but systematic discrimination of girls in the diagnosis and therapeutic process) [23].

Some limitations are present in this study. First, a clinical test was not used to diagnose asthma. The diagnosis of asthma in children is difficult to establish due to the lack of a standard definition of asthma applicable to all cases [9, 24], due to the lack of a simple biological marker or simple clinical test to diagnose asthma [24, 25] and due to the fact that because the disease is chronic, it needs more than a single test to be diagnosed [24]. However, questionnaires for detecting asthma are widely used and proved to be reliable, cost effective and reasonably independent of immediate circumstances like time of the year, temperature, infections and treatment [9].

Secondly, because the asthma questions were included in an already existing adolescent health survey, only a few questions could be included, hence it was not possible to evaluate the grade of severity of asthma and asthmatic symptoms.

Thirdly, 5.7% missing values on the asthma scale were found. Significant differences between missings and not missing were found in gender and age. This may give a distortion of the results as boys and younger children may be underrepresented in the results. Also children, who were not in the classroom when the survey was done, were not questioned. This may also lead to an underrepresentation of asthmatic pupils in the study, as asthma in children is one of the main causes of absenteeism at school [26].

CONCLUSION

To conclude, using a short asthma questionnaire, large differences in asthma prevalence rates

were found between the different countries. These large variations are coherent with those found in previous studies and seem to persist in 2001-2002. In most of the countries, more boys than girls were diagnosed with asthma, while girls reported more symptoms suggestive for asthma. Besides the group of adolescents with diagnosed asthma, this study detected a large group of adolescents with "asthma-like symptoms". This group of adolescents experience several respiratory symptoms and may be an unrecognised risk group in health promotion. Further research must be done to define and characterise this group of adolescents with "asthma-like symptoms". Given the high frequency of asthma and asthmatic symptoms, and the loss of quality of life it can lead to, it is interesting to have at disposal a valid short scale that can be included in global life-style surveys.

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APPENDIX 1. — **The HBSC-asthma screening instrument**.

1. Has the doctor ever told you that you have asthma?	"yes": label: "having asthma"
2. Have you had wheezing or whistling in the chest in the last 12 months?	"yes" to 2 of the 3 questions: label: "having asthma-like symptoms"
3. In the last 12 months, has your chest sounded wheezy during or after exercise?	
4. In the last 12 months, have you had a dry cough at night, apart from a cough associated with a cold or a chest infection?	
5. In the last 12 months, have you been to a doctor, an emergency room, or a hospital for wheezing?	"yes": label: "asthma-like symptoms/possible asthma"

Chapter 2.3:

Smoking in young people with asthma.

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Smoking in young people with asthma

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ABSTRACT

Background Modern guidelines for the management of asthma state that asthmatic patients should be strongly advised not to smoke. However, it remains unclear to what extend young people with asthma actually behave like this. This study compares the prevalence of daily smoking between 15-year adolescents with diagnosed asthma and without asthma, and evaluates to what extent risk factors for smoking play a comparable role in the smoking behaviour of these two groups.

Methods The study is part of the 2001–2002 international HBSC study. Besides questions about health behaviour, individual and social resources, a set of asthma questions were included in six countries.

Results Adolescents with diagnosed asthma are more likely to be daily smokers than non-asthmatic adolescents. In asthmatic and non-asthmatic adolescents, similar associations with risk factors are found for daily smoking (drunkenness, cannabis use, low life satisfaction, spending evenings with friends, having smoking parents and peers). Diagnosed asthmatics are more prone to score high on these factors than non-asthmatics.

Conclusions Smoking in adolescents with asthma is a public health problem. Smoking prevention efforts directed towards young people should pay attention to young people with asthma and the curative sector should increase their efforts to motivate asthmatic adolescents not to smoke.

Keywords adolescents, asthma, risk factors, smoking

Introduction

Asthma is one of the most common chronic diseases among adolescents, especially in Western countries.[1,2] The disease has consequences in most children in everyday life such as difficulties while playing with peers, doing sports and having contacts with pets; it leads to sleeping disturbances, negative emotions such as anxiety and missing school days.[3–5] Recently, management of asthma has improved in the way that most people with asthma can have normal lives without significant symptoms.[6]

Adolescence is a period in which many youth engage in health risk behaviours such as regular smoking, alcohol abuse and illegal drug use.[7] Risk behaviours can be seen as part of the adolescent process in which youths become more independent from parents and the peer group becomes more important. Youth participate in these risk behaviours, e.g. to enhance self-image, to fit into the peer group and to take part in ritual activities.[8]

One might expect that asthmatic adolescents would avoid certain risk behaviours, particularly smoking, as it can provoke or worsen asthmatic symptoms.[9,10] Asthmatic adolescents who smoke are more symptomatic, have a more rapid decline in pulmonary function and have higher rates of hospitalization.[8,9] Cigarette smoking may interfere with asthma treatment as it may reduce the anti-inflammatory action of glucocorticosteroids used in asthma management.[11] Various guidelines for the management of asthma

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are clear in relation to smoking. They explicitly state that asthmatic patients should be strongly advised not to start smoking, to stop smoking and to avoid passive smoking.[11,12] In adults, it is found that asthmatic patients are likely to stop smoking or continue to smoke, but at a moderate rate.[10] However, in adolescence, asthma (like other chronic conditions) leads to negative social consequences that might limit popularity because of the need to take drugs and it limits certain activities. These social consequences may result in asthmatic youth feeling additional pressure to fit in with peers, including engaging in risk behaviours.[8] There is a considerable body of empirical research that has identified adolescent–peer relationships as a primary factor involved in adolescent cigarette smoking.[13]

Few studies have addressed smoking in adolescents who have been diagnosed with asthma.[14,15] The results show that asthmatic adolescents in Australia and the United States of America are as likely as, or even more likely to smoke than non-asthmatic adolescents. However, comparable data for other countries are missing. In addition, the role of risk factors for smoking in asthmatics is unclear.

A first objective of the international study presented in this paper is to compare the prevalence of daily smoking and other smoking characteristics between 15-year-old adolescents with diagnosed asthma and adolescents without asthma. Are asthmatic adolescents more likely to smoke and what is their smoking profile? A second objective is to evaluate to what extent a broad range of factors associated with daily smoking differ in asthmatic and non-asthmatic adolescents in order to identify fields for preventive action. The factors associated with smoking used in this paper were found in Beyers *et al.*[16]

Methods

Study design and population

The present study is part of the 2001–02 Health Behaviour in School-aged Children (HBSC) study, a four-year cross-national research conducted in collaboration with the WHO Regional Office for Europe.[17] The study aims at increasing the understanding of young people's health and well-being, their health behaviours and their social context. The target population of the HBSC study is young school-attending people, aged 11, 13 and 15 years. In this paper, only the 15-year-old students are analysed, as the prevalence of smoking risk behaviours is low in the younger age groups.

The survey is carried out on nationally representative samples and consists of more than 1200 students for each age group in each country. The study uses cluster sampling

(schools or classes) as the sampling method. More details on methods can be found in Roberts et al.[17] Besides the core HBSC questions, six countries included the HBSC-Asthma Scale (AS) in their national survey: Belgium (Flanders), Canada, Denmark, Finland, France and the Netherlands. The response rate at the school level ranged from 52% in the Netherlands to 86% in Denmark. At the student level, the response rate ranged from 74% in France and Canada to 95% in Belgium. The six countries and the large number of students within the countries raise the power for the analysis, especially when several subgroups are compared.

Questionnaire

The self-administered questionnaire is completed by students in the classroom and consists of a standard questions developed by the HBSC international research network. Topics in the questionnaire are socio-demographic variables, individual and social resources, health risk behaviours and health outcomes. The HBSC questionnaire covers several risk factors for smoking.[17]

Demographic variables

Information on *age, gender and country* is included, and *parental occupation* provides information about the adolescent's social background. Information on the profession of mother and father is gathered and recoded in six categories: from 1 (the highest category) to 5 (the lowest category) and category 6 the non-employed. The occupation of the parent with the highest status is retained and scored as low (category 4 + 5), medium (category 3) or high (category 1 + 2). The non-employed are included in the lowest category.

Asthma scale

An asthma scale (HBSC-AS) was developed and described previously.[18] The first HBSC-AS question deals with asthma diagnosed by a doctor ('Has the doctor ever told you that you have asthma?'). If the answer is positive, the student is categorized as 'having diagnosed asthma' (further called 'asthmatic'). This group also includes former asthmatics for which smoking remains a risky behaviour in the development of lung diseases. The next three questions refer to the most common symptoms of asthma that occurred in the last 12 months: wheezing, wheezing after play or exercise and nocturnal cough. A final question asks whether the student has had a consultation for wheezing by a doctor or in an emergency room in the last 12 months. The weighted kappa for the scale was 0.64 (95% CI, 0.57–0.72) when compared with parents' self-reports.[18]

Smoking characteristics

The main outcome variable in this study is *daily smoking* (contrasted with non-smokers and smokers who do not smoke on a daily basis). Other smoking-related characteristics are *age of smoking first cigarette, number of cigarettes smoked a week* (question asked only in Belgium, Canada, Finland and France), *smoking alone often and smoking with friends often.* The two last variables were asked only in Belgium, Canada and France.

Factors associated with daily smoking

School variables include *liking school* (liking versus not liking school) and an estimation of *academic achievement* (above or below average).

Risk behaviours include lifetime prevalence of *drunkenness* (≥4 times), *cannabis use in last year* (≥6 times) and being *physically inactive* (<2 days a week).

Psychosocial variables include *communication with parents* (highest score of the questions being able to talk to mother, father, stepmother and stepfather), *evenings spent with friends* (≥5 evenings a week), *life satisfaction* (from 10, best possible life, to 0, worst possible life).[19] Low life satisfaction is defined as less than score 5.

A smoking environment is measured by *parental smoking* (none, one or both parents smoke) and *smoking friends* (more than half of their friends smoking). These questions are asked in three countries (Belgium, Canada and France).

Analysis

For the first objective, characteristics of asthmatic and non-asthmatic daily smoking adolescents are compared. Taking into account the hierarchical structure of the database (adolescents in schools or classes in different countries), multilevel modelling with three levels (countries, schools/classes and adolescents) was used, controlling for gender, age and socio-economic level of the parents.

For the second question, asthmatics and non-asthmatic adolescents are compared separately on several factors associated with smoking. Here also, multilevel modelling with three levels and controlling for gender, age and socio-economic level of the parents was used. To study whether the associations between smoking and these factors are the same in asthmatics and non-asthmatics, interaction between daily smoking and asthma status on the several risk factors was computed. No interactions proved significant at the 0.01 level and hence were omitted from the models (only main effects are presented). Data are analysed using SAS 9.1.

Results

Population

In the six countries using the HBSC-AS, 9735 students aged 15 years participated in this study, of which 48.4% were boys and 51.6% were girls (Table 1). The mean age was 15.5 years. The number of respondents varied from 1143 in Canada to 2498 in France. The group of asthmatics included 1261 respondents in the six countries of which 51.5% were boys.

Profile of asthmatic youth who smoke

The characteristics of the study population by asthma status can be observed in Table 2. The results of the multilevel analyses show that boys and adolescents of parents with a low socio-economic status are more likely to have asthma. Asthmatics are more likely to report their academic achievement to be below average and to dislike school than non-asthmatics. Also, asthmatics are more likely to indicate a low life satisfaction and to have been drunk more than four times. Finally, asthmatics are more likely to have smoking parents.

Daily smoking prevalence in non-asthmatics is 17.9% when compared with 20.5% in asthmatic adolescents. In the

Table 1 Number of students, mean age of students, relative frequency of asthma and daily smoking in percent by country and sex

	Boys				Girls			
	n	*Age (mean)*	*Asthma (%)*	*Daily smoking (%)*	*n*	*Age (mean)*	*Asthma (%)*	*Daily smoking (%)*
Belgium	965	15.5	8.7	18.3	971	15.5	8.0	18.9
Canada	490	15.7	22.7	13.1	653	15.7	21.1	10.7
Denmark	631	15.8	14.4	13.3	690	15.7	14.6	15.8
Finland	809	15.8	9.4	22.0	835	15.8	7.3	23.6
France	1229	15.1	17.2	19.0	1269	15.2	14.0	20.0
The Netherlands	590	15.5	12.9	18.0	603	15.5	9.3	19.6
Total	4714	15.5	13.8	17.9	5021	15.5	12.2	18.6

Table 2 Population characteristics by asthma status

	Non-asthmatic (n = 8508)	Asthmatic (n = 1261)	P-value[a]
Gender (% girls)	52.0	48.5	0.009
Mean age (years)	15.5	15.5	0.17
Socio-economic status parents (% low)	36.0	40.6	0.03
School variables			
Academic achievement: below average (%)	9.5	12.4	0.002
Do not like school (%)	41.0	43.9	0.007
Psychosocial variables			
Low life satisfaction (%)	13.3	18.7	<0.0001
Difficult communication with parents (%)	19.2	18.5	0.43
Spending ≥5 evenings with friends (%)	19.8	20.1	0.33
Risk behaviour			
Being <2 days physical active a week (%)	33.0	29.9	0.30
Been drunk ≥4 times (%)	21.4	23.8	0.03
Used cannabis ≥6 times in last year (%)	10.1	12.8	0.40
Smoking environment[b]			
At least one parent smokes (%)	26.9	32.2	0.04
Both parents smoke (%)	9.6	12.8	0.01
More than half of friends smoke (%)	32.3	34.8	0.06

[a]According to multilevel modelling controlling for gender, age and socio-economic status of the parents.
[b]Data only available in Belgium, Canada and France.

multilevel model controlled for gender, age and socio-economic status of the parents, a significant odds ratio for daily smoking in asthmatics is found to be 1.26 (95% CI: 1.08–1.47; P = 0.003).

Smoking characteristics and breathing difficulty symptoms of daily smokers

Table 3 shows the profile of smoking students concerning smoking-related characteristics and breathing difficulty symptoms in both non-asthmatics and those diagnosed with asthma by a doctor. No significant differences are found between the smoking profile of non-asthmatic and asthmatic smokers. Obviously, asthmatics who smoke daily have significantly more breathing difficulty symptoms than smoking non-asthmatics, but surprising enough, non-asthmatic smokers also have some asthmatic symptoms, with up to a

Table 3 Smoking related characteristics and asthmatic symptoms among smoking adolescents

	Non-asthmatic daily smokers (n = 1516)	Asthmatic daily smokers (n = 259)	P-value[a]
Smoking characteristics			
Age first cigarette (mean)	12.0	11.8	0.06
Mean cigarettes a week[b] (%)	46.2	45.2	0.74
Smoke often with friends[c] (%)	88.5	87.8	0.84
Smoke often alone[c] (%)	38.5	37.7	0.44
Asthmatic symptoms			
Wheezing (%)	24.2	60.2	<0.001
Wheezing after play or exercise (%)	27.6	64.9	<0.001
Nocturnal cough (%)	32.7	50.2	<0.001
Going to a doctor for wheezing (%)	6.3	28.6	<0.001

[a]According to multilevel modelling controlling for gender, age and Socio-economic status of the parents.
[b]Data only available for Belgium, Canada, Finland and France.
[c]Data only available for Belgium, Canada and France.

third of them having nocturnal cough. To study the impact of smoking on asthmatic symptoms, smoking asthmatics are compared with non-smoking asthmatics (results not shown). We have found that daily smoking asthmatics are more likely to have nocturnal cough (50.2 versus 36.9%; P < 0.001) and to go to the doctor more often (28.6 versus 22.5%; P < 0.001) than non-daily smoking asthmatics. There are no significant differences between non-daily smoking and daily smoking asthmatics regarding wheezing symptoms (55.5% wheezing in non-daily smokers compared with 60.2% in daily smokers; 63.3% wheezing after play or exercise in non-daily smokers compared with 64.9% in daily smokers).

Factors associated with daily smoking and asthma status

In Table 4, asthmatic and non-asthmatic daily smoking and non-smoking adolescents are compared on several risk factors associated with smoking. Increased odds for all selected risk factors are associated with daily smoking in non-asthmatic as well as in asthmatic adolescents.

Discussion

Main finding of this study

Despite the guidelines for asthma management about smoking and the negative influence that smoking can have on the asthmatic condition, asthmatic adolescents are more likely to

Table 4 Associations between risk factors for smoking by asthmatic status and smoking status

	Non-asthmatic			Asthmatic		
	Non-smokers (ref group) (n = 6958)	Smokers (n = 1516)	OR (95% CI)[b]	Non-smokers (ref group) (n = 1002)	Smokers (n = 259)	OR (95% CI)[b]
School variables						
Academic achievement: below average	7.3	19.8	3.14 (2.69–3.67)	9.2	24.8	3.27 (2.29–4.66)
Do not like school	36.9	59.8	2.54 (2.27–2.85)	38.5	64.5	2.89 (2.17–3.85)
Psychosocial variables						
Low life satisfaction	11.0	23.8	2.52 (2.19–2.90)	15.1	32.7	2.72 (1.99–3.73)
Bad communication with parents	17.9	25.0	1.53 (1.34–1.75)	17.3	23.3	1.46 (1.05–2.03)
Spending ≥5 evenings with friends	14.7	43.4	4.45 (3.94–5.03)	15.1	39.1	3.61 (2.67–4.90)
Risk behaviour						
Being <2 days physical active a week	31.0	42.4	1.64 (1.46–1.84)	28.5	35.5	1.38 (1.03–1.85)
Been drunk ≥4 times	15.3	49.3	5.38 (4.77–6.07)	17.7	47.3	4.17 (3.11–5.59)
Used cannabis ≥6 times in last year	4.3	36.2	12.53 (10.70–14.68)	5.2	42.9	13.71 (9.37–20.06)
Smoking environment[a]	(n = 3959)	(n = 818)		(n = 635)	(n = 165)	
Parents smoking						
One parent smokes	29.3	37.5	2.23 (1.87–2.67)	28.3	39.4	3.11 (2.02–4.78)
Both parents smoke	14.3	30.2	3.67 (3.02–4.47)	16.1	35.8	4.98 (3.16–7.85)
More than half of friends smoke	22.4	79.8	13.70 (11.37–16.51)	24.7	73.3	8.39 (5.68–12.39)

[a]Questions only asked in Belgium, Canada and France.
[b]Odds ratios of multilevel moddeling controlling for gender, age and socio-economic status of the parents.

be daily smokers compared with non-asthmatic adolescents. The consequences are that these daily smoking asthmatic adolescents are more likely to have nocturnal cough and have more medical visits than non-smoking asthmatics.

This study shows that the selected risk factors associated with daily smoking are the same in both asthmatics and non-asthmatics. Daily smokers are more likely to spend evenings with friends, to have a low life satisfaction and to engage in other risk behaviours like being drunk more often, using cannabis and being less likely to be physically active. Daily smokers are more likely to have smoking parents and smoking peers, and are less likely to have a good contact with their parents. Bad perceptions of school and of their own academic achievement are also related to daily smoking.

Although the factors associated with daily smoking are the same for asthmatics and non-asthmatics, asthmatics score worse on some of these risk factors than do the general student population. In general, asthmatics in this study are more likely to think they perform below average at

school and are less inclined to like school. In this selected group, these factors are even more important, because evidence exists that school attachment is a protective factor for smoking.[20] In addition, asthmatic adolescents report a lower life satisfaction compared with non-asthmatic adolescents. This may result in depressive feelings; another reported risk factor for smoking.[14,20] We also found that asthmatic adolescents are more likely to have two smoking parents. Passive smoking in the direct environment of the child and adolescent can cause asthma, or at least trigger or worsen asthmatic symptoms.[11] Smoking parents are role models for their children therefore a risk factor for smoking in adolescents. This was confirmed in these analyses.

What is already known on this topic

This study confirms and strengthens other studies stating that daily smoking in 15-year-olds with asthma is a real public health problem.[14,21]

What this study adds

Our study adds to the literature that the same risk factors of smoking are important for asthmatic patients, but that asthma patients score worse on school variables and life satisfaction. Besides, by using multilevel modelling, we do not find significant differences between countries regarding smoking and asthma, and hence, smoking in asthmatic adolescents can be seen as a universal health problem, independent of national health systems and health promotion strategies.

Our study also shows that the international guidelines of asthma management concerning smoking have failed regarding adolescents. Several explanations can be found for the gap between these asthma guidelines and practice. Patients may not be compliant with the advice of their physician, as with modern medication patients are almost symptom free and may think that smoking can not harm the evolution of their disease. Also, patients may want a normal life and smoking can be seen as part of this, especially for adolescents.[22] From a medical point of view, one might expect that asthmatic adolescents would avoid certain risk behaviours, particularly smoking, as this can provoke or worsen asthmatic symptoms. However, this study shows that for young people, despite their asthmatic condition, the advantages of smoking must be more important than its physical consequences. On the other hand, physicians may not follow the guidelines and fail to give adequate smoking cessation advice. In the literature, several barriers in physicians were identified for not giving such advice, including perceptions of a lack of success, self-confidence, self-efficacy, resources and time.[23–25]

Moreover in this study, we observed that many asthmatic adolescents live in a 'smoking environment', which jeopardizes the efficacy of smoking cessation advices given by physicians. Therefore, physicians should also motivate parents of asthmatic children to stop smoking. They are role models for their children, increase the likelihood of their children's smoking and also increase the risk of problems with asthma due to passive smoking. General smoking prevention towards young people should give extra attention to young people with asthma. Smoking prevention in adolescents is mainly focused on strategies emphasizing social pressure, a negative aspect of their social environment.[26] As non-asthmatic smoking adolescents also show breathing difficulty symptoms (24% wheezing and 33% nocturnal cough), more research must be done to investigate whether smoking prevention focusing on passive smoking, in addition to adolescents taking responsibility for their peers (with and without asthma), could be more effective.

Limitations of this study

One of the limitations in this cross-national research, and cross-national research in general, is the inability to demonstrate causal relations. In the HBSC study, it is not possible to claim that adolescents who are diagnosed with asthma are more likely to start smoking. It may also be that adolescents who smoke are more likely to develop asthma and do not change their behavioural pattern once the diagnosis is made. Although this assumption is less plausible as asthma is a disease of the young child, longitudinal research could address this question more adequately.

A second limitation of our research is that the questionnaire is self-reported. Although the questionnaire was anonymous, adolescents could be tempted to give socially desirable answers to some questions about risk behaviours and to deny asthma. However, although no clinical diagnosis is used to assess asthma, the value of the HBSC-AS was found in large-scale studies.[18]

A third limitation is the relatively small number of questions on our topic. As this study is part of a broader large-scale health behaviour study, the questionnaire could not cover all variables related to smoking and asthma.

In summary, adolescents with self-reported asthma are more likely to be daily smokers than adolescents without asthma. The same associated risk factors of daily smoking are important for both asthmatic and non-asthmatic adolescents, but adolescents with asthma score worse on the risk factors of daily smoking. Therefore, general smoking prevention in adolescents should have attention for young people with asthma and asthmatic symptoms. In asthma management programmes, more attention should be given to smoking prevention or cessation, and to possible risk factors for daily smoking such as poor life and school satisfaction.

Acknowledgements

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GENERAL DISCUSSION

1. Main findings

2. Limitations – critical remarks

3. Implications for practice and future research

4. References

1. Main findings

Although in most countries actions have been taken on the country as well as on the community and the individual level, tobacco use, and specifically tobacco use in adolescents, remains an important issue in public health. The objectives of this thesis are: to study trends of smoking in adolescents in different cultures (countries) throughout Europe and Canada; to study associations between tobacco control policies in different countries and the smoking prevalence of adolescents; and to study smoking in a specific risk population of adolescents: adolescents with self-reported asthma. The international Health Behaviour in School-aged Children (HBSC) study is used to explore these objectives.

In a first paper, large differences in smoking prevalence and gender differences can be observed between 1990 and 2002 in ten European countries and Canada. It can be concluded that smoking prevalence in adolescents follow a course, previously described by Lopez et al (1994) in adults. Both in boys and girls, three different trends are observed showing the same geographical pattern. In boys, the Nordic countries, Austria and Hungary show a declining or stabilising smoking trend; in the Western countries an initial increase is followed by a decrease in daily smoking; and in Switzerland and Eastern European countries an increase is followed by a stabilisation in smoking prevalence between 1998 and 2002. In girls, similar daily smoking trends can be found with a few exceptions. First, no country in the study shows a continuous decline in daily smoking prevalence in girls. Second, Hungary is the only country in this study where smoking prevalence in girls has increased in the period between the last two surveys. Third, Austria and Hungary follow the trend of the Eastern European countries, while in boys a stagnating trend is observed. Therefore, it is concluded that the results predict a huge burden on the health care systems of the Eastern European countries in 20 to 30 years time.

A second paper addresses the issue of the effect of country level policies. Smoking policy in 29 European countries is studied in relation to the regular smoking (defined as daily and weekly smoking) prevalence in boys and girls. Results from this second paper show that around 3,5% of the variance in regular smoking is due to the country structure in which 15-year-olds live. This may seem superficial but if the country variables that predict this variance can be

identified, a substantial decrease in smoking can be obtained. Our study shows that for boys a price policy, a ban on cigarette vending machines and the affluence in the country are important variables on the country level. However, in girls, the variables studied are not sufficient. Only a ban of cigarette vending machines is associated with less regular smoking in girls. In our analyses, country level policies seem to have a differential effect on girls and boys.

Another, rather neglected topic in smoking prevention is smoking in specific risk populations, namely adolescents having respiratory problems or more specifically a self-reported asthma diagnosis. Other asthma questionnaires were not suitable to be included in the HBSC study: they are too long, include a video about wheezing, or include parents' reports (Wolf et al, 1999; Asher et al, 1995). Therefore, an asthma scale with five questions was developed. Questions ask about asthma diagnosed by a doctor, wheezing in the last 12 months, wheezing after exercise in the last 12 months, coughing at night and visiting a doctor or the hospital for wheezing. In a third paper, the validation of the scale is described. In 10 to 12-year-olds (the youngest age category in the HBSC study), an absolute agreement with parents' reports of 92% is found for the whole scale and a kappa agreement of 0.59. For asthma diagnosis only, an absolute agreement of 97% is found and a kappa agreement of 0.73. It is concluded that the questionnaire is suitable to be included in the HBSC questionnaire. Especially the question on asthma diagnosed by a doctor can be used to detect the intended risk population.

In a fourth paper, the study population is described. Six member countries of the HBSC study have included the asthma scale into their national surveys. Large differences in prevalence between the countries are found going from 7.5% in Belgium (Flanders) to 19.8% in Canada. Also a substantial group of youngsters having asthma-like symptoms not resulting in an asthma diagnosis could be detected in all countries (up to 23% of the girls in Canada). Also large gender differences are found: diagnosed asthma is more prevalent in boys, while girls are more likely to have asthma-like symptoms that are not diagnosed as asthma. The paper shows that the risk population, adolescents with self-reported diagnosed asthma, is large enough for further study.

In paper five, daily smoking in 15-year-old adolescents having asthma is studied. Only adolescents who reported to have asthma diagnosed by a doctor are included in the analyses. This is an important limitation of the risk population as

this group of adolescents knows (or thinks) it has asthma and should/could act accordingly. Other adolescents with asthma-like symptoms that are not diagnosed as asthma are not included in this risk group, as they probably have not visited a doctor yet for their 'possible' asthma or do not recall the diagnosis. All asthma management guidelines are clear: asthmatic patients should not smoke (WHO, 2002; Scottish Intercollegiate Guidelines Network et al, 2003; GINA, 2007). The study shows that despite these guidelines, adolescents who report that they have asthma are more likely to be daily smokers. Their smoking behaviour also influences their asthma condition as they are more likely to have nocturnal cough and have more medical visits compared with non-smoking asthmatic adolescents. Similar associations are found between risk factors for smoking in asthmatic adolescents and non-asthmatic adolescents. At the intra-personal level, daily smokers are more likely to have a low life satisfaction and to engage in other risk behaviours such as being drunk more often, using cannabis, and being less likely to be physical active. Bad perceptions of school and of their own academic achievement are also related to daily smoking. At the inter-personal level, daily smokers are more likely to have smoking parents and smoking peers, are less likely to have a good contact with their parents, and spend more evenings with friends. But, asthmatics are more likely to score higher on these risk factors than non-asthmatics. Besides, due to the international perspective of this study, smoking in asthmatic adolescents can be seen as a universal health problem, independent of national health systems and health promotion strategies.

2. Limitations – critical remarks

Limitations of this work are the following:

First, some limitations are due to the type of research. All presented work is based on the HBSC study, an international cross-sectional study on a wide range of health and health behaviour topics. Like in all cross-sectional research, it is not possible to study causal relations. Only associations between variables can be investigated. This has implications for the papers on relations between smoking and policy measures and asthma (paper two and five). At the country level, with the current analyses, it is not possible to say that a certain policy has

an impact on smoking prevalence in young people. Although we are not sure about the causality, the results can give an indication of which policies are important for adolescents. At the individual level, the study cannot establish if the adolescent is first diagnosed with asthma and began smoking, or the other way round. The results show that adolescents with self-reported asthma are more likely to smoke. Although this is a limitation in the study, it is still an important finding as adolescents with asthma should not start smoking (if the diagnosis is given first) or should stop smoking (if the diagnosis is given after smoking initiation). Furthermore, for most children, asthma begins in late toddler age groups and remains problematic until or after puberty. Therefore, in most adolescents asthma was first established before smoking. Longitudinal studies can address these problems.

As HBSC is a school-based study, school drop-outs are not included. This may give an underestimation of smoking prevalence as school drop-outs are more likely to smoke (Lam, 2004). Non-participation of the schools, which in some countries is high, may distort the results and make comparison between countries difficult. Schools that are refusing may be high-risk schools for certain behaviours such as smoking, alcohol use and drug use. At this time, no information is available to examine reasons for non-participation of schools internationally. Pupils not present at the time of the inquiry are also not included. Reasons for absence may be illness and truancy. Non-participation due to illness may result in an underestimation of the smoking prevalence as smokers are more vulnerable to illnesses (see paper 2.3 for respiratory problems and visits to the general practitioner). Besides, pupils who truant are more at risk for smoking. It may also underestimate the prevalence of asthma as asthmatic adolescents are more likely to be absent due to illness (Silverstein et al, 2001). Pupils may also refuse to participate in the study. Every country has tot follow their own ethical guidelines. A lot of variation exists going from no consent asked, to informed consent, to active consent by the parents and the pupils. Certain sub-population may be more reluctant to participate resulting in a distortion of smoking and/or asthma prevalence.

The HBSC study is a study that gathers information on a wide range of health-related topics. But for some research questions, the study is less in-depth than is sometimes necessary. On the other hand, the strength of the study is the large

number of participating countries, which makes a generalization of the results more acceptable.

To conclude, HBSC has several advantages to explore health-related problems, such as smoking, in a large multi-cultural population. For more in-depth studies, specific research and longitudinal research is needed.

Second, some limitations are present due to the variables used: self-reported smoking and asthma.

First, smoking prevalence is self-reported. In general, self-reported smoking prevalence has been considered as a good indicator of the actual smoking status and has been compared with biochemical validated smoking prevalence (Patrick et al, 1994; Newell et al, 1999), especially in epidemiology, but may still give an underestimation of the problem in adolescents (Newell et al, 1999). Although the questionnaire had to be completed anonymously, cultural differences in answering questions may be a problem, especially with questions with a social stigma (Pirkens et al, 2003). As smoking can be stigmatised in certain cultures, in certain time periods and for boys or girls, underreporting of smoking can occur.

Second, in all papers, only cigarette smoking prevalence (daily or regular smoking) is studied. Although cigarettes are used the most of all, also other tobacco products become more and more available. 'Exotic' tobacco products such as bidis, kreteks, hookahs (or nargil), are common in developing countries but are finding their way to the Western countries via the internet and by other means (Prokhorov et al, 2006; Warren et al, 2006). In Europe, 10% of the boys and 6% of the girls are using tobacco products other than cigarettes (Centers for Disease Control and Prevention, 2006). The problem with these products is that they seem less harmful than the manufactured common cigarettes (as they are often labelled as 'natural' products), but this is not the case. Most of them contain more carbon monoxide and tar (Mackay & Eriksen, 2002). Smokeless tobacco becomes more and more common in Nordic countries. In Sweden smokeless tobacco is much used in youth, especially in boys (14.5% used snuff weekly in 2002) (Tynjälä et al, 2003). The different method of using, sniffing or orally, can result in a wide range of oral and nasal diseases and cancers. These other tobacco products are not studied in this work. The tobacco problem described may therefore be an underestimation of the real tobacco problem.

Third, only prevalence of smoking is studied and not the smoking behaviour such as the way of inhalation, the amount of cigarettes and the type of cigarettes. At the country level, countries with low smoking prevalence can use for example high tar cigarettes, while countries with high smoking prevalence can use more low tar cigarettes. This difference can have an impact on smoking-attributable diseases and mortality. Some studies have already investigated this problem. In high tax states, young adults are more likely to smoke cigarettes with a higher tar and nicotine content compared with young adults living in low tax states (Chaloupka, 1999). Also, the time used to smoke a cigarette is longer in young adults in high tax states. In the study on smoking and asthma, only daily smoking is analysed. The way of inhalation and the amount of cigarettes smoked may be important elements of smoking behaviour. Due to the asthma condition, deep inhalation may be impossible, resulting in smoking more cigarettes to obtain the same amount of nicotine.

Finally, also the questions to determine the risk population are self-reported and no clinical test is used to detect asthma. Although the HBSC asthma scale was validated against parents' reports, and proven to be good, adolescents (15-year-olds) may deny the asthma diagnosis due to experiences of stigmatisation (Zbikowski et al, 2002). However, questionnaires for detecting asthma are widely used and proved to be reliable, cost-effective and reasonably independent of immediate circumstances such as the time of the year, temperature, infections and treatment (Burr, 1992).

Only adolescents who reported to have asthma diagnosed by a doctor are included in the paper on smoking and asthma, although in paper four a substantial group of adolescents is detected with asthma-like symptoms but without asthma diagnosis. As we do not have a clear picture about this group adolescents (do they have undiagnosed asthma?; are these adolescent heavy smokers having asthma-like respiratory problems?), this group is omitted in this paper. But this group of 'possible asthmatics' can be an unrecognised risk group in health promotion and a high-risk group for substance (ab)use (Ringsberg et al, 2001; Yeats et al, 2003a; Yeats et al, 2003b).

3. Implications for practice and directions for future research

The results concerning the differences in smoking prevalence between boys and girls, the differential effects of policies on both genders, and the lack of differences in smoking prevalence rates between adolescents with and without respiratory problems, raise the question of using selective prevention approaches or universal prevention approaches. This question is often posed in the prevention field (Weissberg et al, 2003). Based on this work, we can conclude that smoking prevention on the country level (which is an universal approach such as the tobacco control policy) as well as smoking prevention targeting a specific risk population (which is a selective approach) are equally important.

At the country level, the population strategy may have less impact in relation to efficacy but due to the large amount of adolescents reached, it is an important and cost-effective tobacco control strategy. With the internationally Framework Convention of Tobacco Control (WHO, 2003), a lot of willingness from governments has been shown to work on tobacco control and to stimulate countries to develop tobacco control policies. More support should be given to the countries with a low affluence, as their smoking prevalence is still increasing. Based on the Tobacco Control Scale developed by Joossens & Raw (2006), there is still room for improvements for all countries and more specifically for low affluent countries. For example, Latvia, Lithuania, Czech Republic, Slovenia and Estonia are the countries with the lowest scores on the price subscale of Joossens & Raw (2006). In high-income countries, tax comprises between 2/3 and 4/5 of the price of cigarettes, while in low-income countries tax is generally less than ½ of the price (Jha & Chaloupka, 2000).

But equally important, countries with a declining or stabilising daily smoking trend in adolescents must stay alert and policy makers should face the challenge of keeping the smoking prevalence declining or at least constant by searching for initiatives that are innovative and suitable for both boys and girls. More research is needed on policy measures that have an impact on smoking prevalence in girls. The tobacco industry has created so called 'females' brands such as the light cigarettes by taken gender roles and norms into consideration in its market research for decades (WHO, 2007). Also due to sponsorship of fashion shows,

concerts and movies, the tobacco industry connects smoking with the ideal body image of the Western world. Therefore, girls may use smoking to obtain this ideal body image, and more specific to control weight. At national policy level, it is possible to incorporating gender into national tobacco control measures. The descriptors such as light, mild or low-tar should be forbidden (included in the FCTC). Also specific textual and pictorial health warnings for women reflecting sex and gendered effects can be expanded (WHO, 2007). For girls/ women, it can be stressed that smoking causes wrinkles, premature ageing of the skin, discoloration of the teeth … (Mackay J & Eriksen, 2002).

Also other levels of the ecological framework can be examined. The community level is worthwhile to study as it can reach a large group of adolescents and at the meantime it can be specific or tailored enough to be effective for adolescents. Research shows that, when smoking is used to control weight, a cluster of unhealthy ways to control weight is found with physical inactivity, unhealthy eating and dieting as other elements of the cluster (Potter et al, 2004). Schools can play an important role in educating healthy eating and exercise (Kendzor et al, 2007). By education, girls learn about healthy alternatives to control their weight. In a review of Potter et al (2004), one study found that BMI was related to smoking in girls in independent schools, but not in state schools. Therefore, also the atmosphere of a school is important. A school where all pupils are accepted as they are, is important for girls' positive and healthy body image, body satisfaction and self-efficacy.

At individual level, gendered cessation programs should be implemented (WHO, 2007). Nicotine Replacement Therapy is found to be less effective in girls because of fear of weight gain. Realistic information must be given and alternatives to control weight. Programs that reduce weight concerns and dieting behaviours by cognitive behavioural interventions can be used (Kendzor et al, 2007).

Further 'semi'-longitudinal research can address the causality between smoking prevalence in adolescents and tobacco control policies. Joossens et al (personal communication) have repeated their research on the tobacco scale and have made a second version. The aim of this second version is to verify if and how countries have improved their tobacco control policies. Plans are made to investigate score differences between the two versions of the scale with the

difference in smoking prevalence between the HBSC 2005-2006 and the next HBSC survey in 2009-2010. Based on these results, statements on causality between tobacco control policy and smoking prevalence can be made.

At the individual level, current guidelines for asthma management seem not to result in non-smoking in asthmatic adolescents. Physicians' perceptions of a lack of success, self-confidence, self-efficacy, resources and time are mentioned in the literature as reasons why physicians may not follow the guidelines and fail to give adequate smoking cessation advice (Taylor et al, 1999; Cabana et al, 2000; Cabana et al, 2001; Kaplan et al, 2004). Especially in adolescents, physicians often fail to build a good relationship for tobacco prevention because parents are present during the visit (Kaplan et al, 2004). Precht et al (2003) explain that physicians and nurses just assume that asthmatic adolescents do not smoke. Therefore, they do not ask adolescents about their smoking behaviour. Making them aware of this problem, may motivate them to ask about the smoking status and to help in smoking cessation. Van De Ven et al (2007) found that young non-smoking asthmatics have more negative attitudes towards smoking and a lower intention to smoke compared to non-smoking healthy adolescents. However, once the transition to smoking is made, their intention and attitudes change dramatically, making them tenacious smokers. Therefore, anti-smoking advice must start at a young age and the advice must be repeated regularly. The minimal intervention program can be used to offer such a smoking intervention. Four steps must be followed: to assess the smoking status, to advise not to smoke, to assist in smoking cessation, and to arrange follow-up (Lancaster & Stead, 2004).

Thereby, our research and research of others (Otten et al, 2005) show that asthmatic adolescents are more likely to have parents that smoke. Otten et al (2005) hypothesised that parents who are smoking in presence of their asthmatic children may give the message that smoking is not dangerous for asthmatic people. This message may lead to an underestimation of the health consequences of smoking by adolescents (asthmatic and non-asthmatic). Smoking interventions should therefore also focus on parental smoking by giving parents information about the health consequences of smoking in adolescents with asthma, but also about the health consequences of smoking in healthy adolescents.

As smoking prevalence rates remain relatively high, also additional and innovative strategies have to be found to reach young people. By establishing tobacco control policies (bans on tobacco advertisements, bans on smoking in public places …), the social norms about smoking in the general population can be changed. As adolescents are in a period of revolting against adults and other external controlling forces, some of these policies can have the opposite effect in older adolescents (Miller et al, 2006). Changing the social norm on smoking in this subgroup of older adolescents is a real challenge. Smoking prevention at the individual level often focuses on social pressure which is a negative aspect of the social environment (Simons-Morton, 2001). Smoking prevention towards adolescents gives a paternalistic message ('you may not smoke'), which restricts their freedom, resulting in reactance against anti-smoking messages (Miller et al, 2006). Therefore, smoking prevention for older adolescents should focus on giving implicit non-controlling messages (Grandpre et al, 2003). That way, adolescents are allowed to have more freedom and control in making their own choices regarding healthy behaviours (such as the concept of empowerment in public health terms). One approach that can be used towards adolescents is prevention focusing on passive smoking. Messages can point to the responsibility that adolescents feel for their (asthmatic and non-asthmatic) peers. We found that non-asthmatic smoking adolescents also have respiratory problems. Approaches that focus on recognising these negative implications for their own health but especially for the health of their friends, can change smoking from a social habit to a more 'individual' habit, making it less attractive to initiate and to continue.

Also the use of new media such as the internet, game consoles and chat rooms could be explored to reach adolescents in their environment. Woodruff et al (2007) for example, used an internet-based, virtual reality world as smoking cessation intervention. The results are promising and not related to socio-demographic characteristics such as gender, age and ethnic group (Woodruff et al, 2008).

To finalise, making adolescents totally smoke-free is probably impossible. Besides smoking as a risk behaviour that has to be prevented, smoking as a behaviour in adolescence can also have a positive function in the (social) development. Smoking is also related to good social contacts (Bond et al, 2007).

Adolescents are in the ages between childhood and adulthood. The developmental tasks adolescents have to fulfil are, among others, searching for an own identity and autonomy, emancipating against parents, and developing self-determination and effectance (Verhofstadt-Denève, 1994; Miller et al, 2006). To succeed in this developmental stage, young people experiment with limits and test capacities (Nic Gabhainn & Francois, 2000). As some behaviour is characteristic for older, more mature adolescents or young adults, imitating this behaviour can be successful to show that they have made the transition to another phase (Verhofstadt-Denève, 1994). Therefore, preventing one behaviour can have an influence on other, often not recommended, behaviours (for example drinking alcohol, cannabis use). The epidemiology of multiple substance use is understudied as well as transitions between the use of different substances because of changes in laws, health promotion initiatives, treatment for the use of one substance or for other reasons. In the last few years some studies in this field have been published (Kulbok & Cox, 2002; Kuntsche, 2004 on HBSC data). This topic needs more attention, also by public health experts.

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SUMMARY - SAMENVATTING

Summary

As smoking causes a wide range of preventable diseases and deaths, prevention and treatment of smoking are high priorities in public health. Smoking is generally initiated during adolescence, and an addiction to nictone is developed shortly after. Therefore, it is imperative to target adolescents in smoking prevention.

Decades of research on determinants of smoking reveal a broad picture of factors on different levels integrated in an ecological model. At the intrapersonal level, smoking is related to several socio-demographic, personal and behavioural factors. Furthermore at the interpersonal level, the direct social environment, such as parents and peers, plays a fundamental role in smoking initiation, experimentation and continous smoking. Specific subpopulations, such as adolescents with chronic respiratory problems, are adviced against smoking.

Tobacco control policies have been implemented in several countries, supported by the World Bank and the WHO Framework Convention on Tobacco Control. At the community level, school is an important environment to implement smoking prevention strategies for adolescents.

The aim of the thesis was to study factors on two levels of the ecological framework, the country level and the individual level.

At the country level, the specific objectives were to describe international gender-specific trends in adolescent smoking (article 1) and to assess associations between tobacco control policies and adolescent smoking prevalence rates (article 2). At the individual level, the research focused on a specific risk population: adolescents with self-reported asthma. The specific objectives were to develop an instrument to identify adolescents with respiratory problems (article 3), to describe international prevalence rates of asthmatic symptoms and self-reported diagnosed asthma in adolescents by gender, age and country (article 4), and to measure smoking prevalence and the determinants of smoking in adolescents with respiratory problems (article 5).

All original research is based on the international Health Behaviour in School-aged Children (HBSC) study. This study, under the auspices of the World Health Organisation Regional office for Europe, aims at gaining new insight into and increasing our understanding of adolescent health, health behaviours and well being in their social context. HBSC is a school-based study using self-completion questionnaires administered in the class room on a wide range of health indicators, health-related behaviours and life circumstances.

A first paper described the large differences in smoking prevalence between 1990 and 2002 in ten European counttries and Canada. Smoking prevalence in adolescents follows three different trends that are gender specific and dependent on the geographical location. In boys, a declining or stabilising smoking trend was observed in the Nordic countries, Austria and Hungary. In the Western countries, an initial increase is followed by a decrease in daily smoking; while in Switzerland and the Eastern European countries, the initial increase is followed by a stabilisation in smoking in boys. In girls, no country in the study shows a continuous decline in daily smoking prevalence. In Hungary, smoking prevalence in girls has even increased between the last two surveys. Also in Austria, girls smoking prevalence is increasing instead of stagnating as in boys.

In a second paper, by using multilevel modelling, the associations of tobacco control policies at country level were studied in 29 European countries in relation to regular smoking in 15-year olds. About 3.5% of the variance in regular smoking in adolescents can be attributed to the country structure. A ban on cigarette vending machines is associated with less regular smoking in boys and girls. In boys, an efficient price policy and living in a high affluent country was also related to less regular smoking. Country level policies seem to have a differential effects on girls and boys.

In a third paper, the development of an asthma scale with 5 questions to be included in the HBSC study, was described. The scale is validated against parents' reports in 10-12 year old pupils. In 10-12 year olds, an absolute agreement of 92% is found for the whole scale. The question used in the further analyses, self-reported asthma diagnosed by a doctor, had an absolute agreement of 97% and a kappa agreement of 0.73.

In a fourth descriptive paper of the study population, large gender, age and country differences in the prevalence of self-reported diagnosed asthma, and asthmatic symptoms were found in the six countries that had included the asthma scale in their national surveys. Also, a substantial group of adolescents with asthmatic symptoms but without diagnosis was found in all countries.

In a fifth paper, daily smoking in 15-year old pupils with self-reported diagnosed asthma is studied. The study showed that these adolescents were more likely to be daily smokers than non-asthmatic pupils. Their asthma condition was also influenced by their smoking behaviour as they were more likely to cough during the night and had more medical visits compared with non-smoking asthmatic pupils. Similar associations were found between smoking determinants in adolescents with and without asthma, but asthmatic pupils were more prone to score high on these risk factors.

Although limitations are present in the study, such as the inability to determine causal relations, a lack of in-dept information, and the use of self-reports of smoking and diagnosed asthma, important implications for practice and future directions for research can be given.

Support should be given to East-European and low affluent countries in implementing an efficient tobacco control policy as smoking trends predict a high burden of smoking attributable morbidity and mortality in the future. An elaborate price policy and a total restriction of vending machines can influence adolescent smoking, especially in boys. Moreover, countries with a declining or stabilising smoking trend should face the challenge to keep the smoking prevalence decreasing or stable by searching for innovative strategies. Research is needed on policy measures that impact on the smoking prevalence in girls.

Current guidelines for asthma management seem not to have an impact on smoking in asthmatic adolescents. Our research found that parents of asthmatic adolescents are more likely to be smokers themselves. Information should be given to parents of asthmatic adolescents about the dangers of smoking in the environment of their child and their function as role model for their children. Several other channels through which smoking prevention can be given for this specific group can be suggested. First, physicians should be aware about the higher prevalence of smoking in adolescents. Anti-smoking advice can be given in the medical consultations. Second, innovative strategies should be found to

reach young people with and without asthma. Messages to adolescents pointing at the responsibility towards their peers with and without asthma, can be used.

The thesis concluded that general smoking prevention measures on the country level, as well as smoking prevention targeting specific risk populations are equally important.

Samenvatting

Het roken van tabak is nog steeds de oorzaak van een brede waaier aan vermijdbare ziekte en sterfte. Tabakspreventie en rookstop zijn dan ook prioriteiten in volksgezondheid. Roken wordt over het algemeen geïnitieerd tijdens de adolescentie. Verslaving aan nicotine volgt kort daarop. Daarom is het van primordiaal belang dat rookpreventie gericht is naar adolescenten.

Decennia van onderzoek naar de determinanten van roken hebben een breed beeld van factoren blootgelegd die kunnen geïntegreerd worden in de verschillende niveaus van een ecologisch model. Op intra-persoonlijk niveau is roken gerelateerd aan verschillende socio-demografische, persoonlijke en gedragsfactoren. Op interpersoonlijk niveau speelt de directe sociale omgeving, zoals de ouders en vrienden, een fundamentele rol in de initiatie van roken, het experimenteren met roken en het regelmatig roken bij jongeren. Specifieke subpopulaties, zoals adolescenten met chronische respiratoire problemen, worden geadviseerd niet te roken.

Maatregelen inzake tabaksbeleid zijn geïmplementeerd in verschillende landen, met ondersteuning van de Wereldbank en de "WHO Framework Convention on Tobacco Control". Op gemeenschapsniveau is de school een belangrijke omgeving voor de implementatie van rookpreventie strategieën voor adolescenten.

Het doel van de thesis was het bestuderen van factoren van roken op twee niveaus van het ecologische kader, namelijk op landenniveau en op individueel niveau.

De specifieke objectieven op landenniveau waren het beschrijven van internationale geslachtsspecifieke trends van roken bij adolescenten (artikel 1) en het bepalen van de associaties tussen een nationaal tabaksbeleid en de prevalenties van regelmatig roken bij adolescenten (artikel 2). Op individueel niveau was het onderzoek gefocust op een specifieke risicopopulatie: adolescenten met zelfgerapporteerde astma. De specifieke objectieven waren het ontwikkelen van een instrument om adolescenten met respiratoire problemen te identificeren (artikel 3), het beschrijven van de internationale prevalentie van

astmatische symptomen en zelfgerapporteerde gediagnosticeerd astma bij adolescenten naar geslacht, leeftijd en land (artikel 4), en het meten van de prevalentie en de determinanten van roken bij adolescenten met respiratoire problemen (artikel 5).

Het origineel onderzoek is volledig gebaseerd op de internationale studie Health Behaviour in School-aged Children (HBSC). Deze studie, onder toezicht van de Wereldgezondheidsorganisatie (regionaal kantoor voor Europa), heeft tot doel nieuwe inzichten te genereren in de gezondheid van adolescenten, hun gezondheidsgedrag en hun welzijn binnen hun sociale omgeving. HBSC is een studie uitgevoerd in scholen die gebruik maakt van vragenlijsten, in te vullen in de klas. De vragen bestrijken een brede waaier aan gezondheidsindicatoren, gezondheidsgerelateerde gedragingen en levenssituaties.

Een eerste artikel beschrijft grote verschillen in de prevalentie van dagelijks roken tussen 1990 en 2002 in tien Europese landen en Canada. De rook-prevalentie van adolescenten volgt drie verschillende trends die geslachtsspecifiek zijn en afhankelijk van de geografische locatie. Bij jongens werd een dalende of stabiliserende trend geobserveerd in de Noordelijke landen, Oostenrijk en Hongarije. In de Westelijke landen, werd een initiële stijging van dagelijks roken vastgesteld en gevolgd door een daling. In Zwitserland en de Oost-Europese landen, werd een initiële stijging gevolgd door een stabilisatie van het dagelijks roken bij jongens. Bij meisjes was in geen enkel land in de studie een daling in het dagelijks roken vast te stellen. In Hongarije was de rook-prevalentie bij meisjes zelfs gestegen tussen de twee laatste bevragingen. Ook in Oostenrijk was de rook-prevalentie bij meisjes gestegen in plaats van gestabiliseerd zoals bij de jongens.

In een tweede artikel werd multilevel modelling gebruikt om de associaties tussen tabaksbeleid op landenniveau en het regelmatig roken van 15-jarigen te bestuderen in 29 Europese landen. Ongeveer 3.5% van de variantie in regelmatig roken kan men toeschrijven aan de landenstructuur. Een verbod op verkoopautomaten voor sigaretten is geassocieerd met minder regelmatig roken bij jongens en meisjes. Bij jongens was een efficiënt prijsbeleid en het leven in een land met een hogere welvaart ook gerelateerd aan minder regelmatig roken.

Het beleid op nationaal niveau blijkt een differentieel effect te hebben op jongens en meisjes.

In een derde artikel werd de ontwikkeling van de astma schaal bestaande uit 5 vragen beschreven. Deze schaal werd gevalideerd bij 10- tot 12-jarigen tegenover zelfgerapporteerde antwoorden van de ouders. Bij 10-12 jarigen werd een absolute overeenkomst van 92% gevonden voor de hele schaal. De vraag die we verder zullen gebruiken in de analyses, namelijk zelfgerapporteerde gediagnosticeerde astma, had een absolute overeenkomst van 97% terwijl de kappa overeenkomst 0.73 bedroeg.

In een vierde beschrijvend artikel van de studiepopulatie in de zes landen die de astmaschaal hadden opgenomen in hun nationale bevraging, werden grote verschillen gevonden in geslacht, leeftijd en tussen de landen in de prevalentie van zelfgerapporteerde astma en astmatische symptomen. Er werd tevens een substantiële groep van adolescenten gevonden met astmatische symptomen maar zonder astma diagnose en dit in elk land.

In een vijfde artikel werd dagelijks roken van 15-jarigen met zelfgerapporteerde astma bestudeerd. De resultaten toonden dat deze adolescenten meer kans hadden om dagelijks te roken dan niet astmatische adolescenten. Hun astma conditie werd ook beïnvloed door het roken aangezien ze meer hoesten tijdens de nacht en meer medische consultaties hadden in vergelijking met niet rokende astmatische adolescenten. Gelijkaardige associaties werden gevonden tussen de determinanten van het roken bij adolescenten met en zonder astma. Astmatische leerlingen waren wel meer geneigd om hoger te scoren op deze risicofactoren dan niet astmatische leerlingen.

Niettegenstaande de beperkingen van de studie, zoals het niet kunnen vastleggen van causale relaties, een gemis aan gedetailleerde informatie, en het gebruik van zelfrapportage voor roken en astma, kunnen toch belangrijke conclusies getrokken worden voor de praktijk en verder onderzoek.
Steun moet gegeven worden aan Oost-Europese landen en landen met een lagere welvaart voor het implementeren van een efficiënt rookbeleid aangezien de trends wijzen op een hoge kost in de toekomst voor tabaksgerelateerde

morbiditeit en mortaliteit. Een uitvoerig prijsbeleid en een totale restrictie van verkoopautomaten kan de prevalentie van roken bij adolescenten beïnvloeden, vooral bij jongens. Bovendien moeten landen met een dalende of stabiliserende rook-prevalentie alert blijven zodat de prevalentie blijft dalen of stabiel blijft door te zoeken naar vernieuwende strategieën. Meer onderzoek is nodig naar beleidsmaatregelen die een impact kunnen hebben op de rook-prevalentie bij meisjes.

De huidige richtlijnen voor de behandeling van astma blijken weinig impact te hebben op het roken bij adolescenten met astma. Ons onderzoek toonde aan dat ouders van astmatische jongeren zelf meer roken in vergelijking met ouders van niet-astmatische jongeren. Meer informatie zal moeten gegeven worden aan deze ouders over de gevaren van het roken in de omgeving van hun kind en over hun functie als rolmodel voor hun kinderen.

Er worden verder suggesties gegeven over verschillende andere kanalen voor het geven van rookpreventie aan deze specifieke groep. Ten eerste moeten dokters zich bewust zijn van de hogere prevalentie van roken bij astmatische jongeren. Antirook advies kan gegeven worden in de dokterspraktijk. Ten tweede moeten vernieuwende strategieën gevonden worden om jongeren met en zonder astma te bereiken. Het effect van boodschappen naar adolescenten die wijzen op hun verantwoordelijkheid voor hun vrienden met en zonder astma zou kunnen nagegaan worden.

De thesis besluit dat zowel algemene tabakspreventie op landenniveau als tabakspreventie gericht op specifieke risicopopulaties belangrijk zijn.

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Anne Hublet
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ABOUT THE AUTHOR

Anne Hublet was born on July 7, 1974 in Ghent, Belgium. She followed secondary school at the Visitatiehumaniora in Ghent and finished secondary education in 1992. In the same year, she started informatics sciences at the Ghent University for one year. In 1993, she started Psychology Sciences at the Ghent University and obtained her degree in 1998.

After working as a psychologist in a Centre for Mental Health, in 1999 she started working at the Flemish Institute of Health Promotion at the project on guidelines for smoking cessation. In 2000, she started working part-time at the Ghent University on the project Health Behaviour in School-aged Children study but stayed also part-time at the Flemish Institute of Health Promotion. In 2001, she was working fulltime at the Ghent University, part-time on a project of Levenslijn to develop a short asthma questionnaire and part-time on a project on diabetes and work. Since 2003, Anne Hublet is working 60% for the HBSC study.

From 2001 until now, Anne Hublet is member of the HBSC network and of the Risk Behaviour Group within this network. Her expertise is on smoking and she is author of the protocol chapter on tobacco smoking in the international HBSC study 2005-2006 and of the chapter on tobacco smoking in the international reports of the 2001-2002 and 2005-2006 surveys.

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