Smoking during adolescence

Association with other cardiovascular risk factors in Belgian adolescents

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Background: The objective of the present study was firstly to collect data on smoking in adolescents from a high cardiovascular risk population and, secondly, to analyse the association between smoking and other cardiovascular risk factors. **Methods:** A cross-sectional study was conducted in 1,526 adolescents (12–17 years) in 24 secondary schools of the Belgian province of Luxembourg. Data collection included smoking, physical activity habits, blood pressure, total cholesterol, anthropometry, diet (e.g. alcohol consumption) and oral contraceptive use. **Results:** The prevalences of current and occasional smokers were 14.8 and 5.4% respectively, with similar proportions in both genders. The proportion of smokers was significantly higher in the technical course than in the classical one (35.6 versus 24% in the 15–17 years age group). In the 15–17 year old group, regular smokers consumed significantly more free sugar, alcohol, coffee and soft drinks and male smokers ate less fruit and vegetable than non-smokers. In the same age group, 32.6% of female smokers were oral contraceptive users versus 17.9% in the non-smokers group. Other cardiovascular risk factors were similar in regular smokers and non-smokers. **Conclusion:** Adolescent smoking is a cause for concern in this sample from a high cardiovascular risk population. Few links were found between the prior and other cardiovascular risk factors. However, the high prevalence of smoking in the technical course and its combined usage with oral contraceptives in teenagers deserve careful attention.

Keywords: adolescence, cardiovascular risk factors, smoking

In Europe smoking in youth is an overwhelming public health problem for the following three reasons. First of all, direct health consequences as the development of premature atherosclerotic lesions have been shown in youth.[1,2] Secondly, the onset of this habit leads to deleterious health effects in later adulthood.[3,4] Finally, smoking in teenagers is often associated with unhealthy lifestyle.[5–8] Due to these reasons, smoking uptake during adolescence entails harmful consequences on the current as well as on future population health. Research was conducted in the Belgian province of Luxembourg to study this public health problem in teenagers. The aim was to analyse smoking habits in adolescents and to examine the association with other cardiovascular (CV) risk factors. The significance of this survey is found in its choice of study population. The Belgian province of Luxembourg has indeed a high CV disease morbidity and mortality burden in comparison with neighbouring regions. Moreover, MONICA surveys have found high CV risk factors levels in adults and children from this province.[9,10] The present study therefore provides the missing link between observations made in adults and children from the same population.

METHODS

Survey population

The present survey was carried out in the province of Luxembourg, the southern part of Belgium. This rural area has a population of 240,000, with 7.8% of young people aged 12–17 years (n=18,800). Participants were recruited by a multiclustered sampling technique. Eligibility criteria were age (12–17 years), Belgian nationality and residence in the province. Twenty-four secondary schools were randomly selected out of the 48 schools in the province. A course was allocated to each school with probability proportional to the distribution registered in the statistics of the province. Belgian students aged 12–18 years have actually the choice between classical courses (i.e. mainly theoretical lessons) or technical courses (i.e. from 25 to 75% practical lessons). Classes were finally selected randomly as cluster units. The eligible population had 1,826 subjects. A high participation rate was recorded with 83.6% of the adolescents (n=1,526) taking part in the study (742 boys and 784 girls). The age distribution was homogeneous in middle age groups with fewer participants in the youngest and oldest ones. Of the 300 non-respondents, 108 were not at school during the survey and 192 subjects refused to participate. The first reasons put forward were recent medical examination (n=31), omission of the appointment (n=24) and parental refusal (n=19). Ethical approval was secured beforehand and written consents were obtained for all participants.

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Data collection

Information on smoking was collected through a confidential self-administered questionnaire and participants were classified into five categories according to their habits.

■ Never smoked.
■ Trials (if they ever took a puff at a cigarette).
■ Ex-smoker (smoked for at least 3 months but stopped more than 1 month prior to the survey).
■ Occasional smoker (smoked at least one cigarette a week).
■ Regular smoker (smoked at least one cigarette a day).

Regular, occasional and ex-smokers were asked about the age when they started, the age when they stopped eventually and their usual weekly or daily consumption. The self-administered questionnaire asked about leisure time physical activity (e.g. type, frequency and duration). Information was also collected about oral contraceptive (OC) use by girls, including the type and duration of use. A food frequency questionnaire was given to all participants. Information on portion sizes was recorded by interview in a random subgroup of 234 adolescents using a picture book and food samples. Specific questions determined the amount of beer, wine and spirits consumed. Physical examination included blood pressure, heart rate and anthropometric indices measurement. Blood pressure (mmHg) was measured as recommended by the second Task Force on Blood Pressure in Children and Adolescents.[11] The level was recorded twice with a standard mercury sphygmomanometer (left arm, subject sitting). The size of the cuff depended on the size of the upper arm. The fifth Korotkoff sound was used for diastolic blood pressure. Anthropometric indices included height, weight, triceps and subscapular skinfolds. Measurements were carried out according to the guidelines of the World Health Organisation.[12] Quality control procedures included double measurements by external observers, checks at data entry and during data processing. Education level was assessed by parental education (five levels) and by the participant course (either classical or technical curriculum).

Statistical analyses

Statistical analyses were performed using an SAS® statistical package.[13] Means and standard deviations were computed for continuous parameters and frequencies for qualitative data. *t*-Tests were used for comparing two means, analysis of variance was applied for more than two subgroups and χ^2 tests were used for categorical variables.

RESULTS

Figure 1 shows the distribution of smoking habits of both genders. One-fifth of the adolescents (n=302) were occasional or regular smokers. The prevalence of regular smoking was equal to 14.4% (n=220) and similar for both genders (14.8% for boys and 14% for girls). Median age of onset did not differ significantly between boys and girls (13 years). Regular smokers' consumption ranged between one and 50 cigarettes a day. Median daily consump-
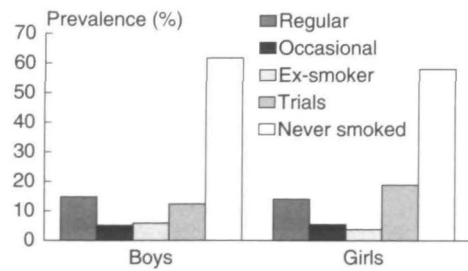

Figure 1 Smoking prevalence by gender

tion was ten cigarettes, but 10% of the regular smokers consumed more than one pack per day. Regular female smokers had a lower mean consumption than boys (10.8 versus 11.2 cigarettes a day) but the difference was not statistically significant (p>0,05). Five percent of the participants were regular smokers (5.4%, n=82), with similar proportions for both genders (i.e. 5.1% boys and 5.5% girls). Mean weekly consumption (4.8 cigarettes) and median age when they started (14 years) did not differ between genders in the occasional smokers' group. However, age when they started was significantly higher than in the regular smoking group (p<0.001). The proportion of ex-smokers was equal to 4.8% (n=74) for the whole sample but higher in boys (5.9%) than in girls (3.8%). Mean smoking duration was one year for both genders. Sixteen percent of the participants (15.6%, n=239) had experienced at least one puff at a cigarette. More girls than boys had had trials (18.8% versus 12.4%). Sixty percent of the adolescents (59.7%, n=911) had never smoked. *Table 1* illustrates the rise of smoking prevalence with age for both genders. Twenty-six percent (26.3%, n=61) of the adolescents aged 17 years smoked at least one cigarette a day.

Smoking habits differed widely between courses. Analyses were performed in 15–17 year olds (n=787) to compare similar age groups (mean age = 16.4 years for both courses). One-third of the adolescents from the technical course (30.6%, n=115) were regular smokers versus 15.3% (n=63) in the classical course (*figure 2*). More detailed analyses confirmed the significantly higher smoking pre-

Table 1 Smoking prevalence (regular smokers) by age and gender group (742 boys and 784 girls)

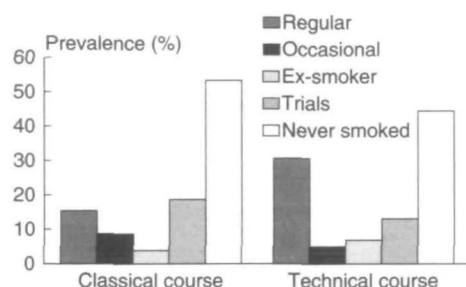| Age (years)		Boys		Girls	
	n	%	n	%	n
12	182	1.1	1	3.1	3
13	300	4.5	7	6.2	9
14	257	9.4	13	7.5	9
15	277	21.5	28	22.4	33
16	278	22.3	31	18.0	25
17	232	31.9	30	22.5	31
All ages		14.8	110	14.0	110

Figure 2 Smoking prevalence by course (15-17 years)

valence in the technical course for all ages (p<0.05). Level of consumption differed also significantly between courses. Mean weekly cigarette consumption of occasional smokers was equal to 4.3 cigarettes in the classical course compared to 8 in the technical one. Results for regular smokers were 10 and 13.1 cigarettes a day in the classical and technical options respectively. In contrast, neither the paternal nor the maternal education level significantly influenced adolescents' smoking.

Table 2 summarizes the comparison of CV risk factors between regular smokers and non-smokers in the same age group (15–17 years), in order to have sufficient quantity and duration of consumption to produce perceivable health consequences. Mean ages were similar for regular smokers (16.5 years, n=178) and for non-smokers (16.4 years, n=554). All but one mean difference in the associ-

ated CV risk factors were not significant. For each gender, total cholesterol, diastolic blood pressure, leisure time physical activity, body mass index (BMI) and skinfolds were similar for regular smokers and non-smokers (p>0.05). Only mean systolic blood pressure differed significantly between regular smokers and non-smokers. For boys, mean systolic blood pressure was equal to 124 and 128 mmHg in smokers and non-smokers respectively (p for the difference <0.01). For girls, the corresponding values were 118 and 123 mmHg (p<0.001). The prevalence of oral contraceptive use was equal to 21.3% (n=89) in girls who had had their menarche. All but one user were taking OC containing less than 0.040 mg ethinylestradiol and two-thirds of the users (66.2%, n=59) mentioned brand names with either gestoden or desogestrel. OC use was more frequent in female smokers than in non-smokers. One-third of female smokers (32.6%, n=29) were OC users versus 17.9% (n=54) of non-smokers. In the 17 year old age group (n=138), half of the girls who smoked regularly were also OC users. Finally, dietary habits differed between regular smokers and non-smokers, for boys in particular. Daily consumption of fruit and vegetables was significantly less frequent for male smokers than for non-smokers. The prevalences of daily fruit and vegetable consumption in boys who did not smoke were equal to 44.0 and 39.1 % respectively, whereas in male smokers these proportions were equal to 28.1 (p<0.01) and 25.8% (p<0.05) respectively. Three-quarters of the male smokers drank alcohol at least once a week versus half of the non-smokers (76.4 versus 52.4%, p=0.001). In girls, these percentages were equal to 51.7

Table 2 Cardiovascular risk factors: comparison of mean (± sd) level between regular smokers and non-smokers (15–17 year old group)

	Regular smokers n=178		Non-smokers n=554		p value for the difference
	Mean	± SD	Mean	± SD	
SBP boys (mmHg)	124	11	128	12	<0.01
SBP girls (mmHg)	118	11	123	11	<0.001
DBP boys (mmHg)	72	10	73	11	NS
DBP girls (mmHg)	74	10	75	9	NS
TC boys (mg dl⁻¹)	151	29	155	29	NS
TC girls (mg dl⁻¹)	176	29	176	31	NS
LTPA boys (H/week)	8.0	6.9	8.0	5.9	NS
LTPA girls (H/week)	5.1	4.3	5.3	4.5	NS
BMI boys	21.4	3.7	21.2	3.5	NS
BMI girls	21.4	2.7	21.5	3.3	NS
Triceps boys	10.7	6.1	10.7	5.8	NS
Triceps girls	17.5	5.5	17.4	5.6	NS
Prevalence of OC use (%)	32.6		17.9		
Alcohol at least once a week (boys) (%)	76.4		52.4		
Alcohol at least once a week (girls) (%)	51.7		23.2		
Daily fruit (boys) (%)	28.1		44.0		
Daily fruit (girls) (%)	59.5		61.8		
Daily vegetables (boys) (%)	25.8		39.1		
Daily vegetables (girls) (%)	50.5		50.0		

NS: if non-significant difference
SBP: systolic blood pressure; DBP: diastolic blood pressure; TC: total cholesterol;
LTPA: leisure time physical activity; BMI: body mass index; triceps: triceps skinfold.
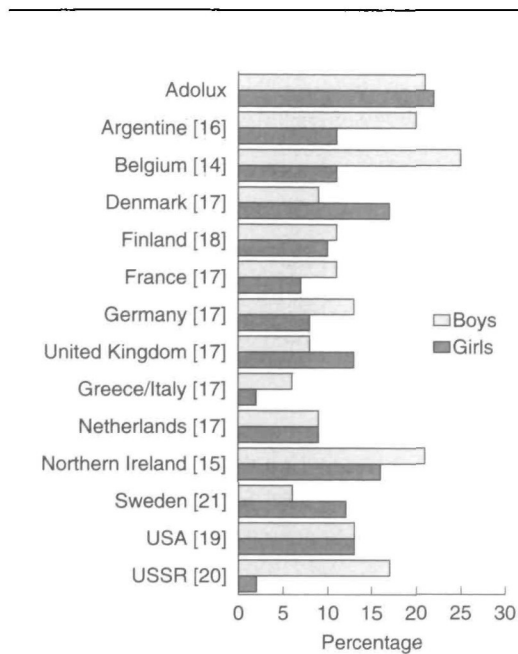
Figure 3 Daily smoking in 15 year olds: international comparison

Sources: Adolux: present study (1994); [ ] References

and 23.2% for smokers and non-smokers respectively (p=0.001 for differences between consumptions of smokers and non-smokers). Soft drinks and coffee consumption was also significantly higher in smokers than in non-smokers. Half of the smokers drank coffee at least once a day (52.8%) and 43.8% drank soft drinks daily. In non-smokers, the prevalences of daily consumers of coffee and soft drinks were 39.0 and 29.8% respectively (p=0.001 for differences between consumptions of smokers and non-smokers). These differences remained statistically significant when analysing boys and girls separately. The diet composition of smokers and non-smokers did not differ significantly for proteins and lipids intake. As mentioned above, alcohol intake was higher in smokers than in non-smokers (4.9 and 2.7% of total caloric intake in smokers and non-smokers respectively). Total caloric intake was slightly higher in smokers than in non-smokers, but this difference became insignificant after taking into account calories from alcohol intake (p>0,05). Non-smokers consumed a higher percentage of carbohydrates than smokers did (p<0.01), with a significantly lower proportion of free sugars (p<0.01).

DISCUSSION

The overall figure recorded in this study for cigarette use (19%) showed that adolescent smoking is a public health problem in this high CV risk province. The worrisome finding is that prevalence reached 36% in 17 year olds, a higher figure than those recorded for Belgian adults.[14] Moreover, female smoking in the present study was two fold higher than the figures published for the same age group by the survey cited above.[14] Smoking prevalence

in teenagers from the province of Luxembourg was also compared with international data (figure 3).[15–21] The figures for the province of Luxembourg were higher than those of other regions, except Northern Ireland and Argentine.[15,16] This high smoking prevalence raised some hypotheses. First of all, smoking might have actually increased among young Belgian people as recorded by the Belgian Centre de Recherche et d'Information des Organisations de Consommateurs.[14] Next, the confidentiality of the self-administered questionnaire might have enhanced the validity of the answers. Confidential smoking self-reports by adolescents have been found valid in comparison with a measure of carbon monoxide of expired air.[22] Other surveys found in the literature have used interviewer-based designs, which might have affected the answers of the respondents. Finally, cigarette consumption in adolescents from the province of Luxembourg might actually be higher than in other Belgian and international samples. A few years ago, the MONICA adult survey also found a high smoking prevalence in the same province.[9] Moreover, a recent national health survey recorded a smaller smoking prevalence in 15–17 year-olds (16.7%) than in the present study (22.6%).[23]

Differences in smoking habits between genders were not found in this study, illustrating the trend observed in some other countries e.g. The Netherlands, the UK, Scandinavian countries and the USA (figure 3).[17–19,24–26] This pattern could be partly explained by more reliable reports from girls today than a few years ago, as their smoking habits are socially better accepted. Besides this hypothesis, an actual increase in girls' smoking is evidenced by the results of the recent national health survey.[23] The prevalence of regular smoking in the 15–17 year old group was higher for girls (18.1%) than for boys (15.4%). Results from a Norwegian study suggested that concern about body image and weight gain played an increasingly significant role in girls' smoking uptake.[27]

The link between low education level and unfavourable CV risk profile (mainly through smoking habits, being overweight and diet) has been described in adults.[28–30] In adolescence, neither education level nor profession is available to determine social class but course is an indicator of the future education level of the participant. Adolescents from technical courses smoked more often and had higher mean cigarette consumption than students from the same age registered in the classical course. The negative influence of low education was therefore similar to the findings of other adolescent studies.[25,31] Data on parental education were also a marker of the participant's family environment, but this parameter was less associated with adolescent smoking than course. Adolescent smoking was therefore more influenced by its own social environment than by its family background, even if the border between both is impossible to lay out.

Although there is universal agreement on the harmful consequences of smoking, the perceptible effects during adolescence were not observed in this study. Associations with other CV parameters were not significant except with a lower systolic blood pressure. This inverse associ-

ation was found in other adolescent surveys.[32-34] The low blood pressure observed in young smokers has raised specific hypotheses for this age group. Better arterial elasticity might explain that total peripheral vascular resistance normalizes more quickly after smoking than in middle-aged smokers.[35] Smoking might assuage the emotional stress in smokers and decrease their blood pressure level.[36] The hypothesis of pre-existing lower blood pressure in future young smokers was also tested in an English prospective cohort.[37] Finally, researchers suggested a vasodilatation due to regular inhaled nitric oxide exposure.[38] The positive association between smoking and sedentary lifestyle described in the Finnish cohort study was not observed here.[6] However, the current results corroborated other findings of this cohort study. First, the Cardiovascular Risk in Young Finns Study found also an unhealthy diet in adolescent smokers. Similar findings have been observed in adult smokers, in particular for low fruit and vegetable consumption.[39,40] Secondly, adolescent smokers reported higher alcohol consumption than non-smokers. The association between smoking and alcohol use has been also mentioned in the Bogalusa study.[41] Both risk factors are in fact more frequent in low social groups. They are influenced by the same determinants, i.e. peer group pressure and risk-taking behaviour. Another harmful association observed in this research was OC use in young female smokers. This association has been noted in women studies.[7,42,43] The present work showed that both risk factors co-existed already in one out of ten girls aged 17 years. These findings were in accordance with those published for Finnish girls.[44] Oral contraceptives are medically prescribed in Belgium. Further thought to this prescription in young cigarette users needs to be given by physicians.

CONCLUSION

The results of this study emphasized the importance of smoking in European adolescents from a population at high risk of CV disease. Smoking prevalence in late adolescence was similar to the figures recorded in adults without any significant difference between genders. This finding emphasizes the need for selective prevention action in youth. In particular, adolescents with low education level are obviously a group at risk of smoking uptake. Possible preventive actions must target these adolescents whose knowledge, beliefs, and familial and cultural environment contribute early to a less favourable CV risk profile. In the light of the present study, it also appears that a second target group for intervention should be female smokers who often combine smoking and OC use. Any prevention strategy must rely on a sound knowledge of interests and health beliefs of adolescents. However, a decrease in youth smoking will become reality only if action at the community level aim at changing sociocultural, economical and physical environments. The willingness and collaboration of political decision makers are essential in finding solutions to this worrying public health problem.

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