# The alcohol-tobacco relationship: a prospective study among adolescents in six European countries

# J. J. L. Wetzels<sup>1</sup>, S. P. J. Kremers<sup>1</sup>, P. D. Vitória<sup>2</sup> & H. de Vries<sup>1</sup>

Department of Health Education and Health Promotion, University of Maastricht, Maastricht, the Netherlands<sup>1</sup> and Portuguese Council for Smoking Prevention, Lisbon, Portugal<sup>2</sup>

Correspondence to: S. P. J. Kremers Department of Health Education and Health Promotion University of Maastricht PO Box 616 6200 MD Maastricht the Netherlands Tel: + 31433882431 Fax: + 31433671032 E-mail: s.kremers@gvo.unimaas.nl

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#### ABSTRACT

Aim This study examined the earliest stages in drug involvement, in terms of the relationship between alcohol and tobacco use, among adolescents from six European countries (Denmark, Finland, the Netherlands, Portugal, Spain and the United Kingdom). International, gender and age differences were studied.

**Design, setting and participants** A large international sample of European adolescents (n = 10170, mean age = 13.3 years) was followed longitudinally. Data were gathered in the autumn terms of 1998 and 1999 by means of self-administered questionnaires.

**Measures** Adolescents' self-reports on smoking and alcohol behaviour were used. Both behaviours were classified into two categories, that of adolescents who had never used the substance and that of those who had used the substance at least once in their lives. Logistic regression was used to determine which substance was the best predictor of the subsequent use of the other substance.

**Findings** Alcohol use and tobacco use were found to be associated with each other reciprocally. Results revealed that in Europe as a whole, tobacco use predicted subsequent alcohol use better than the converse. However, for Dutch girls, alcohol use predicted subsequent smoking behaviour better than the converse.

**Conclusion** The findings suggest that the development of alcohol and tobacco use patterns are closely related, but the order of progression is not universal and may reflect cultural factors.

**KEYWORDS** Adolescence, alcohol, tobacco.

### INTRODUCTION

Many studies have investigated the relationship between the use of alcohol and tobacco among adolescents (e.g. Torabi, Bailey & Jabbari 1993; Sutherland & Willner 1998; Johnson *et al.* 2000; Johnson, Boles & Kleber 2000; Ritchey, Reid & Hasse 2001; Jackson *et al.* 2002). A consistent finding in these studies is the co-occurrence of tobacco and alcohol use. Drinkers are more likely to smoke than non-drinkers, and smokers are more likely to drink than non-smokers. Additionally, a combination of excessive alcohol consumption and tobacco use may have synergistic effects on the risk of developing cancer and cardiovascular diseases (Schlecht *et al.* 1999). As Jackson *et al.* (2002) has pointed out clearly, four classes of theories can be proposed to account for co-occurring alcohol and tobacco use: (1) alcohol use causes tobacco use; (2) tobacco use causes alcohol use; (3) alcohol use and tobacco use influence each other reciprocally; and (4) alcohol and tobacco use are a function of common third variables.

Most of the studies on the alcohol-tobacco relationship have been of a cross-sectional or retrospective nature. Results that have been found in longitudinal studies have been inconclusive. Some prospective studies have suggested that alcohol use predicts cigarette use more strongly than the converse (Kandel & Faust 1975; Andrews *et al.* 1991; Ellickson, Hays & Bell 1992; Jackson *et al.* 2002), while other longitudinal studies identified that cigarette use was particularly important for subsequent involvement in alcohol use (Newcomb & Bentler 1986; Fleming *et al.* 1989; Duncan, Duncan & Hops 1998; Lewinsohn, Rohde & Brown 1999).

In addition to their cross-sectional nature, studies on the alcohol-tobacco relationship share a similarity, in that most of them have been executed on the American continent. Consequently, it is currently unclear whether or not the alcohol-tobacco relationship is similar across countries. Adler & Kandel (1981) investigated international perspectives in adolescent cigarette and alcohol use in France and Israel. Their cross-sectional study found that the use of alcohol preceded the use of cigarettes in Israel, whereas the reverse was found in France.

Gender differences have also been topics of interest in research on the alcohol-tobacco relationship. A 9-year follow-up of the Kandel & Faust (1975) study showed no clear gender differences regarding alcohol and cigarette use (Yamaguchi & Kandel 1984). A 20-year follow-up of the Kandel & Faust (1975) study was also non-conclusive in this respect (Kandel, Yamaguchi & Chen 1992).

The overall interest of the present large-scale longitudinal study was the relationship between the onset of alcohol and tobacco use among European adolescents. Prevalence rates of alcohol and tobacco use are given for the full sample and they are described by age, gender and country. Cross-sectional and prospective relations between alcohol and tobacco use are examined, giving special attention to possible international, gender and age differences.

#### **METHODS**

#### Participants and recruitment

In the present study, a large international sample of European adolescents ( $n = 10\ 170$ ) was followed longitudinally. The sample consisted of the control group of a Community Intervention Trial [the community-based equivalent of the randomized controlled trial (RCT)], named the ESFA smoking prevention project (European Smoking Prevention Framework Approach; Kremers, Mudde & De Vries 2001a; De Vries *et al.* 2003). Six member states of the European Union (Denmark, Finland, the Netherlands, Portugal, Spain and the United Kingdom) participated in this project. In every country, schools were asked to participate in the intervention trial, and schools were assigned to either the experimental or control groups. Only the control groups were included in the present study. In Finland, 14 control schools in the city of

Helsinki participated, with 80 classes in total. In Denmark, 30 schools with 54 classes served as control schools. Seventeen control schools with 87 classes were recruited in the Netherlands and a total of 11 control schools with 76 classes were recruited in Portugal. In Spain, 31 control schools in the city of Barcelona participated with 37 classes in total. In the United Kingdom, the sample consisted of 21 schools and 166 classes. For more information on the recruitment procedures, we refer to De Vries *et al.* 2003).

In September/October 1998 (T1) and 1999 (T2), questionnaires were distributed to schools that participated in the project. Teachers were instructed to distribute the questionnaire to each student in the 7th grade (1998) or 8th grade (1999).

Of the total sample, 9.1% lived in Denmark, 15.1% in Finland, 23.7% in the Netherlands, 14.3% in Portugal, 9.1% in Spain and 28.7% in the United Kingdom. At baseline, a total of 51.2% was 12 years old, 43.9% was 13 and 4.9% was 14 years of age (mean = 13.3 years; SD = 0.7), and 50.5% were males.

#### Attrition analyses

A logistic regression analysis was conducted to compare those who participated in both measurements with those not participating in the second measurement, using data of the first measurement as predictors of non-response. Independent variables were gender (1 male), age, country (1 Finland, 2 Denmark, 3 the Netherlands, 4 Portugal, 5 Spain, 6 the United Kingdom), smoking behaviour (0 never smoked, 1 smoked) and alcohol behaviour (0 never used alcohol, 1 used alcohol).

Non-respondents at the second measurement (n = 2233) were found to be older (OR = 1.32, 95%) CI = 1.24–1.41) and less often from Finland (OR = 0.32, 95%) CI = 0.27–0.38), the Netherlands (OR = 0.23, 95%) CI = 0.20–0.27) and Spain (OR = 0.62, 95%) CI = 0.53–0.73) than from the United Kingdom. They were also more likely to smoke (OR = 1.43, 95%) CI = 1.30–1.57) and they used more alcohol (OR = 1.32, 95%) CI = 1.20–1.45). No differences were found for gender. These findings are consistent with attrition effects noted in other longitudinal studies among adolescents (Kandel 1985; Newcomb & Bentler 1988; Duncan *et al.* 1998). Due to missing or incomplete data on key variables, 438 cases (5.5%) were excluded from the analysis.

#### Measuring conditions

Adolescents' self-reports on smoking and alcohol behaviour were used. Weiss *et al.* (1998) found that self-reports on substance use were highly valid. Several studies have found little discrepancy between self-reports and high concordance with biological indicators. A number of studies have shown a high validity of selfreports on alcohol use among adolescents (Polich 1982; Winters *et al.* 1990; Smith, McCarthy & Goldman 1995; Williams *et al.* 1995). A study by Brown, Kranzler & Del-Boca (1992) compared self-reports on alcohol use with toxicological analyses of blood and urine samples. This comparison showed self-reports to be valid, with 97% agreement between verbal report and laboratory data. Assuring strict confidentiality of responses was found to optimize measuring conditions (Hansen, Mallote & Fielding 1985; Murray & Perry 1987; Dolcini *et al.* 1996).

adolescents' self-reported smoking is good, and shows

#### Measures

#### Questionnaire

The questionnaire was based on a review of the literature and on earlier work regarding adolescent smoking behaviour conducted over the last 15 years (De Vries & Kok 1986; De Vries, Dijkstra & Kuhlmann 1988; De Vries *et al.* 1994; Dijkstra *et al.* 1999). Identification and linkage of questionnaires between the two measurements was accomplished through the use of unique identification code numbers.

#### Tobacco use

Adolescents were asked to pick a statement that best described them, from a set of specific (cigarette) smoking related-statements. Responses were cross-validated using an algorithm consisting of concepts measuring current smoking and life-time smoking. In the case of incongruent answers, the respondent was allocated the least favourable response (for more information on the assessment instrument, we refer to Kremers, Mudde & De Vries 2001b). Smoking behaviour was classified into two categories, consisting of adolescents who had never smoked in their life-time, not even one puff (0) and adolescents who had smoked at least once in their life-time (1). This classification is consistent with current practice in epidemiological drug studies (Kandel & Faust 1975; Kandel 1982; Andrews et al. 1991; Lewinsohn et al. 1999). Smoking status at the second measurement was checked against status at the first measurement. Adolescents who reported never to have smoked at the second measurement while they had reported to have smoked at T1 were reclassified as smokers at T2.

#### Alcohol use

As with smoking behaviour, adolescents were asked to pick a statement that best described them. They were asked to indicate how often they drank alcohol, on a fivepoint scale ranging from never to at least once a week. These responses were cross-validated with a question about the frequency of alcoholic drinks in an average weekend and an average week on an eight-point scale, ranging from no alcoholic drinks to more than 40 glasses of alcoholic drinks. If the answers were incongruent, the least favourable answer was allocated. Subsequently, alcohol behaviour was divided into two categories, consisting of adolescents who had never drunk alcohol in their life-time (0) and adolescents who had drunk alcohol at least once in their life-time (1). This classification is in accordance with common practice in epidemiological drug studies (Kandel & Faust 1975; Kandel 1982; Andrews et al. 1991;). Like the smoking status, the alcohol status at the second measurement was checked against the alcohol status at the first measurement. Adolescents who reported never to have consumed alcohol at T2 while they had reported to have drunk alcohol at the first measurement were reclassified as alcohol users at T2.

#### Statistical analysis

First, data were analysed using prevalence rates of the demographic variables, alcohol and tobacco use. Secondly, correlations between smoking and alcohol use at both measurements were calculated. Thirdly, logistic regressions were used to study the prospective relations between alcohol and tobacco use, controlling for prior (T1) use. Age, gender and country were controlled in these analyses. In case of significant interactions with age and gender, analyses were performed separately for these variables. In addition, logistic regressions were executed for each separate country, controlling for age and gender. Again, in case of significant interactions, analyses were performed separately for these variables.

#### RESULTS

# Smoking and alcohol behaviour at the first and second measurements

Overall, 2747 adolescents (36.6%) had smoked at least once in their life-time at the first measurement (Table 1). This percentage had increased to 53.1% 1 year later

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	T1 smoking % (n)	T2 smoking % (n)	T1 alcohol use % (n)	T2 alcohol use % (n)
Total	36.6 (2747)	53.1 (3985)	45.7 (3426)	67.1 (5034)
Country (n)				
Denmark (600)	45.8 (275)	61.7 (370)	68.2 (409)	87.0 (522)
Finland (1273)	36.5 (465)	55.6 (708)	51.8 (659)	73.2 (932)
Netherlands (2132)	38.6 (822)	52.0 (1108)	42.1 (898)	65.7 (1400)
Portugal (956)	23.2 (222)	41.3 (395)	20.6 (197)	39.6 (379)
Spain (698)	34.4 (240)	56.0 (391)	26.1 (182)	46.6 (325)
United Kingdom (1840)	39.3 (723)	55.1 (1013)	58.8 (1081)	80.2 (1476)
Gender (n)				
Boy (3734)	37.1 (1384)	52.0 (1943)	48.9 (1827)	69.2 (2584)
Girl (3764)	36.2 (1362)	54.2 (2041)	42.5 (1599)	65.1 (2499)
Age at TI (n)				
12 years (3826)	32.3 (1237)	48.6 (1858)	39.7 (1519)	61.4 (2348)
13 years (3281)	40.4 (1327)	57.5 (1885)	52.8 (1733)	73.9 (2424)
14 years (369)	47.4 (175)	61.5 (227)	44.7 (165)	67.2 (248)

**Table I** Frequencies of smoking and alcohol behaviour; overall (n = 7499), per country, per gender and per age category.

Table 2 Pearson's correlations between smoking and alcohol use at both measurements.

	T1 smoking	T1 alcohol use	T2 smoking	T2 alcohol use
TI smoking	1.000			
TI alcohol use	0.327	1.000		
T2 smoking	0.714	0.307	1.000	
T2 alcohol use	0.293	0.642	0.344	1.000

(n = 3985). Of all adolescents, 45.7% (n = 3426) had used alcohol at the first measurement, increasing to 67.1% 1 year later (n = 5034).

A comparison of smoking behaviour between countries revealed that the Danish sample contained the highest percentage of smokers, both at the first and at the second measurements, while Portuguese adolescents showed the lowest percentages at both measurements. The second highest percentage at T1 was found in the United Kingdom, followed by the Netherlands, Finland and Spain. A somewhat different pattern was found at T2. After Denmark, the highest percentage of smokers was found in Spain, followed by Finland, the United Kingdom and the Netherlands. The considerable increase in smoking among Spanish adolescents is a striking phenomenon.

The percentage of adolescents consuming alcohol—at both measurements—was highest in Denmark and lowest in Portugal, where the percentage of adolescents who had used alcohol almost doubled between the two measurements. At both the first and second measurements, the second highest percentage was found in the United Kingdom, followed by Finland, the Netherlands and Spain. There was a difference between the genders in alcohol behaviour. At both measurements, fewer girls than boys had used alcohol (P < 0.001). There was no significant difference between boys and girls in smoking behaviour, neither at the first nor at the second measurements. With regard to age, a steady increase of smoking initiation was found at both measurements (P < 0.001). The same age difference was found with regard to alcohol behaviour of 12- and 13-year-olds (P < 0.001). However, no differences were found for alcohol consumption of 13- and 14-year-olds.

# Correlations between tobacco and alcohol use at T1 and T2

Table 2 shows that the strongest correlations were found between T1 smoking and T2 smoking (0.714) and between T1 alcohol use and T2 alcohol use (0.642). Correlations between T1 smoking and T2 alcohol use and between T1 alcohol use and T2 smoking were similar (0.293 versus 0.307).

The correlations in Table 2 cannot rule out any of the proposed theories of co-occurrence that were presented in the introduction. However, we examined the extent to which the alcohol–tobacco association was attenuated or eliminated in the presence of aetiologically important third variables (i.e. age, gender, country, smoking behaviour of father and mother, and whether or not one lives in a disrupted family). Pearson correlations were reduced from a range of 0.293–0.714 to a range of 0.274–0.700. Thus, although these third variables account for some shared association between alcohol and tobacco use, the correlations remained evident in the presence of third variables.

#### Co-occurrence of alcohol and tobacco use

At T1, the largest group consisted of those adolescents who had never smoked and had never used alcohol, with the highest percentages in Portugal and the lowest in Denmark (Table 3). This group included more girls than boys and more younger than older adolescents. Overall, more adolescents had used alcohol without smoking than had smoked without using alcohol. A group comprising 24.6% of the total sample (n = 1844) engaged in both behaviours at T1, with the highest percentages found among Danes (37.2%), boys (25.6%) and 13-yearolds (30.2%). The lowest percentages of adolescents engaging in both behaviours were found in the southern countries (Portugal 10.5%, Spain 13.5%).

At the second measurement, almost half of the adolescents had smoked and used alcohol. Again, the largest group was found in Denmark and the smallest in the southern countries. Among the smokers and alcohol users there was hardly any difference between boys and girls. As at T1, more adolescents had used alcohol without smoking than had smoked without using alcohol. A slight increase was found in the group using alcohol but no cigarettes, while a small decrease was found in the group of smokers not using alcohol. A total of 23.5% adolescents had never smoked and had never used alcohol at T2.

#### Prediction of smoking and drinking at T2

Smoking behaviour at T1 predicted alcohol use at T2, controlling for T1 drinking behaviour, age, gender and country (Table 4). Interaction analyses revealed an interaction with age. Consequently, logistic regressions were executed for the three separate age categories. Results show that the predictive value of T1 smoking behaviour is largest for the youngest adolescents and smallest for the oldest respondents.

Analogously, T1 alcohol use predicted T2 tobacco use, controlling for T1 smoking behaviour, age, gender and country. The odds ratio for this prediction was smaller than the odds ratio for the prediction of alcohol use with prior smoking behaviour. Interaction analyses revealed a

Table 3 Frequencies of smoking and alcohol behaviour combined; overall, per country, per gender and per age category.

		Non-smoking and not using alcohol % (n)	Smoking but not using alcohol % (n)	Using alcohol but non-smoking % (n)	Smoking and using alcohol % (n,
Total	ΤI	42.3 (3170)	12.0 (903)	21.1 (1582)	24.6 (1844)
	Τ2	23.5 (1759)	9.4 (706)	23.4 (1844)	43.7 (3279)
Country					
Denmark	ΤI	23.2 (139)	8.7 (52)	31.0 (186)	37.2 (223)
	Τ2	8.5 (51)	4.5 (27)	29.8 (179)	57.2 (343)
Finland	ΤI	41.9 (533)	6.4 (81)	21.6 (275)	30.2 (384)
	T2	22.8 (290)	4.0 (51)	21.6 (275)	51.6 (657)
Netherlands	ΤI	42.0 (895)	15.9 (339)	19.5 (415)	22.7 (483)
	Τ2	23.5 (501)	10.8 (231)	24.5 (523)	41.1 (877)
Portugal	ΤI	66.6 (637)	12.8 (122)	10.1 (97)	10.5 (100)
0	Τ2	44.6 (426)	15.8 (151)	4.  ( 35)	25.5 (244)
Spain	ΤI	53.0 (370)	20.9 (146)	12.6 (88)	13.5 (94)
	Τ2	29.8 (208)	23.6 (165)	14.2 (99)	32.4 (226)
United Kingdom	ΤI	32.4 (596)	8.9 (163)	28.3 (521)	30.4 (560)
9	Τ2	15.4 (283)	4.4 (81)	29.6 (544)	50.7 (932)
Gender					
Воу	ΤI	39.6 (1479)	11.5 (428)	23.3 (871)	25.6 (956)
	Т2	22.3 (833)	8.5 (317)	25.7 (958)	43.5 (1626)
Girl	ΤI	44.9 (1691)	12.6 (474)	8.9 (7  )	23.6 (888)
	Т2	24.6 (926)	10.3 (389)	21.2 (797)	43.9 (1652)
Age at TI					
12 years	ΤI	47.3 (1810)	13.0 (497)	20.4 (779)	19.3 (740)
	Т2	27.9 (1068)	10.7 (410)	23.5 (900)	37.8 (1448)
13 years	ΤI	36.9 (1212)	10.2 (336)	22.6 (742)	30.2 (991)
	Τ2	18.7 (615)	7.4 (242)	23.8 (781)	50.1 (1643)
14 years	ТΙ	37.4 (138)	17.9 (66)	15.2 (56)	29.5 (109)
	T2	19.0 (70)	13.8 (51)	19.5 (72)	47.7 (176)

	T2 alcohol use	T2 tobacco use
TI tobacco use	2.23 (1.92–2.59)	
T1 alcohol use		1.92 (1.68–2.20)
TI tobacco		
Boys	2.23 (1.79–2.77)	
Girls	2.23 (1.81-2.74)	
T1 alcohol		
Boys		1.62 (1.34–1.97)
Girls		2.25 (1.86–2.72)
TI tobacco		
12 years	2.65 (2.16–3.25)	
13 years	1.97 (1.54–2.51)	
14 years	1.79 (0.97–3.29)	
T1 alcohol		
12 years		1.86 (1.54–2.26)
13 years		1.94 (1.59–2.38)
14 years		1.95 (0.96–3.98)

**Table 4** Odds ratios (adjusted for gender and age) showing prediction of T2 alcohol use from T1 tobacco use and T2 tobacco use from T1 alcohol use

Significant interactions are shown in italic type.

significant interaction with gender. Separate logistic regressions showed that the predictive value of prior alcohol use was higher for girls than for boys. Moreover, the odds ratio for girls (2.25) was slightly higher than the odds ratio for the prediction of T2 alcohol use with prior cigarette use for girls (2.23). Thus, whereas smoking cigarettes predicted subsequent alcohol use better than the converse for boys, this pattern was not found for girls in the total population.

Separate analyses within each country were executed in order to examine possible differences between the countries in the present study (Table 5). The results showed that odds ratios for the prediction of alcohol use with prior smoking behaviour were larger than those for the prediction of tobacco use with prior alcohol use in every country. This result indicates a similar overall pattern in every country, in which tobacco use predicts subsequent alcohol use better than the converse. The results did not reach statistical significance in Denmark, as well as the prediction of T2 tobacco use in Spain. Interactions were identified in the Netherlands, showing the same trends as found in the total sample: tobacco use predicted subsequent alcohol use better in younger subjects, and alcohol use predicted smoking better in girls. Further, smoking cigarettes predicted subsequent alcohol use better than the converse for Dutch boys (OR = 2.04 for prediction of alcohol use versus 1.41 for prediction of smoking), whereas alcohol use predicted subsequent tobacco use better than the converse for Dutch girls (OR = 2.01 for prediction of alcohol use versus 2.73 forprediction of smoking).

**Table 5** Odds ratios per country (adjusted for gender and age) showing prediction of T2 alcohol use from T1 tobacco use and T2 tobacco use from T1 alcohol use.

	T2 alcohol use	T2 tobacco use
Denmark		
TI tobacco	1.83 (0.92-3.64)	
T1 alcohol		1.31 (0.80-2.15)
Finland		
TI tobacco	3.09 (1.87-5.12)	
T1 alcohol		2.72 (1.99–3.73)
Netherlands		
TI tobacco	2.01 (1.56-2.60)	
TI alcohol		1.95 (1.48–2.57)
TI tobacco		
Boys	2.04 (1.41–2.94)	
Girls	2.01 (1.41-2.88)	
T1 alcohol		
Boys		1.41 (0.96–2.08)
Girls		2.73 (1.84–4.04)
TI tobacco		
12 years	2.62 (1.83–3.68)	
13 years	1.53 (1.01–2.32)	
14 years	1.11 (0.35–3.49)	
TI alcohol		
12 years		2.36 (1.65–3.38)
13 years		1.44 (0.91–2.28)
14 years		2.16 (0.46–10.14)
Portugal		
TI tobacco	3.92 (2.59–5.95)	
TI alcohol		1.86 (1.16–2.96)
Spain		
TI tobacco	1.99 (1.31–3.01)	
T1 alcohol		1.53 (0.94–2.49)
United Kingdom		
TI tobacco	2.29 (1.58–3.32)	
TI alcohol		2.14 (1.63–2.82)

Separate effects of gender and age are shown only in the case of significant interactions. Significant interactions are shown in italic type.

### DISCUSSION

Research (mainly among American adolescents) has shown that there is a relationship between the use of alcohol and tobacco, but results with regard to the sequence in which the two behaviours occur have been inconclusive. To the best of our knowledge, the present study is the first large, prospective, international European study on the alcohol–tobacco relationship. The main result of the study was that in Europe, alcohol use and tobacco use are linked reciprocally. Overall, tobacco use predicted subsequent alcohol use better than the converse. However, for Dutch girls, alcohol use predicted subsequent smoking behaviour better than the converse. The prediction of alcohol use from previous tobacco use appeared to be strongest for younger adolescents. Further results showed that alcohol was the substance used most frequently at both measurements. A comparison between tobacco and alcohol use showed that the largest group at the first measurement consisted of those adolescents who did not use any substances. At the second measurement, the largest group consisted of those adolescents using both substances. At both measurements, alcohol use without smoking was fairly prevalent, while smoking without using alcohol was rarer (see also Pohjanpää *et al.* 1997).

The results of the present study do not necessarily prove causality between smoking and alcohol use, because even longitudinal methods do not provide proof of causation (Conrad, Flay & Hill 1992). Cigarette use at a particular moment needs to be interpreted as a predictor of alcohol use at a later moment, rather than as a cause. Note that this does not imply that all those who smoke will necessarily end up using alcohol. A further comment needs to be made with regard to the representativeness of the sample. In some countries participating and cofinancing organizations had demands that violated the original design of selecting a sample that is representative for the total population. In Finland and Spain, the participating organizations demanded schools to be located exclusively in Helsinki and Barcelona, respectively, which then became our communities of research. Although we aimed to assign schools to experimental and control groups randomly, this procedure was not achieved in the Netherlands and Spain. As many schools already used a national drug prevention programme, schools were assigned to their preference of allocation in the Netherlands. In Spain, the control group for the ESFA project was selected from the control condition of an existing smoking prevention project. As a result, the data cannot be considered to represent a random sample of the adolescent population. Nevertheless, the size of the sample and the fact that the schools were drawn from geographically and demographically diverse locations suggest that the data may have some degree of representativeness. This is confirmed by the fact that despite different sampling procedures, similar results were found.

Differences in results between the various studies could be due to differences in the method of measurement. In our study, smoking and alcohol behaviour were coded as never users versus those who had used the substance at least once. This is similar to the method used by Kandel & Faust (1975) and Andrews *et al.* (1991). However, Fleming *et al.* (1989), for example, compared daily users with others and Kandel *et al.* (1992) contrasted individuals who had used a substance up to 10 times with others. Greater consistency in the measurement methods used would be desirable, because there is no accepted method so far to study the alcohol–tobacco relationship. This could have a major influence on the results. The

outcomes of the present study may also have been influenced by the fact that the study was based on selfreported substance use. Moreover, the attrition analyses showed that dropouts were older and used more substances than respondents.

Further longitudinal research is needed to confirm the results of the present study on the European continent. Such research should also include Eastern Europe. Further research is also needed on the influence of the level of alcohol and tobacco use and the age of initiation on the use of the substance. These characteristics of an individual's substance use history are especially important predictors of progression to the use of other drugs (Kandel & Faust 1975; USDHHS 1988; Henningfield, Clayton & Pollinn 1990; Johnson & Jennison 1992; Parra-Medina *et al.* 1995; Duncan *et al.* 1998; Grant 1998; Lewinsohn *et al.* 1999), but they were not included in the present study.

The reciprocal relationship between alcohol and tobacco use found in this study is important from the perspective of prevention. It suggests that prevention of alcohol use may be more successful if it is linked closely to the prevention of cigarette use, and vice versa. School health education curricula may provide smoking and alcohol prevention programmes within the same school vear. In addition to prevention programmes, adolescent smoking cessation and alcohol cessation programmes might be more successful when the close link between tobacco and alcohol use is acknowledged. However, when the health education messages for smoking (abstinence) and alcohol use (moderation) are different, it may not be sensible to combine the two approaches into one programme. More research is needed on how to best combine the two prevention strategies when different messages are communicated. The combined treatment of alcohol and cigarette use has already proved a promising approach in alcohol cessation programmes for adults (Miller, Hedrick & Taylor 1983; Bobo et al. 1987; Bobo 1989; Sandor 1991). Furthermore, higher cigarette prices could lead to lower levels of alcohol use. Promising results in this matter were found with regard to the use of cigarettes and marijuana (Chaloupka et al. 1999; Farrelly et al. 1999).

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