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Cigarette smoking and alcohol drinking in a representative sample of English school pupils: Cross-sectional and longitudinal associations

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ABSTRACT

Objective. The aim of our study was to examine cross-sectional and longitudinal associations between cigarette smoking and alcohol drinking, in a representative sample of English pupils.

Method. Data from 13,635 school pupils in the Longitudinal Study of Young People in England (LSYPE) on usage of cigarettes from 2004 (typical age 14) to 2006 (age 16) and alcohol from 2004 to 2007 (age 17), analyzed with latent growth curve models.

Results. The weighted percentage of pupils drinking alcohol increased from 26% at age 14 to 71% by age 17, smoking from 12% to 27% by age 16. Pupils with lower socio-economic status were more likely to smoke but less likely to drink alcohol regularly. Both behaviors were positively correlated at age 14, adjusted for several confounding factors. The rate of increase over time was also positively correlated.

Conclusion. Cigarette smoking and alcohol drinking are already correlated by age 14, are socio-economically patterned, and 'move together' during adolescence. Future studies and interventions should be targeted at a younger age range, to identify early smoking and potentially hazardous alcohol drinking patterns.

Introduction

Cigarette smoking in adolescence has been associated with alcohol use both cross-sectionally (NHS Information Centre, 2011) and longitudinally (Donovan, 2004; Mathers et al., 2006). There have been reductions in the overall prevalence of smoking by English school pupils since the mid-1990s (NHS Information Centre, 2011). Factors such as age, sex, parental socio-economic status (SES) and parental educational attainment may influence the onset of smoking and alcohol use. In a cohort of adolescents in the UK (Boyd et al., in press), higher SES was associated with earlier alcohol use, lower SES with earlier smoking and more hazardous alcohol use (Melotti et al., 2011). Repeated measurements of smoking and alcohol are relatively rare (Melotti et al., 2011; Schoon and Parsons, 2003).

Reported associations between smoking and alcohol use in adolescence are mostly cross-sectional, making it difficult to determine the causal sequence. It is possible that (a) both behaviors could be adopted together, (b) smoking could be a risk factor for later alcohol use, or conversely, (c) alcohol use could be a risk factor for later smoking. Evidence for 'gateway' effects has acquired mixed support (Biederman and Monuteaux, 2005; Chen et al., 2002; Gold and Frost-Pineda, 2006; Mathers et al., 2006), limited by the scarcity of population studies having repeated measures of both behaviors.

To our knowledge, no study has examined both cross-sectional and longitudinal associations between cigarette smoking and alcohol drinking, in a representative sample of school pupils providing data on both behaviors over several repeated measures covering early to late adolescence. The aim of the current study was to identify these associations, using data from a large cohort of school pupils.

Method

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils. The study began in 2004, when the cohort was typically aged 13 to 14. Socio-economically deprived schools, defined as the quintile with the highest proportion of pupils receiving free school meals, were over-sampled by a factor of 1.5 and each ethnic minority group to N = 1000. Annual interviews incorporated computer-assisted self-completion elements, including smoking (2004 to 2006) and alcohol consumption (2004 to 2007).

Measures

Cigarette smoking

Pupils were asked, 'Now read all the following statements carefully and type in the number next to the one which best describes you'. Responses were coded as: I have never smoked (1), I have only ever tried smoking once (2), I used to smoke sometimes but I never smoke a cigarette now

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(3), I sometimes smoke cigarettes now but I don't smoke as many as one a week (4), I usually smoke between one and six cigarettes a week (5), I usually smoke more than six cigarettes a week (6). Options 4 to 6 were recoded as 'current smoker' and options 1 to 3 as non-smoker.

Alcohol drinking

Pupils were asked, 'Thinking about the last 12 months, about how often did you usually have an alcoholic drink? Was it…' Responses were coded as: most days (1), once or twice a week (2), 2 or 3 times a month (3), once a month (4), once every couple of months (5), less often (6) or not applicable. Options 1 to 4 were coded as current alcohol drinker (at least monthly). These questions were preceded by a routing question used to identify 'never' alcohol drinkers: 'Have you ever had a proper alcoholic drink? That is a whole drink, not just a sip. Please do not count drinks labeled low alcohol' which had response options no (0) or yes (1). Non-current drinkers were coded as 0.

Demographic covariates

Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, and Chinese. The maximum of either parent's educational attainment was recorded on a six-point scale ranging from 'no qualification' (0) to 'degree or equivalent' (6). Occupational social class was recorded on an eight-point scale ranging from 'never worked or long term unemployed' (1) to 'higher managerial and professional occupations' (8), for one or both parents.

Statistical analysis

A small proportion of pupils reported cigarette or alcohol consumption in a given wave and then subsequently reported never having engaged in the behavior; known as recanting (Shillington et al., 2011). For example, 0.6% of pupils who self-reported as smokers in 2004 recanted this behavior in 2005 and 2006. Pupils who reported alcohol use in 2004 had recanting rates of 4.6% in 2005, 2.4% in 2006, and 1.6% in 2007. These pupils were removed from the analysis, resulting in an analytic sample size of 13,635 pupils who had data on covariates and either smoking or alcohol use at least once.

Logistic regression with sample weights in Mplus version 6.11 was used to explore the cross-sectional association between each behavior at baseline separately (2004), in a smaller sample of pupils with available data on both outcomes (N = 12,356). Logistic regression within the Generalized Estimating Equation (GEE) framework in Stata version 12.1 was used to explore the association between current regular cigarette smoking and current regular alcohol from baseline (2004) to the end of follow-up for each behavior separately, taking the repeated measures design into account (N = 10,516). For the main analysis, multivariate latent growth curve modeling (Bollen and Curran, 2006; Curran et al., 2010) using Mplus version 6.11 (Muthén and Muthén, 1998–2010) and the WLSMV estimator was used. The mean and the variance for each behavior's intercept (initial status) and linear slope (rate of change over time) were estimated in a single model, capturing individual differences in the change in the log odds of engaging in each behavior over time. The hypothesized model is shown in Fig. 1. Sample weights were used to obtain correct standard errors, taking over-sampling into account. Age, sex, ethnic minority status (reference = White), parental social class and parental educational attainment were covariates. For associations between intercepts and slopes, which are continuous variables, both unstandardized (B) and standardized coefficients (β) are reported for completeness.

In sensitivity analyses, we evaluated whether different cut points for regular smoking and alcohol drinking influenced the findings. We also repeated models on a nested sample of 7707 pupils who provided complete data on both behaviors at all possible waves, allowing us to evaluate possible bias resulting from non-random dropout over time. We also repeated GEE models after excluding smokers/drinkers who subsequently stopped.

Results

Of the main analytic sample, 70.3% of pupils had three waves of smoking data, 83.8% had at least two waves. 59.1% of pupils had four waves of alcohol data, 75.0% had at least three waves, and 83.9% had at least two waves. In preliminary analyses, results were not materially different for male/female pupils, leading us to analyze all pupils together.

Table 1 shows the unweighted descriptive statistics for the available sample at each study wave. At baseline in 2004 (age 13/14), 19.6% of pupils reported current regular alcohol drinking and 9.6% reported current cigarette smoking. By 2007 (age 16/17), 61.1% reported regular

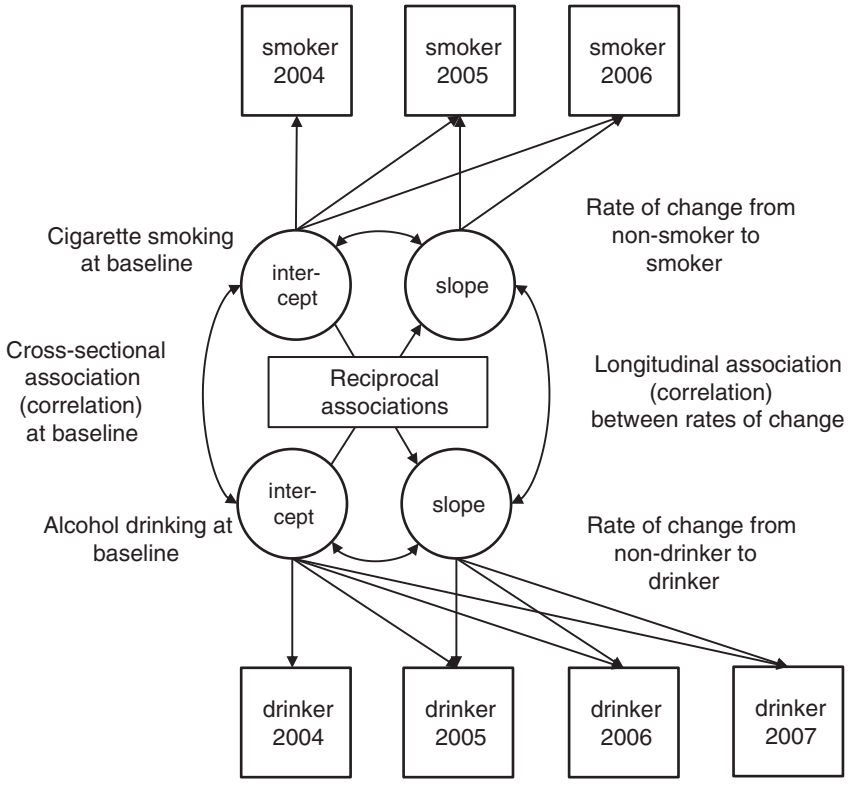

Fig. 1. Conceptual model showing the multivariate latent growth curve model.

Table 1
Characteristics of pupils from the Longitudinal Study of Young People in England (LSYPE) at each study phase, 2004–2007.

	2004 (N = 12,356)	2005 (N = 10,698)	2006 (N = 10,095)	2007 (N = 9484)
Age, mean (SD)	14.33 (0.48)	15.33 (0.47)	16.33 (0.47)	17.32 (0.47)
Male, N (%)	6328 (51.2)	5409 (50.6)	5074 (50.3)	4727 (49.8)
White ethnic group, N (%)*	8152 (66.0)	7276 (68.0)	6947 (68.8)	6644 (70.1)
Parental educational attainment				
Less than GCSE or equivalent, N (%)	3597 (29.1)	2905 (27.2)	2696 (26.7)	2473 (26.1)
GCSE or A level or equivalent, N (%)	5067 (41.0)	4446 (41.6)	4191 (41.5)	3946 (41.6)
Higher education or degree, N (%)	3692 (29.9)	3347 (31.3)	3208 (31.8)	3065 (32.3)
Parental occupational social class				
Routine or unemployed, N (%)	6377 (51.6)	5372 (50.2)	5044 (50.0)	4682 (49.4)
Intermediate, N (%)	3561 (28.8)	3153 (29.5)	2978 (29.5)	2824 (29.8)
Professional, N (%)	2418 (19.6)	2173 (20.3)	2073 (20.5)	1978 (20.9)
Current alcohol drinker, N (%)	2421 (19.6)	3688 (34.5)	4468 (44.3)	5787 (61.0)
Current smoker, N (%)	1181 (9.6)	2027 (18.9)	2411 (23.9)	

Note. Sample sizes refer to those with available data at each study phase. The figures are unweighted and therefore do not account for over-sampling of pupils with low socio-economic status and ethnic minority groups.

alcohol drinking. By 2006 (age 15/16), the proportion of pupils smoking cigarettes had increased to 23.9%.

Both behaviors were associated cross-sectionally at baseline. The odds of also smoking at baseline were around 2.4 times higher for pupils who also reported regular alcohol drinking (N = 12,356, OR = 2.44, 95% CI 2.26, 2.63) compared to those not reporting regular alcohol drinking, controlling for age, sex, ethnic minority status, parental education and parental occupational social class (hereafter, 'fully adjusted'). Similarly, the odds of regular alcohol drinking at baseline were around 2.7 times higher (N = 12,356, OR = 2.71, 95% CI 2.48, 2.96) for pupils who also reported cigarette smoking compared to non-smokers, in fully adjusted models.

Both behaviors were also associated longitudinally, in Generalized Estimating Equation (GEE) models. Smoking was associated with alcohol use from baseline to follow-up (N = 10,516, OR = 3.60, 95% CI 3.34, 3.88), in fully adjusted models. Alcohol use was associated with smoking from baseline to end of follow-up (N = 10,516, OR = 3.15, 2.93, 3.40) in fully-adjusted models. These models were not weighted and only consider one behavioral outcome at a time.

Results from the multivariate latent growth curve model are shown in Fig. 2, using the full analytic sample (N = 13,635), all available data from both behaviors and sample weights. The weighted prevalence of smoking was 11.6% at age 14, and 27.2% by age 16. Alcohol use rose from 25.5% at age 14 to 71.3% at age 17. The model was a good fit to the data (CFI = .998, TLI = .994, RMSEA = .013, WRMR = .836)(Schreiber et al., 2006). The intercepts were significantly correlated at baseline (β = .62, p < .001), showing that smoking and alcohol were strongly associated at the first time point. The slopes were also correlated (β = .60, p < .001), indicating that the rate of change of pupils moving from being a non-smoker to smoker is correlated with the rate of change in movement from being non-drinker to drinker. The standardized beta (β) shown here and in Fig. 2 for double-headed arrows is broadly equivalent to the Pearson correlation (r) between the two latent variables, in the latent variable and structural equation modeling framework (Schreiber et al., 2006).

The alcohol use intercept was associated with faster rate of change in the smoking slope (B = 0.32, 95% CI 0.04, 0.61), showing that alcohol use had a reciprocal effect on the estimated movement from non-smoker to smoker. The smoking intercept was associated with slower rate of change in the alcohol slope (B = −0.09, 95% CI −0.12, −0.06). Model estimates were adjusted for covariates, several of

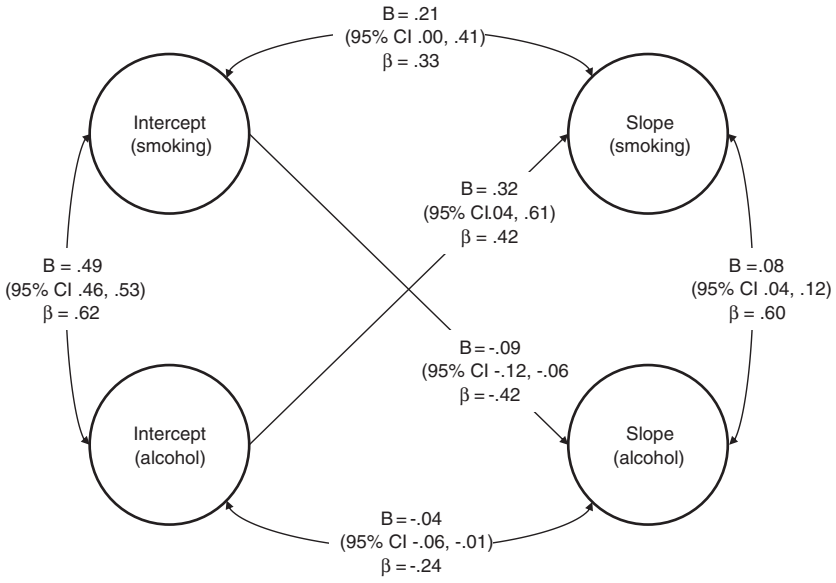

Fig. 2. Results from the multivariate latent growth curve model. Single-headed arrows represent regression coefficients, double-headed arrows represent correlation coefficients. The unstandardized coefficients (B) are shown with 95% confidence intervals. Standardized coefficients (β) are broadly equivalent to the correlation between behaviors at baseline (correlated intercepts), and the correlation between the rate of change in each behavior over time (correlated slopes). To facilitate interpretation only the latent variables (intercept and slope) are shown but the model itself is equivalent to Fig. 1. Although not shown in the figure, intercepts and slopes were regressed on covariates (Table 2).

Table 2
Latent growth curve model coefficients for covariates, 95% confidence intervals and p values: pupils in England, 2004–2007.

	Intercept (smoking)		Intercept (alcohol)		Slope (smoking)		Slope (alcohol)	
	B (95% CI)	β	B (95% CI)	β	B (95% CI)	β	B (95% CI)	β
Age	0.20 (0.13, 0.27)	0.09	0.17 (0.12, 0.22)	0.09	−0.05 (−0.12, 0.02)	−0.03	−0.02 (−0.04, 0.01)	−0.04
Female (vs. male)	0.31 (0.24, 0.38)	0.15	−0.01 (−0.07, 0.04)	−0.01	0.16 (0.01, 0.30)	0.11	−0.03 (−0.06, 0.00)	−0.07
Parental education	−0.08 (−0.11, −0.06)	−0.16	0.02 (0.00, 0.03)	0.04	−0.03 (−0.06, 0.01)	−0.07	0.00 (−0.01, 0.01)	0.00
Mixed (vs. White) group	−0.08 (−0.25, 0.09)	−0.01	−0.30 (−0.43, −0.17)	−0.05	0.05 (−0.13, 0.22)	0.01	−0.03 (−0.09, 0.04)	−0.02
Asian (vs. White) group	−1.03 (−1.19, −0.86)	−0.24	−1.53 (−1.72, −1.34)	−0.38	0.08 (−0.08, 0.25)	0.03	−0.11 (−0.23, 0.01)	−0.12
Black (vs. White) group	−0.60 (−0.79, −0.41)	−0.10	−1.02 (−1.17, −0.87)	−0.18	−0.10 (−0.30, 0.10)	−0.02	−0.09 (−0.19, 0.00)	−0.07
Chinese (vs. White) group	−1.03 (−1.30, −0.77)	−0.15	−0.89 (−1.11, −0.66)	−0.14	0.37 (0.05, 0.69)	0.08	−0.14 (−0.25, −0.02)	−0.09
Parental occupational class	−0.02 (−0.04, 0.00)	−0.05	0.04 (0.02, 0.05)	0.08	−0.01 (−0.04, 0.01)	−0.04	0.00 (−0.01, 0.01)	0.00

B = unstandardized beta coefficient. β = standardized beta coefficient. The correlation between alcohol and smoking intercepts is 0.62. The correlation between alcohol and smoking slopes is 0.60. All estimates are from the same model shown in Fig. 2, which does not show covariates.

which were significantly associated with smoking and alcohol intercepts and slopes (Table 2). For example, pupils with lower socio-economic status were more likely to smoke but less likely to drink alcohol regularly.

Results were not changed materially when using different cut points to define current smoking and alcohol use. Re-running the model defining smoking at 6 or more cigarettes per day and alcohol drinking as at least weekly resulted in similar correlations between intercepts ($\beta = 0.64$, $p < 0.001$) and slopes ($\beta = 0.73$, $p < 0.001$). Results from GEE models were similar after excluding smokers/drinkers who subsequently stopped. Results were very similar when repeating the model on a nested sample of 7707 pupils who had complete data on covariates and both behaviors at every wave.

Discussion

In a representative sample of over 13,000 English school pupils, both cigarette smoking and alcohol drinking were already strongly positively correlated at age 14. The rate of change in both behaviors over time was also positively correlated, suggesting that both behaviors 'moved together' over time (Schulenberg and Maggs, 2001). There were also reciprocal effects. Alcohol was associated with faster rate of change from non-smoker to smoker. Smoking was associated with slower rate of change from non-drinker to drinker.

Although we found evidence for reciprocal effects between the behaviors, the negative association seen for smoking in relation to the alcohol slope may reflect that relatively fewer smoking pupils at baseline could make the transition from non-drinker to drinker, owing to the high correlation between smoking and alcohol. This could result in an apparently slower rate of change, for this subgroup of pupils. Alternatively, pupils who already smoke but do not drink alcohol may do so for particular reasons, reasons which also slow the overall rate of change from non-drinker to drinker in subsequent years. Additionally, it is worth noting that pupils may have left school after the third wave, introducing a change in alcohol consumption patterns not captured by our linear model. Replications are needed in other cohorts and over a longer follow-up period, before drawing strong conclusions about reciprocal and possible 'gateway' effects.

Strengths of the study include the large sample size, representative of an entire school year for a young cohort, with repeated measures of alcohol and smoking. Such data are rare and provide a unique opportunity to study how smoking and alcohol drinking influence each other during adolescence. The follow-up began in early adolescence, following pupils from around age 13/14 to age 16/17. As we made adjustment for age, sex, ethnic minority status, and two important markers of parental socio-economic status (occupational social class and education); the reported estimates are independent from those covariates.

The key limitation of the study is that data on alcohol use or cigarette smoking were not available prior to age 14. British birth cohort studies have collected information on both alcohol and cigarette use from age 16, as in the 1958 (Power and Elliott, 2006) and 1970 (Elliott and Shepherd, 2006) birth cohorts, but not from childhood and early adolescence. The context in which each behavior was introduced might influence its association with the other behavior, which we were not able to evaluate. Other established risk factors for early alcohol drinking were not modeled, including: anticipated regret (Conner et al., 2006), intentions to smoke or drink alcohol (Conner et al., 2006; McMillan and Conner, 2003), personality traits (Hagger-Johnson et al., 2012), physiological factors, family history, parenting style, family conflict, and early drug use (Hawkins et al., 1992). It is worth noting that regular alcohol use is not necessarily an unhealthy behavior in adulthood, given that alcohol can be consumed within recommended limits. Current guidelines however, recommend an alcohol-free childhood, at least until age 15, when if children do consume alcohol, they should do so in supervised conditions and infrequently (Donaldson, 2009). Any early alcohol use is a risk factor for later hazardous alcohol drinking patterns and adverse health outcomes (Donovan, 2004). Finally, although the threshold we set for defining regular smoking was low (at least weekly), results were similar when defining regular smoking as at least 6 cigarettes/week. Even occasional smoking in childhood or adolescence is addictive and therefore has public health relevance (DiFranza et al., 2000; Fidler et al., 2006; Jackson and Dickinson, 2004).

Our results are consistent with recent cross-sectional data from the UK (NHS Information Centre, 2011) and reports from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort (MacArthur et al., 2012), showing that smoking and alcohol are associated during adolescence. In ALSPAC, higher SES was associated with more prevalent alcohol use, lower SES with more prevalent smoking (Melotti et al., 2011). We also found a similar association in that both behaviors were associated with socio-economic status in opposing ways. Peer and maternal alcohol use are associated with adolescent drinking patterns (Cable and Sacker, 2008). Future studies should therefore record the quantity, frequency, location and context of alcohol and cigarette smoking in children younger than age 13–14 and the associations between peer, parental and adolescent alcohol and cigarette use over time.

Public health policies have traditionally focused on behaviors separately but are increasingly considering multiple health behaviors (Hale and Viner, 2012; Jackson et al., 2012). Jointly engaging in two or more unhealthy behaviors can contribute to the launching of 'trajectories toward chronic diseases' in adulthood (Spring et al., 2012) and early old age (Sabia et al., 2012). Early smoking and alcohol use should be monitored in studies that aim to identify the causes, and possibly common causes, of these behaviors throughout the life course.

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Conflict of interest statement

No authors disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work.

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