



Does the association between different dimension of social capital and adolescent smoking vary by socioeconomic status? a pooled cross-national analysis

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Abstract

Objectives To analyze how dimensions of social capital at the individual level are associated with adolescent smoking and whether associations differ by socioeconomic status.

Methods Data were from the ‘Health Behaviour in School-aged Children’ study 2005/2006 including 6511 15-year-old adolescents from Flemish Belgium, Canada, Romania and England. Socioeconomic status was measured using the Family Affluence Scale (FAS). Social capital was indicated by friend-related social capital, participation in school and voluntary organizations, trust and reciprocity in family, neighborhood and school. We conducted pooled logistic regression models with interaction terms and tested for cross-national differences.

Results Almost all dimensions of social capital were associated with a lower likelihood of smoking, except for friend-related social capital and school participation. The

association of family-related social capital with smoking was significantly stronger for low FAS adolescents, whereas the association of vertical trust and reciprocity in school with smoking was significantly stronger for high FAS adolescents.

Conclusions Social capital may act both as a protective and a risk factor for adolescent smoking. Achieving higher levels of family-related social capital might reduce socioeconomic inequalities in adolescent smoking.

Keywords Smoking · Socioeconomic inequalities · Adolescence · Social capital · Health Behaviour in School-aged Children

Introduction

Smoking is the most important cause of premature mortality, and is a major risk factor for six of the eight leading causes of death (Yach et al. 2004). Smoking disproportionately impacts people of low socioeconomic status. There is a clear socioeconomic gradient in tobacco use already in younger

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age groups (Due et al. 2011; Hanson and Chen 2007; Richter et al. 2009). Since smoking initiation occurs most frequently between the ages 12 and 16 years (Schneider et al. 2008), understanding the developmental processes contributing to, and individual factors associated with smoking, is critical to the development of effective interventions and for determining the optimal moment to prevent smoking.

Plausible explanations for adolescent smoking and socioeconomic inequality in smoking can be derived from the theory of Social Capital (Kawachi et al. 2008). The term social capital refers to resources that are inherent in relationships that enable a range of social outcomes (Coleman 1994). Social capital is conceptualized as a resource of individuals in social relationships, or as a characteristic of groups (Dufur et al. 2013). In this paper, we focus on social capital at the individual level, inherent in the relationship of adolescents with relatives, friends, teachers and others. Research has developed several dimensions of social capital. Social capital is commonly divided into a 'structural' and a 'cognitive' dimension (Harpham et al. 2002). Structural social capital refers to behavioral manifestations and configurations of social networks. Cognitive social capital reflects the subjective and normative aspects of social relationships, such as perceptions of trust and reciprocity within a network. A further division of social capital is that between 'horizontal' and 'vertical' (Islam et al. 2006). Horizontal social capital refers to ties between individuals or groups of equals or near-equals, and vertical social capital involves interactions across explicit, formal or institutionalized power or authority gradients in society, such as relationships between students and teachers (Szreter and Woolcock 2004). Accordingly, the production of social capital occurs in 'formal' and 'informal' networks (Pichler and Wallace 2007). In contrast to formal social capital, the informal component is not officially organized and is most often produced in networks of affective ties. Research also emphasized different settings in which social capital emerges such as the family, friend network, school or neighborhood (Dufur et al. 2013; Morrow 1999).

Evidence suggests that various dimensions of social capital can protect adolescents from smoking but could sometimes also reinforce adolescent smoking behavior. For example, on the family level, studies revealed a lower likelihood of smoking for adolescents living in supportive families measured as family belonging and integration (Morgan and Haglund 2009; Maes and Lievens 2003). In the school context, studies indicated that adolescents who perceive their relationship with teachers to be trusting (vertical social capital) were less likely to smoke (Maes and Lievens 2003; McLellan et al. 1999; Perra et al. 2012; Samdal et al. 2000). Similarly, a positive sense of belonging to school, perceived school connectedness, safeness and school autonomy have been found to act as protective factor for adolescents smoking (Bond et al.

2007; McLellan et al. 1999). In relation to perceived classmates' connectedness, support and acceptance (horizontal social capital), studies reported mixed results, with no clear association that have been established (Ennett et al. 2010; McLellan et al. 1999; Samdal et al. 2000). Some studies demonstrated that the likelihood of smoking increased with peer smoking and with larger networks of friends (Ennett et al. 2010; Maes and Lievens 2003; McVicar 2011).

Little is known about how various dimensions of social capital interact with smoking across socioeconomic groups. Research has established two hypotheses on the relation between social capital, socioeconomic status and health behaviors (Uphoff et al. 2013). First, research suggests that social capital acts as a buffer against risk behaviors as low socioeconomic groups generally benefit more from social capital than high socioeconomic groups (Elgar et al. 2010; Haines et al. 2011). In contrast, the second hypothesis assumes a dependency between social, economic and cultural capital in the social reproduction of inequalities in health behaviors, and suggests that low socioeconomic groups will not benefit from social capital (Uphoff et al. 2013).

How different dimensions of social capital interact with adolescent smoking and whether associations differ by socioeconomic status have yet to be analyzed thoroughly (De Clercq et al. 2014). The present study attempts to address this gap in existing knowledge by focusing on different dimensions of social capital as determinants of adolescent smoking at the individual level. The study has two objectives: (1) to evaluate how different dimensions of social capital are associated with adolescent smoking, and (2) to investigate whether the association between dimensions of social capital and adolescent smoking varies by socioeconomic status. We further test for cross-national differences in our findings.

Methods

Sample

The study analyses data are from the 'Health Behaviour in School-aged Children (HBSC)' study conducted in 2005/2006. The HBSC study, a World Health Organization collaborative cross-national study, collects data from adolescents every 4 years since 1982 (Currie et al. 2009). Research groups in 38 countries in Europe, North America and Israel took part in the 2005/2006 survey, adhering to an internationally agreed-upon protocol (Currie et al. 2006). The survey is based on a self-completed questionnaire that is administered in schools by teachers. Participation was voluntary, and consent (explicit or implicit) was sought from school administrators, parents and adolescents. Each participating country employed a multistage sample

procedure with the school or class being the primary sampling unit. Three age groups of young people were sampled (11-, 13- and 15-year olds).

The present analysis is based on data from the optional packages on Community Network and School Setting within the HBSC study. These questions were used in the Flemish region of Belgium (BE), Canada (CA), Romania (RO) and England (ENG). We focused only on 15-year olds, as smoking rates were too low among 11- and 13-year-old adolescents. We excluded all cases with missing values from the analyses (1–8 % across items). The sample size differs moderately across countries, ranging from 1325 observations in England to 2184 in Canada. In total, this study includes 6511 observations (Table 1).

Measures

Daily smoking

Adolescents' smoking status was measured as follows: 'How often do you smoke tobacco at present?'. Possible responses were 'every day', 'at least once a week but not every day', 'less than once a week' or 'I do not smoke'. Adolescents who smoke every day are considered as daily smokers (coded with value 1). Adolescents who smoke less than daily or do not smoke are regarded as non- and non-regular smokers (coded with value 0). Since participants in the current study are in middle adolescence, also alternative cutoffs have been considered for identifying "smokers" in this developmental

Table 1 Socio-demographic characteristics and social capital measures (Health Behaviour in School-Aged Children Study; Flemish Belgium, Canada, Romania and England; 2005/2006)

	Overall <i>n</i> (%)	Flemish Belgium <i>n</i> (%)	Canada <i>n</i> (%)	Romania <i>n</i> (%)	England <i>n</i> (%)
Total	6511 (100)	1499 (100)	2184 (100)	1503 (100)	1325 (100)
Gender					
Boys	2993 (45.9)	758 (50.6)	1033 (47.3)	563 (37.4)	639 (48.3)
Girls	3519 (54.1)	741 (49.4)	1151 (52.7)	940 (62.6)	686 (51.7)
Daily smoking	630 (9.7)	177 (11.8)	124 (5.7)	183 (12.2)	146 (11.0)
Score variables	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)
Family affluence score: [high] 0–9 [low]	3.61 (2.02)	3.29 (1.78)	3.13 (1.68)	5.26 (2.01)	2.89 (1.78)
Social capital indicators					
Structural social capital					
Informal social capital					
Friend-related social capital [low] 0–21 [high]	12.46 (4.00)	12.0 (3.95)	12.4 (3.90)	12.8 (4.15)	12.7 (4.02)
Formal social capital					
Participation in voluntary organizations [low] 0–7 [high]	1.17 (1.23)	1.12 (0.98)	1.31 (1.32)	0.90 (1.20)	1.31 (1.28)
School participation [low] 0–16 [high]	7.19 (3.12)	6.87 (2.91)	8.03 (2.80)	8.79 (2.97)	4.37 ^a (1.79)
Cognitive social capital					
Family trust/reciprocity					
Family-related social capital [low] 0–21 [high]	16.85 (3.38)	16.5 (3.51)	16.5 (3.36)	17.0 (3.01)	17.6 (3.53)
Neighborhood trust/reciprocity					
General trust/reciprocity [low] 1–21 [high]	14.8 (3.54)	14.4 (3.37)	15.2 (3.24)	14.9 (3.35)	14.5 (4.26)
School trust/reciprocity					
Horizontal trust/reciprocity [low] 0–12 [high]	8.34 (2.24)	8.55 (2.38)	7.95 (2.01)	8.27 (2.15)	8.83 (2.38)
Vertical trust/reciprocity [low] 0–16 [high]	9.73 (2.97)	9.86 (2.93)	10.9 (2.61)	9.54 (2.94)	7.94 ^b (2.71)
General trust/reciprocity [low] 0–12 [high]	7.54 (2.48)	6.83 (2.38)	7.82 (2.30)	7.67 (2.49)	7.71 (2.72)

^a Score only between [low] 0–8 [high] (see supplementary Table 1)

^b Score only between [low] 0–12 [high] (see supplementary Table 2)

stage [e.g., Pfortner et al. (2015)]. The analyses were, therefore, repeated subsequently with weekly smoking as dependent variable.

Socioeconomic status

Socioeconomic status was measured using the Family Affluence Scale (FAS) (Currie et al. 2008). The FAS is a validated measure of material affluence and a composite of four household items: ‘Does your family have a car or van?’ [‘No’ (2) ‘Yes, one’ (1) ‘Yes, two or more’ (0)], ‘Do you have your own bedroom?’ [‘Yes’ (0), ‘No’ (1)], ‘How many computers does your family own?’ [‘None’ (3), ‘One’ (2), ‘Two’ (1), ‘More than two’ (0)] and ‘During the past 12 months, how many times did you travel away on holiday with your family?’ [‘Not at all’ (3), ‘Once’ (2), ‘Twice’ (1), ‘More than twice’ (0)]. We used an additive score of family affluence that was subsequently recoded into tertiles of high, medium, and low FAS.

Social capital measures

Social capital was measured using several indicators of horizontal and vertical participation, including support, trust and reciprocity within the family, school, neighborhood and friend network (Currie et al. 2006). All scores were z-standardized with a mean of zero and a standard deviation of one to allow comparisons of scores. Higher values indicated higher levels of social capital. A full list of the wording of all items (supplementary Table 1), and the consistency measures across and within countries (supplementary Table 2) can be found in the Electronic Supplementary Materials.

Structural dimension of social capital We distinguish between two components of structural social capital: informal (one indicator) and formal social capital (two indicators). Informal social capital indicates the quality and quantity of adolescents’ interpersonal relationships to friends and relatives (Giordano et al. 2011). Friend-related social capital consisted of a four-item score that relates to the number of close male and female friends and the frequency of spending time with friends after school or evenings (see supplementary Table 1). The internal consistency of the scale (Cronbach’s alpha) was moderate ($\alpha = 0.59$) across and within countries (see supplementary Table 2).

The second dimension of structural social capital—formal social capital—was measured by two indicators referring to the level of participation in school and voluntary organizations (De Clercq et al. 2014). School participation was measured by a score based on four items indicating the autonomy and connectedness of students in schools. All items showed a moderate internal consistency

across and within countries ($\alpha = 0.56$). Participation in voluntary organizations includes the number of organizations in which adolescents could participate. In our analyses, we used the sum-score across all items that showed a moderate internal consistency ($\alpha = 0.51$).

Cognitive dimension of social capital The cognitive dimension of social capital consisted of three measures of family (one indicator), neighborhood (one indicator) and school social trust and reciprocity (three indicators). Family trust and reciprocity (family-related social capital) referred to the supportive and reciprocal interactions between parents and adolescents and were measured by eight items (see supplementary Table 1). The internal consistency demonstrated a precise and stable measurement ($\alpha = 0.77$). Neighborhood-related social capital, included general trust and reciprocity measured through local trust and perceptions of safeness. The indicator was based on a five-item scale which showed a good degree of internal consistency ($\alpha = 0.71$) (Boyce et al. 2008).

Within schools, three items relating to horizontal and vertical trust and reciprocity, as well as a general dimension of school-related trust and reciprocity were used to measure the cognitive dimension of social capital. Horizontal trust and reciprocity within schools were indicated by a three-item score that refers to classmate support (Boyce et al. 2008). All three items had a good internal consistency, which indicates a precise measure of perceived horizontal trust and reciprocity between pupils ($\alpha = 0.73$). Vertical trust and reciprocity within schools were based on four items. This measure reflects students’ trust and general relationship towards teachers and teachers’ support (De Clercq et al. 2014). The scale showed a high internal consistency and, thus, measured the same underlying concept ($\alpha = 0.76$). General trust and reciprocity within schools was measured using items referring to adolescents’ perception of school climate, safeness and fairness (Freeman et al. 2009). The items also revealed a high internal consistency ($\alpha = 0.70$).

Analytical model

Analyses were performed using Stata, version 12.0 (StataCorp LP, College Station, TX). Prevalence (mean score) of social capital and family affluence, daily smoking and gender (%) were calculated (Table 1).

Logistic regression models on the likelihood of daily smoking (dependent variable) with robust standard errors taking into account the clustering of adolescents within schools and classes were performed on the pooled country sample (Williams 2000). The first step of logistic regression models was performed to test the general association between dimensions of social capital (explanatory

variables) and daily smoking. Single association of social capital measures with daily smoking was estimated in separate models (Model 1: single-measure models) and, subsequently, we analyzed their association with daily smoking in a model adjusted for all social capital measures (Model 2: fully adjusted model). Regression models were controlled for gender and country dummies.

The main research question, whether the association of different dimensions of social capital with daily smoking differs by socioeconomic status, is essentially a question of statistical interaction between measures of social capital and FAS presented in Model 3 and 4 in Table 3. In the single-measure model (Model 3), interaction terms between social capital measures and FAS were analyzed separately, and in the fully adjusted model (Model 4) combined to assess their interrelation. Again, all regression models were adjusted for gender and country dummies. All models provided odds ratios (OR) of independent variables expressing the increase in the probability of daily smoking, when social capital measures change in one unit, holding all other variables in the equation model constant (OR are given along with their 95 % confidence intervals). Furthermore, we tested for cross-national differences in the association between social capital, family affluence and daily smoking.

From the log odds obtained in the regression analyses, we calculated predicted probabilities of daily smoking for high and low FAS groups by the social capital measure in question (Buis 2010). This approach allows us to graphically compare the different associations of social capital with daily smoking stratified for different levels of FAS.

Results

Table 2 presents the results of the association between daily smoking and the different dimensions of social capital. Results from single-measure models (Model 1) showed that different dimensions of social capital were both risk and protective factors for daily smoking. Friend-related social capital was significantly associated with a higher likelihood of daily smoking. All other measures of social capital were significantly associated with a lower likelihood of daily smoking.

In the fully adjusted model in Table 2 (Model 2), associations did not change significantly, except for school participation and for family-related social capital. As the latter was no longer significantly associated with daily smoking, the former changed its direction and was significantly related with a higher likelihood of daily smoking. Additional analyses on cross-national differences showed a significantly weaker association

between different dimensions of social capital and daily smoking in Romania for participation in voluntary organizations ($p < 0.001$) and for general trust and reciprocity in schools ($p = 0.028$) compared to Flemish Belgium, Canada and England (see supplementary Table 3).

A social gradient in adolescent smoking was observed in all model specifications. For example, in the fully adjusted model (Table 2), adolescents with low FAS were more likely to smoke daily (OR: 1.44, OR 95 %: 1.19–1.83, $p < 0.001$) than medium (1.16, OR 95 %: 0.93–1.45, $p = 0.189$) or high FAS adolescents (reference). As demonstrated in the single-measure models in Table 3 (Model 3), associations between social capital and smoking did not vary by FAS. In the fully adjusted model in Table 3 (Model 4), adolescents' trust towards the neighborhood and towards other students (horizontal school trust/reciprocity) became insignificant. School participation became significant and was associated with a higher likelihood of daily smoking. Only the associations of daily smoking with family-related social capital and vertical school trust and reciprocity differed significantly by FAS.

A detailed picture of the association between daily smoking, social capital and FAS is shown in Fig. 1. The graphs illustrate the predicted probabilities of daily smoking by social capital, stratified for different levels of FAS and controlled for potential confounders from the fully adjusted model in Table 3. Family-related social capital was associated with a lower likelihood of daily smoking only for low FAS adolescents, indicating a buffer effect on inequalities in smoking (OR_{FAS-High}: 1.10, CI 95 %: 0.91–1.34, $p = 0.314$; OR_{FAS-Low}: 0.82, CI 95 %: 0.72–0.95, $p = 0.006$). In contrast, vertical trust and reciprocity between adolescents and teachers (vertical school trust and reciprocity) were associated with a lower likelihood of daily smoking only for high FAS adolescents indicating a dependency effect (OR_{FAS-High}: 0.75, CI 95 %: 0.62–0.91, $p = 0.003$; OR_{FAS-Low}: 0.95, CI 95 %: 0.80–1.13, $p = 0.541$). Results did not differ significantly between countries, except for the association of participation in voluntary organizations with daily smoking ($p < 0.001$) in Romania compared to Flemish Belgium, Canada and England (see supplementary Table 4).

The analyses were repeated with self-reported weekly smoking as the outcome (results are available on request). The results did not change significantly. There was one exception: the positive association of friend-related social capital with weekly smoking for high FAS adolescents (OR_{FAS-High}: 2.48, CI 95 %: 2.11–2.92, $p < 0.001$) was significantly lower for moderate (OR_{FAS-Moderate}: 0.80, CI 95 %: 0.64–0.99, $p = 0.041$) and low FAS adolescents (OR_{FAS-Low}: 0.77, CI 95 %: 0.62–0.95, $p = 0.016$).

Table 2 Pooled logistic regression analyses of daily smoking by different dimensions of social capital (Health Behaviour in School-Aged Children Study; Flemish Belgium, Canada, Romania and England; 2005/2006)

	Single-measure models ^a (Model 1)		Fully adjusted model ^b (Model 2)	
	OR	OR 95 %	OR	OR 95 %
Structural social capital				
Informal social capital				
Friend-related social capital	2.25***	2.03–2.50	2.25***	(2.03–2.50)
Formal social capital				
Participation in voluntary organizations	0.74***	0.67–0.83	0.76***	(0.68–0.85)
School participation	0.89**	0.81–0.97	1.13*	(1.02–1.24)
Cognitive social capital				
Family trust/reciprocity				
Family-related social capital	0.83***	0.76–0.90	0.94	0.86–1.03
Neighborhood trust/reciprocity				
General trust/reciprocity	0.81***	0.74–0.88	0.88**	0.80–0.96
School trust/reciprocity				
Horizontal trust/reciprocity	0.81***	0.74–0.88	0.91 [†]	0.83–1.01
Vertical trust/reciprocity	0.67***	0.62–0.73	0.86**	0.78–0.96
General trust/reciprocity	0.59***	0.54–0.64	0.69***	0.62–0.76

OR odds ratio, CI confidence interval

[†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

^a Single-measure models considered social capital variables separately and gender, FAS and country dummies

^b Fully adjusted model considered all social capital variables and gender, FAS and country dummies

Discussion

The present study analyzed the impact of different dimensions of individual social capital on adolescent smoking and on inequalities in smoking. Higher levels of social capital were associated with a lower likelihood of daily smoking. Only friend-related social capital and participation at school were associated with a higher likelihood of daily smoking. The strongest protective factor for daily smoking was school-related including general trust in schools and social capital via teachers. The results showed socioeconomic inequalities in adolescent smoking, with less affluent adolescents were more likely to smoke than more affluent adolescents. We found that increasing family trust and reciprocity were associated with a decreased likelihood of smoking only for low FAS adolescents according to the buffer hypothesis. The results indicated a dependency effect for adolescents' trust in teachers by a reduced likelihood of smoking only among high FAS adolescents.

Focusing on the general association between social capital and adolescent smoking, the structural dimension showed a fairly consistent pattern. Studies of peer effects on adolescent smoking confirm our finding that adolescent tobacco use is associated with higher levels of friend-related social capital (McVicar 2011). Portes (1998)

identified several negative consequences of social capital of which two seem especially relevant in the context of adolescent risk behavior. First, group participation creates demands for conformity that stems from group and internal normative pressure (Nichter et al. 1997). Second, strong peer ties can lead to the exclusion of outsiders and to a selection of peers with a similar smoking behavior (Simons-Morton 2007). According to a recent review, both processes are interactive and relevant for adolescent smoking (Simons-Morton and Farhat 2010).

The indication of a higher likelihood of daily smoking with higher levels of school participation was also found in previous research (De Clercq et al. 2014). This finding might be based on the specific structure of low-status schools, where more students' decision-making autonomy is provided, independently from higher smoking rates. Methodological issues might also account for the inconsistency, even though we found no support for a suppression effect or multi-collinearity among social capital measures (see supplementary Table 4). On the other hand, participation in voluntary organizations can have important protective effects on adolescent smoking (Lundborg 2005; Zambon et al. 2010). The participation in organizations provides large and diverse networks of bonding and bridging ties. These promote a sense of belonging, social control and support, which were

Table 3 Pooled logistic regression analyses of daily smoking by different dimensions of social capital interacting with family affluence (Health Behaviour in School-Aged Children Study; Flemish Belgium, Canada, Romania and England; 2005/2006)

	Single-measure models ^a (Model 3)			Fully adjusted model ^b (Model 4)		
	High FAS (main association)	Medium FAS (interaction term)	Low FAS (interaction term)	High FAS (main association)	Medium FAS (interaction term)	Low FAS (interaction term)
	OR (CI 95 %)	OR (CI 95 %)	OR (CI 95 %)	OR (CI 95 %)	OR (CI 95 %)	OR (CI 95 %)
Structural social capital						
Informal social capital						
Friend-related social capital	2.52*** (2.07–3.08)	0.90 (0.69–1.18)	0.81 (0.63–1.05)	2.51*** (2.07–3.05)	0.90 (0.69–1.17)	0.83 (0.64–1.08)
Formal social capital						
Participation in voluntary organizations	0.81* (0.69–0.95)	0.95 (0.73–1.24)	0.79 (0.60–1.05)	0.82* (0.70–0.97)	0.94 (0.73–1.21)	0.81 (0.62–1.07)
School participation	0.90 (0.77–1.05)	(0.84–1.30)	0.92 (0.75–1.14)	1.17 [†] (0.98–1.40)	1.04 (0.82–1.32)	0.89 (0.69–1.13)
Cognitive social capital						
Family trust/reciprocity						
Family-related social capital	0.94 (0.78–1.13)	0.86 (0.69–1.09)	0.83 (0.66–1.04)	1.10 (0.91–1.34)	0.90 (0.70–1.15)	0.75* (0.59–0.94)
Neighborhood trust/reciprocity						
General trust/reciprocity	0.83** (0.72–0.95)	0.96 (0.78–1.18)	0.98 (0.80–1.19)	0.91 (0.78–1.06)	0.94 (0.75–1.18)	0.95 (0.76–1.19)
School trust/reciprocity						
Horizontal trust/reciprocity	0.88 [†] (0.76–1.02)	0.83 [†] (0.68–1.01)	0.95 (0.77–1.16)	0.97 (0.81–1.16)	0.85 (0.67–1.07)	0.96 (0.75–1.23)
Vertical trust/reciprocity	0.63*** (0.55–0.73)	1.08 (0.89–1.31)	1.13 (0.92–1.37)	0.75** (0.62–0.91)	1.20 (0.93–1.55)	1.27 [†] (0.98–1.64)
General trust/reciprocity	0.56*** (0.49–0.64)	1.06 (0.88–1.28)	1.12 (0.92–1.36)	0.63*** (0.53–0.76)	1.07 (0.83–1.38)	1.18 (0.91–1.54)

OR odds ratio, CI confidence interval, FAS family affluence scale

[†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

^a Single-measure models considered social capital variables separately and gender, FAS and country dummies

^b Fully adjusted model considered all social capital variables and gender, FAS and country dummies

negatively associated with adolescent smoking. Overall, our findings are in line with studies on the influence of different dimensions of structural social capital on adolescent smoking (De Clercq et al. 2014).

The cognitive dimension of social capital showed the largest differences in determining adolescent smoking behavior. All measures across contexts (family, neighborhood and school) appeared as protective factors of adolescent smoking in single-measure models and were in line with recent findings (Ennett et al. 2010; Maes and Lievens 2003; Morgan and Haglund 2009; Samdal et al. 2000). However, adolescents' general trust and reciprocity in schools appeared as the strongest protective factor for adolescent smoking compared to neighborhood- and family-related social capital. These findings are in line with previous studies on the role of neighborhood-related social capital in adolescent health behaviors, but did not support findings on the influence of family-related social capital (Ennett et al. 2010; Morgan and Haglund 2009). As adolescents spend most of their time in school, which is one of the most influential socialization domains in adolescent's life, our findings are in line with theoretical considerations

(Eccles and Roeser 2011). Being in school comprises processes of socialization, social control and support, and feelings of inclusion and security that influence adolescents' smoking behavior and might overcome family influences (Maes and Lievens 2003; McLellan et al. 1999; Perra et al. 2012).

Our results revealed consistent socioeconomic patterns in adolescent smoking, showing that less affluent adolescents were more likely to smoke than more affluent adolescents. This finding is in line with previous research on socioeconomic inequalities in adolescent smoking (Due et al. 2011). The only significant interaction between social capital and FAS was found for family trust and reciprocity indicating a buffering effect on smoking for less affluent adolescents. Another study found a protective effect of social capital on smoking among adolescents that are at higher risk (Evans and Kutcher 2011). We also found that low FAS adolescents might not benefit in the same way from their trustworthiness towards teachers as better-off adolescents. This dependency effect is in line with recent findings that confirm the efficacy of social capital only within high socioeconomic groups (Uphoff et al. 2013).

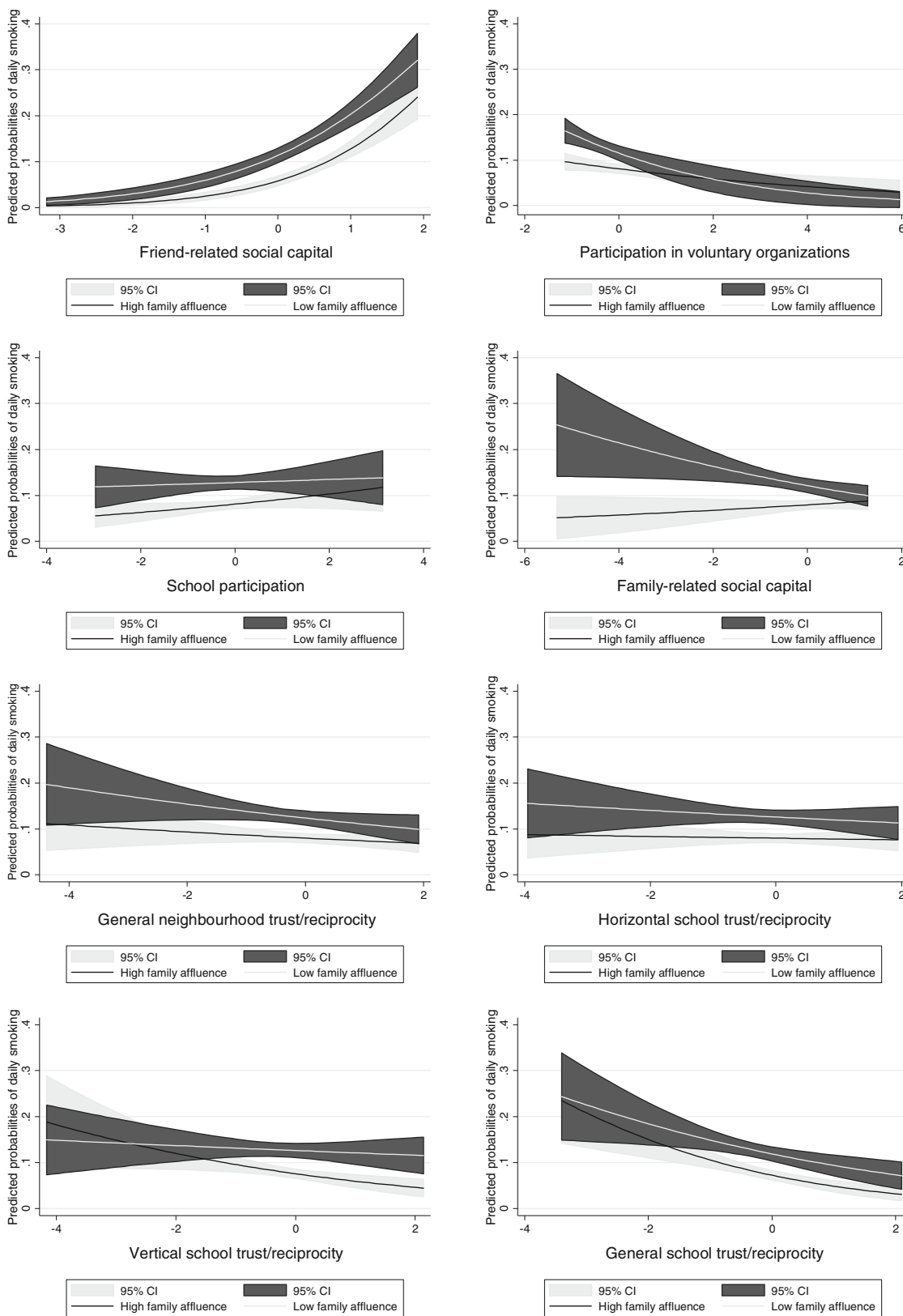


Fig. 1 Predicted probabilities of daily smoking by different dimensions of social capital stratified by family affluence (lowest vs. highest tertile) (Health Behaviour in School-Aged Children Study; Flemish

Belgium, Canada, Romania and England; 2005/2006). Note: Graphs for predicted probabilities of daily smoking were based on the fully adjusted model in Table 3

Strengths and limitations

The strengths of the study include the cross-national design of the study and high response rate that allows for identifying consistent patterns across countries. Students' responses were anonymous, which enhances the validity of the collected data. Further, the broad set of indicators within the HBSC facilitated a comprehensive measurement of different dimensions of adolescent social capital.

Several limitations of this study are noteworthy. First, concerns have been raised about the validity of self-reports of smoking behavior due to social desirability (Johansson et al. 2004). As all adolescents were assured their anonymity in the survey, problems of social desirability were minimized. Second, we were not able to control for peer smoking behavior, which has been shown to strongly influence adolescent smoking. Third, the conceptualization of our social capital measures was not integrated in a well-known concept, but rather relies on other concepts from adolescent research. The theoretical and conceptual implementation of social capital theory in adolescence is still at the beginning and not well developed. However, we provided statistical measures for each scale and a literature review of existing studies to show the reliability of all measures. Fourth, cross-sectional studies cannot assess the causal direction between dependent and independent variables. However, other studies add weight to our findings by indicating the causal pathway of social capital on a range of indicators from different contexts (Mouw 2006). Fifth, the consideration of Flemish Belgium, Canada, Romania and England might be interpreted as selective data collection implying unacknowledged biases. However, our study overcomes single-country studies and offers the opportunity to find consistent cross-national patterns. Only Romania showed an exceptional position compared to Flemish Belgium, Canada and England (see supplementary Tables 3, 4). In Romania, high affluent adolescents were more likely to smoke than less affluent adolescents and formal indicators of social capital played a minor role for adolescent smoking. Pichler and Wallace (2007) describe Romania as a country with a large rural population and a history of transition reforms. Therefore, smoking might appear as a 'luxury item' and a symbol of social status that is only affordable by higher socioeconomic groups (Petrovici and Ritson 2006). In addition, formal and institutionalized structures of interpersonal relations might be much less dominant than informal relations because of the historical experiences of communism in Romania (Pichler and Wallace 2007).

Conclusions

The concept of social capital suggests that health and health-related behaviors are shaped by a range of social and community contexts. The way in which individuals relate to social networks affects their health and well-being (Niemi et al. 2010). Our findings highlight the importance of adolescents' general inclusion in schools and their relation with teachers for not smoking. Independent from its causal relation, the results give support to the emphasis of current prevention strategies on working with teachers to change school and classroom environments, for example by modifying communicative styles or classroom management techniques (Vieno et al. 2005). For low FAS adolescents, especially family belonging and interaction seemed to be the most important protective factor for smoking. In contrast, only high FAS adolescents seemed to benefit from a positive and trustful relationship with teachers. The latter, in particular, implies a strong inequality in opportunities in life chances for low FAS adolescents, as school life and the relationship between teachers and students are fundamental in adolescents' socialization.

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