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Academic performance and adolescent smoking in 6 European cities: the role of friendship ties

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ABSTRACT

Poor academic performance is a known risk factor for adolescent smoking, yet the association remains unclear, as the role of social ties has been rarely examined. Our study aims to investigate the role of friendship ties in this association. In a sample of 11,015 adolescents, aged 14 to 17, in 50 schools within six European cities (SILNE-survey, 2013), we used multilevel models to analyse the mediating effect of the composition of friendship ties and school types on the association between academic performance and smoking. Results show smoking was more prevalent in adolescents with lower academic performance than with higher. This association was stronger in non-vocational schools than in vocational. Adolescents tended to have friendship ties with someone sharing the same smoking status and academic performance. Finally, friendship networks are patterned both on smoking and academic performance. This suggests the educational environment contributes to future socio-economic inequalities in smoking among young people.

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KEYWORDS

Daily smoking; academic performance; adolescents; schools; friendship ties

Introduction

Among adolescents, poor academic performance is associated with a greater risk of smoking initiation, more frequent smoking, a higher number of cigarettes smoked, and fewer attempts to quit smoking (Go, Tucker, Green, Pollard, & Kennedy, 2012; Hu, Lin, & Keeler, 1998; Karp, O'loughlin, Paradis, Hanley, & Difranza, 2005; Kinnunen et al., 2016; Kuntz & Lampert, 2013; Mercken, Snijders, Steglich, & de Vries, 2009). High smoking rates among poor academic performing adolescents have been observed in cross-sectional studies and in longitudinal studies of smoking onset, and across high income countries (Bradley & Greene, 2013; Hu et al., 1998; Karp et al., 2005; Kinnunen et al., 2016; Mercken, Snijders, Steglich, & de Vries, 2009; Schnohr, Kreiner, Rasmussen, Due, & Diderichsen, 2009). Academic performance in part

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is strongly related to socio-economic opportunities later in life (Lorant et al., 2016). The prevention of smoking in poorly performing adolescents is therefore crucial in order to decrease smoking inequalities in adults. However, there is a lack of understanding why adolescents who perform poorly in school are so much more likely to start smoking.

Some previous studies have suggested that poor academic performers are more often smokers due to confounding factors, such as low family socio-economic background (Ali & Dwyer, 2009) and a higher prevalence of smoking among family members (Go et al., 2012; Mercken, Sniijders, Steglich, Vartiainen, & de Vries, 2009; Simons-Morton, Hartos, & Haynie, 2004). Other studies have suggested that the association between academic performance and smoking results from marginalization of poor performing students. Adolescents who perform less well may feel marginalized by teachers and by their better-performing peers (Elstad, 2010). They are less likely to receive social, emotional, and academic support from others. This makes them more likely to cluster together and engage in deviant behaviour, such as violation of school rules and smoking, as a way to create a social identity (Chen & Hsiao, 2009).

Clustering of poor performing students may for a large part be expressed in friendship ties, but the role of such ties has not been extensively studied in the existing literature (Lorant et al., 2015, 2016). Adolescents not only tend to create and maintain friendship ties with other adolescents at a similar level of academic performance (Huang, Soto, Fujimoto, & Valente, 2014; Kobus, 2003; Lomi, Sniijders, Steglich, & Torló, 2011; Mercken, Sniijders, Steglich, & de Vries, 2009; Schaefer, Haas, & Bishop, 2012; Woolf, Potts, Patel, & MCManus, 2012), but also with others with a similar smoking status (Mercken, Sniijders, Steglich, & de Vries, 2009; Go et al., 2012; Schaefer et al., 2012; Seo & Huang, 2012; DeLay, Laursen, Kiuru, Salmela-Aro, & Nurmi, 2013). Based on Dimaggio's theory of social network-induced inequality, adolescents' social ties to students with similar smoking behaviour and similar level of performance contribute to the association between academic performance and smoking. This, in turn, could increase early socio-economic smoking inequalities (DiMaggio & Garip, 2012).

This kind of clustering may also be affected by school type, as some schools track students solely according to their academic performance (van de Werfhorst, 2011; Rathmann et al., 2016). School types, school options (e.g. sport, sciences, arts, etc.), and classroom assignments serve as a primary filter for peer influence because they facilitate physical and social proximity among adolescents who share similar characteristics, including smoking (Go et al., 2012; Mercken et al., 2009; Seo & Huang, 2012) and academic performance (Huang et al., 2014; Kobus, 2003; Lomi et al., 2011; Mercken, Sniijders, Steglich, & de Vries, 2009; Schaefer et al., 2012; Woolf et al., 2012). School type, which is imposed by the educational system, influences the composition of friendship ties among students. Adolescents with higher academic performance are more likely to attend schools that have a greater academic focus and are more oriented towards university degrees, while adolescents with lower academic performance may attend schools with a vocational orientation (Huisman, van de Werfhorst, & Monshouwer, 2012; Van de Werfhorst & Mijs, 2010). Tracking of students according to their academic performance may promote inequalities not only with regard to academic performance and aspirations (Buchmann & Dalton, 2002) but also to smoking (Doku, Koivusilta, Rainio, & Rimpelä, 2010; Rathmann et al., 2016). Richter (2007) showed that students in vocational-orientation schools have a four times higher risk of smoking than students who are enrolled in schools with the highest (university) educational orientation (Richter & Leppin, 2007). We therefore expected that the link between smoking and low academic performance would vary according to school type.

The aim of this study was to test to what extent the association between academic performance and adolescent smoking is explained by the patterning of adolescents' social relationships based on smoking and academic performance. We addressed three specific questions:

- (1) What is the association between academic performance and smoking among adolescents in Europe?
- (2) Does the composition of social ties explain the association between academic performance and smoking?

- (3) Does the association between academic performance and smoking vary according to school type?

Methods

This study used data from the 2013 'SILNE' survey ('Tackling Smoking Inequalities: Learning from Natural Experiments'). SILNE is a school-based social network survey of adolescents in two grades corresponding to 14–17 year-olds and was conducted in six European cities (Namur, Belgium; Tampere, Finland; Hanover, Germany; Latina, Italy; Amersfoort, Netherlands; and Coimbra, Portugal). In each city an average of 8 schools and 1800 adolescents were recruited. A total of 163 schools were contacted and 50 agreed to participate. A total of 13,870 adolescents registered in these schools were invited to fill in a written questionnaire about their social relationships in school, health behaviours, and sociodemographic characteristics. A total of 11,015 adolescents (participation rate of 79.4%) participated, yielding 57,094 collected ties between those adolescents. In each city, ethical approval was obtained from national or local organizations. A detailed description of the design and concepts of the SILNE study has been published elsewhere (Lorant et al., 2015).

Measures

Daily smoking was defined as reporting having smoked at least 1 cigarette per day in the last 30 days. All other respondents were considered non(-daily) smokers.

Adolescent academic performance was based on the student's self-reported marks during the previous year: 'Which of the following best describes your marks during the past year?'. This variable included five initial values based on each country's academic performance assessment system. These values were grouped into three tertile categories: low, average and high.

Adolescents were asked to nominate up to 5 friends (also referred to 'alters') within the two grades. Respondents answered the question, 'who are your best and closest friends?' (Lorant et al., 2015). To identify their peers, adolescents were handed a student directory which contained the names of all students enrolled in the two grades, alphabetically for each class and grade. One code was assigned to each name and respondents were asked to use the codes. In Finland, the names of adolescents had to be written on the questionnaire and the researchers coded them afterwards (name-generator approach).

Relationships established between adolescents in relation to smoking behaviour and academic performance were described at the individual level: (1) the proportion of friendship ties to low academic achievers of the total number of friendship nominations (the number of outgoing ties that a student has) and (2) the proportion of friendship ties to daily smokers of the total number of friendship nominations. In the main analysis, the indices were computed for reciprocal friendship ties. In a sensitivity analysis non-reciprocal friendship ties were also included. Reciprocal friendships are generally considered as involving more trust and social capital than non-reciprocal friendships (Rivera, Soderstrom, & Uzzi, 2010).

To capture the composition of institutional social ties imposed by the educational system, we categorized the students in vocational vs. non-vocational school types. The non-vocational school type is defined as the university-preparatory track and the vocational school type is defined as that of students who enter the labour market after secondary school and before the age of 20. As Finland does not have tracking in the included age-range, we created a 'no-tracking' category for that country. Supplementary Table 1 describes the allocation of the different tracks per school type and per country (Huisman et al., 2012; Moor et al., 2014).

Covariates included the number of smokers among family members in the household, socio-economic status, age, and sex. Socio-economic status was defined by the parental educational level. Parental education was classified into low, middle, high, and unknown, according to the education system of each country (Lorant et al., 2015).

Table 1. Sample characteristics and distribution of daily smoking and academic performance, SILNE, 2013, overall percentage and chi-square test ($n = 9876$).

Covariates	%	<i>N</i>	Daily smoker (%)	χ^2	<i>P</i> value	Low academic performer (%)	χ^2	<i>P</i> value
<i>Gender</i>								
Male	49.7	5071	14.3	10.3	0.001	20.6	41.5	<.001
Female	50.3	5132	12.1			15.7		
<i>Age group</i>								
12–14	27.1	2770	5.7	417.3	<.001	12.8	205.8	<.001
15	38.3	3903	10.3			15.1		
16+	34.6	3530	22.3			25.7		
<i>Cities</i>								
Namur (BE)	17.8	1818	19.2	166.0	<.001	23.3	298.1	0.004
Hanover (DE)	20.2	2064	9.5			18.8		
Amersfoort (NL)	25.4	2594	9.0			10.7		
Latina (IT)	7.3	740	21.1			7.8		
Coimbra (PT)	16.8	1709	15.4			19.3		
Tampere (FI)	12.5	1278	11.7			29.1		
<i>School types</i>								
Non-vocational	56.1	5668	7.7	407.9	<.001	14.2	166.8	<.001
Vocational	31.2	3153	23.2			20.6		
'No tracking' ^a	12.7	1278	11.7			29.1		
<i>Mother's education</i>								
Low	15.9	1625	17.0	67.2	<.001	22.4	120.3	<.001
Medium	32.6	3328	15.0			19.9		
High	32.8	3343	9.7			12.4		
Other/unknown	18.7	1906	12.9			21.4		
<i>Father's education</i>								
Low	18.6	1902	17.5	84.5	<.001	23.3	151.0	<.001
Medium	28.6	2919	14.6			19.1		
High	31.1	3176	9.1			11.7		
Other/unknown	21.6	2207	13.6			21.7		
<i>Academic performance</i>								
Low performance	18.7	1849	23.1	271.0	<.001			
Average performance	43.2	4264	13.6					
High performance	38.1	3763	7.2					
<i>Total</i>			13.2%			18.7%		

^a"No tracking" = Finland.

Data analysis

After excluding 1,139 observations due to missing data, we were left with 9,876 full records.

We first tabulated smoking status and academic performance by socio-demographic groups. We then described the composition of friendship ties according to the adolescent's own smoking status and academic performance level. We used multilevel logistic regression models (random intercept) to quantify the association between academic performance and smoking. Mediation of the association by the composition of friendship ties was tested. In Model 1, we regressed the academic performance variable on daily smoking. In Model 2, we added 3 indices of the composition of friendship ties: the composition of institutional social ties imposed by the educational system (school types), friendship ties with daily smokers, and friendship ties with low-performing peers. In Model 3, we controlled Model 2 for gender, age, parents' education, and the number of smokers among family members. Statistical analyses were carried out with SAS 9.3. As participation differed slightly between schools, we weighted the data by the inverse of the participation rate.

Results

Table 1 describes the sample and the distribution of daily smoking and of academic performance. Older adolescents, students attending vocational schools, and students from lower socio-economic backgrounds were more likely to be smokers and to have low academic performance. Daily smoking

was more frequent among students with lower academic performance than among students with high academic performance (23.1 vs. 7.2%, $\chi^2 = 271$, $p < 0.001$).

Table 2 describes the composition of adolescents' friendships ties according to their own academic performance and smoking status. Each cell is the average percentage of reciprocal ties to smokers (or to low performers) as a proportion of the total number of reciprocal ties. Adolescents had more friendship ties to adolescents with a similar smoking status and with a similar academic performance. The percentage of smoking alters was higher among daily smokers (from 40 to 54%) than among non(-daily) smokers (from 5 to 11%), independent of their academic performance. This association was stronger among high performers (ratio = 8.1) than among low performers (ratio = 4.71). It also varied according to the academic performance. The percentage of daily-smoking friends was higher among lower performers than among higher performers (ratio = 1.34).

Table 2 also shows that the percentage of ties to daily smokers increased as academic performance decreased, both among smokers and non-smokers. A similar pattern was observed for friendship ties to students with low academic performance. Among lower performers, between 45% and 31% of reciprocal friends were low performers, as against 16 to 9% among high performers.

Supplementary Table 2 shows a replication of Table 2 with all ties (reciprocal and non-reciprocal). The same pattern was found, but with less pronounced differences, suggesting that the strength of ties fosters the association between ego-smoking and alters' smoking status.

Table 3 presents the association between daily smoking and academic performance by school types. In all countries there was a dose-response association between academic performance and daily smoking: the lower the academic performance, the higher the prevalence of daily smoking. Students in vocational school type have a higher prevalence of daily smoking than those in non-vocational school types. Overall, the risk of smoking among low-performing adolescents compared to high performers was higher for adolescents in 'no-tracking' schools and the non-vocational type of school than for the vocational type of school.

Table 4 presents the multilevel logistic regression models. In Model 1, low academic performance (OR 3.86, 95% CI 3.28–4.55) was associated with daily smoking. In Model 2, shows that the higher the percentage of friendship ties to daily smokers, the higher the odds of daily smoking (OR = 16.53, 95% CI: 13.36–20.45). A higher percentage of friendship ties with low-performing peers was also associated with higher odds of daily smoking (OR = 1.89, 95% CI: 1.50–2.39). The association between low compared to high academic performance and daily smoking decreased from 3.86 (Model 1) to 2.26 (Model 2). This means that a part of the association between academic performance and daily smoking was attributed by the composition of friendship ties. Moreover, adolescents enrolled in vocational schools compared with those in non-vocational schools were more likely to smoke (OR = 2.28, 95% CI: 1.87–2.76). Model 3 included confounders sex, age, parental education, and the number of family members who are smokers. The risk of daily smoking for low performers decreased slightly between Model 2 and Model 3 (from OR 2.26 to OR 1.99), which suggests that family background and adolescent characteristics

Table 2. Friendship reciprocal ties with smokers and with low academic performers by smoking status and academic performance of ego: average percentage of the number of ties and ratio, SILNE international Survey 2013 ($n = 11,021$).

		Friendship alters in % of total No. of ties			
Smoking status of ego	Composition of friendship ties	Low academic performance	Average academic performance	High academic performance	Ratio low/high
Daily smokers	Friendship ties with daily smokers	53.7%	43.0%	39.9%	1.34
	Friendship ties with low performers	45.3%	24.6%	15.8%	2.86
Non-daily-smokers	Friendship ties with daily smokers	11.4%	7.9%	4.9%	2.32
	Friendship ties with low performers	31.0%	16.1%	9.1%	3.40
Ratio*		4.71	5.44	8.14	

*Ratio of friendship ties with daily smokers among daily smokers / friendship ties with daily smokers among non-daily-smokers.

Table 3. Association of daily smoking with academic performance per school type: percentage and OR, SILNE international study of adolescent health, 2013.

Academic performance	Daily smokers (%) per school type		
	'No-tracking' ^b	Non-vocational	Vocational
Low performance	25.6%	16.5%	29.4%
Average performance	7.8%	8.2%	23.4%
High performance	1.6%	3.9%	18.0%
Total	11.1%	7.5%	23.1%
OR (95%CI)^a	21.90 (9.74–49.23)	3.25 (2.43–4.36)	1.72 (1.35–2.20)

^aOR = Odds ratio of low performers vs. high performers, adjusted for age and sex with 95% Confidence Interval (CI). All the P-values are under 0.001.

^b'No-tracking' = Tampere (Finland).

Table 4. Risk of daily smoking according to academic performance, school type, and composition of friendship ties. Odds ratio from the logistic regression, SILNE international survey of adolescents, 2013.

Covariates	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)
Academic performance (ref = High)			
Average	2.02 (1.74–2.35)***	1.65 (1.36–2.01)***	1.55 (1.27–1.90)***
Low	3.86 (3.28–4.55)***	2.26 (1.81–2.84)***	1.99 (1.58–2.52)***
Friendship ties with daily smokers (%)		16.53 (13.36–20.45)***	13.69 (11.00–17.03)***
Friendship ties with low performers (%)		1.89 (1.50–2.39)***	1.76 (1.39–2.23)***
School type (ref = non-vocational)			
'No-tracking'		0.96 (0.69–1.34)	1.13 (0.80–1.60)
Vocational		2.28 (1.87–2.76)***	1.79 (1.46–2.20)***
Age			1.43 (1.32–1.56)***
Sex (Ref=female)			
Male			0.98 (0.83–1.15)
Parents' education (ref = high and middle)			
Low level			1.02 (0.85–1.22)
Smoking family members			1.48 (1.40–1.56)***

Notes: Model 1 regressed the academic performance variable on daily smoking.

Model 2 added 3 indices of friendship-ties composition and random intercept at the city level.

Model 3 controlled Model 2 by gender, age, parents' education, the number of smokers among family members, and random intercept at the city level.

*** = P-value under 0.001.

'No-tracking' = Tampere (Finland).

slightly confound the association between adolescents' own performance and daily smoking. Friendship ties and school type remained strongly related to smoking, independent of family background and adolescent characteristics.

Discussion

Main findings

The origin of the association between smoking and poor academic performance in adolescents has remained unclear so far. Using an original international social-network study across six countries, we investigated the role of social ties in this association, looking at both the individual level and the dyad level. We found that friendship ties were homophilous both in relation to smoking and in relation to academic performance. Adolescents who are daily smokers have more friends who are smokers than non-smokers and low-performing adolescents have more ties to other low-performing adolescents. Adolescents enrolled in vocational schools are more likely to smoke than their counterparts in non-vocational or non-tracking schools. This composition of friendship ties and school type partly explains the association between smoking and academic performance. Although smoking is more prevalent in vocational schools than in non-vocational schools, low academic performance is more strongly

associated with daily smoking in vocational schools than in non-vocational schools and particularly strongly in non-tracking schools.

Consistency and interpretation

Adolescents tended to have social ties with those who had the same smoking status and academic performance level. This is consistent with previous studies on both smoking (Mercken, Snijders, Steglich, & de Vries, 2009; Schaefer et al., 2012; Seo & Huang, 2012) and academic performance (Huang et al., 2014; Kobus, 2003; Lomi et al., 2011; Mercken, Snijders, Steglich, & de Vries, 2009; Schaefer et al., 2012; Woolf et al., 2012). Our study shows that friendship networks are patterned on both characteristics simultaneously. This means that poorly performing adolescents who smoke have a double social jeopardy: they have more friends who both perform poorly and also smoke. Social homophily on these two individual characteristics provide the backbone for health behaviour inequality in a school context. One possible explanation may be that smoking and low academic performance are signals of low social status, which may trigger greater social inclusiveness. Horn's study (2006), cited by Killen, showed that adolescents who identified with low-status peer-group members were socially more cohesive than their high-status-group peers. This social cohesion, on one hand, reinforces the social identity of a group, but, on the other hand, also has consequences for health, well-being at school, emotional engagement, and academic performance (Killen, Rutland, & Jampol, 2009; Ladd, 2009). Our finding that reciprocal ties were more associated with the same smoking behaviour and the same level of performance than non-reciprocal ties makes clear the role of social cohesion (Fujimoto & Valente, 2012).

This may be related to the stronger association of academic performance and smoking in non-vocational schools (or in schools with no tracking) than in vocational schools. Within non-vocational schools, students who perform worse are less likely to receive social, emotional, and academic support from others and are thus more likely to cluster together and to engage in deviant behaviour such as violation of school rules and smoking (Chen & Hsiao, 2009). The association between smoking and academic performance may be weaker in vocational schools than in non-vocational schools because, there, low academic performance and smoking are more prevalent and thus socially less salient.

Potential limitations

Our study has some limitations. First, the differences between countries' educational systems and grading systems are likely to affect the overall association between smoking and academic performance. In addition, the validity of the association between academic performance and smoking relies on the validity of academic performance, which was self-reported: it is possible that the social desirability of higher academic performance may lower the true association.

Second, our cross-sectional design cannot ascertain the direction of the association between smoking and academic performance and cannot disentangle causal effects from selection effects in the friendship network: adolescents may have similar friends in terms of smoking (or academic performance) either because they were influenced by their friends' smoking status or because they selected them according to their own smoking status (Mercken, Snijders, Steglich, & de Vries, 2009).

Conclusions

Smoking rates are higher among adolescents with poor academic performance than among those with high academic performance. This association was to a considerable extent explained by homophily of friendship ties to smokers and to poor performers. This suggests that the educational environment contributes to socio-economic inequalities in smoking in young people. Further studies are needed to ascertain whether reducing the clustering of poor performers, e.g. class formation, could reduce this association (Valente, 2012).

Authors' contribution

POR conceived the research question, participated in the data collection, performed the data analysis, and drafted the manuscript. AK contributed to the survey design and coordinated the study. POR, MK, KR, IM, JK, AR, JP, BF, and MR carried out the study in each European city and contributed to the manuscript. AK, MK, KR, IM, JK, AR, and JP helped draft the manuscript. VL designed the survey, supervised the data collection, assisted in the study's conception, and contributed to the manuscript. All authors read and approved the final manuscript.

Ethics approval

In each country, ethical approval from local or national ethical committees was requested and obtained. In addition, in some countries, permission to conduct the survey was requested from educational authorities. School principals, parents, and adolescents received leaflets, information letters, and parental consent letters, according to each country's regulations. Informed consent was obtained from all individual participants included in the study.

Italy

Name of the committee: Ethics committee, Azienda Unità Sanitaria Locale Frosinone, Italy
Approval's reference number: 862, approved on 13/11/2012

Netherlands

Name of the committee: Medical Ethical Committee of the AMC Approval's reference number: W12_256#12.17.0290

Finland

Name of the committee: Ethics Committee of the Tampere region Favourable Statement reference number: 10/2012

Germany

Name of the committee: Ethics committee, Medical Faculty, Martin-Luther-University Halle-Wittenberg, Germany Approval's reference number: 2012-112, approved on 13/12/2012.

Belgium

Name of the committee: Commission d'Éthique Biomédicale
Approval's reference number: 2012/09OCT/461

Portugal

Name of the committee: General Directorate for Education
(Direção Geral da Educação)
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Keypoints

- Smoking was more prevalent in poorly performing adolescents than in high-performing adolescents.
- This association was stronger in no-tracking school and in non-vocational schools than in vocational schools.
- This suggests that the educational environment contributes to socio-economic inequalities in smoking in young people.
- The friendship network is patterned both on smoking and on academic performance.
- Further studies are needed to ascertain whether reducing the clustering of poor performers, e.g. class formation, could reduce this association.

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Disclosure statement

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References

- Ali, M. M., & Dwyer, D. S. (2009). Estimating peer effects in adolescent smoking behavior: A longitudinal analysis. *Journal of Adolescent Health, 45*(4), 402–408.
- Bradley, B. J., & Greene, A. C. (2013). Do health and education agencies in the United States share responsibility for academic achievement and health? A review of 25 years of evidence about the relationship of adolescents' academic achievement and health behaviors. *Journal of Adolescent Health, 52*(5), 523–532.
- Buchmann, C., & Dalton, B. (2002). Interpersonal influences and educational aspirations in 12 countries: The importance of institutional context. *Sociology of Education, 75*(2), 99–122.
- Chen, X. C., & Hsiao, C. J. (2009). Peer interactions and relationships from a cross-cultural perspective. In K. H. Rubin, W. M. Bukowski, & B. Laursen (Eds.), *Handbook of peer interactions, relationships, and groups* (pp. 432–451). New York, NY: Guilford Press.
- DeLay, D., Laursen, B., Kiuru, N., Salmela-Aro, K., & Nurmi, J. E. (2013). Selecting and retaining friends on the basis of cigarette smoking similarity. *Journal of Research on Adolescence, 23*(3), 464–473.
- DiMaggio, P., & Garip, F. (2012). Network effects and social inequality. *Annual Review of Sociology, 38*, 93–118.
- Doku, D., Koivusilta, L., Rainio, S., & Rimpelä, A. (2010). Socioeconomic differences in smoking among Finnish adolescents from 1977 to 2007. *Journal of Adolescent Health, 47*(5), 479–487.
- Elstad, J. I. (2010). Indirect health-related selection or social causation? Interpreting the educational differences in adolescent health behaviours. *Social Theory and Health, 8*(2), 134–150.
- Fujimoto, K., & Valente, T. W. (2012). Social network influences on adolescent substance use: Disentangling structural equivalence from cohesion. *Social Science & Medicine, 74*(12), 1952–1960.
- Go, M. H., Tucker, J. S., Green, H. D., Pollard, M., & Kennedy, D. (2012). Social distance and homophily in adolescent smoking initiation. *Drug and Alcohol Dependence, 124*(3), 347–354.
- Hu, T. W., Lin, Z., & Keeler, T. E. (1998). Teenage smoking, attempts to quit, and school performance. *American Journal of Public Health, 88*(6), 940–943.
- Huang, G. C., Soto, D., Fujimoto, K., & Valente, T. W. (2014). The interplay of friendship networks and social networking sites: Longitudinal analysis of selection and influence effects on adolescent smoking and alcohol use. *American Journal of Public Health, 104*(8), e51–e59.
- Huisman, C., van de Werfhorst, H. G., & Monshouwer, K. (2012). Adolescent tobacco use in the Netherlands: Social background, education, and school organization. *Youth and Society, 44*(4), 567–586.
- Karp, I., O'Loughlin, J., Paradis, G., Hanley, J., & Difranza, J. (2005). Smoking trajectories of adolescent novice smokers in a longitudinal study of tobacco use. *Annals of Epidemiology, 15*(6), 445–452.
- Killen, M. R., Rutland, A., & Jampol, N. S. (2009). Social exclusion in childhood and adolescence. In K. H. Rubin, W. M. Bukowski, & B. Laursen (Eds.), *Handbook of peer interventions, relationships and groups* (pp. 249–266). New York, NY: Guilford Press.
- Kinnunen, J. M., Lindfors, P., Rimpelä, A., Salmela-Aro, K., Rathmann, K., Perelman, J., ... Lorant, V. (2016). Academic well-being and smoking among 14- to 17-year-old schoolchildren in six European cities. *Journal of Adolescence, 50*, 56–64.
- Kobus, K. (2003). Peers and adolescent smoking. *Addiction, 98*(Supplement 1), 37–55.
- Kuntz, B., & Lampert, T. (2013). Educational differences in smoking among adolescents in Germany: What is the role of parental and adolescent education levels and intergenerational educational mobility? *International Journal of Environmental Research and Public Health, 10*(7), 3015–3032.
- Ladd, G. W. E. A. (2009). Peers and motivation. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 323–348). New York and London: Routledge.
- Lomi, A., Snijders, T. A. B., Steglich, C. E. G., & Torló, V. J. (2011). Why are some more peer than others? Evidence from a longitudinal study of social networks and individual academic performance. *Social Science Research, 40*(6), 1506–1520.
- Lorant, V., Rojas, V. S., Robert, P. O., Kinnunen, J. M., Kuipers, M. A. G., Moor, I., ... Kunst, A. E. (2016). Social network and inequalities in smoking amongst school-aged adolescents in six European countries. *International Journal of Public Health, 1*–10.
- Lorant, V., Soto, V. E., Alves, J., Federico, B., Kinnunen, J., Kuipers, M., ... Kunst, A. (2015). Smoking in school-aged adolescents: Design of a social network survey in six European countries. *BMC Research Notes, 8*(1), 91.
- Mercken, L., Snijders, T. A. B., Steglich, C., & de Vries, H. (2009). Dynamics of adolescent friendship networks and smoking behavior: Social network analyses in six European countries. *Social Science and Medicine, 69*(10), 1506–1514.
- Mercken, L., Snijders, T. A. B., Steglich, C., Vartiainen, E., & de Vries, H. (2009). Dynamics of adolescent friendship networks and smoking behavior. *Social Networks, 32*(1), 72–81.

- Moor, I., Lampert, T., Rathmann, K., Kuntz, B., Kolip, P., Spallek, J., & Richter, M. (2014). Explaining educational inequalities in adolescent life satisfaction: Do health behaviour and gender matter? *International Journal of Public Health*, 59(2), 309–317.
- Rathmann, K., Moor, I., Kunst, A. E., Dragano, N., Pfortner, T., Elgar, F. J., ... Richter, M. (2016). Is educational differentiation associated with smoking and smoking inequalities in adolescence? A multilevel analysis across 27 European and North American countries. *Sociology of Health and Illness*, 38(7), 1005–1025.
- Richter, M., & Leppin, A. (2007). Trends in socio-economic differences in tobacco smoking among German schoolchildren, 1994–2002. *European Journal of Public Health*, 17(6), 565–571.
- Rivera, M. T., Soderstrom, S. B., & Uzzi, B. (2010). Dynamics of dyads in social networks: Assortative, relational, and proximity mechanisms. *Annual Review of Sociology*, 36, 91–115.
- Schaefer, D. R., Haas, S. A., & Bishop, N. J. (2012). A dynamic model of US adolescents' smoking and friendship networks. *American Journal of Public Health*, 102(6), E12–E18.
- Schnohr, C. W., Kreiner, S., Rasmussen, M., Due, P., & Diderichsen, F. (2009). School-related mediators in social inequalities in smoking: A comparative cross-sectional study of 20,399 adolescents. *International Journal for Equity in Health*, 8, 17.
- Seo, D. C., & Huang, Y. (2012). Systematic review of social network analysis in adolescent cigarette smoking behavior. *Journal of School Health*, 82(1), 21–27.
- Simons-Morton, B. G., Hartos, J. L., & Haynie, D. L. (2004). Prospective analysis of peer and parent influences on minor aggression among early adolescents. *Health Education and Behavior*, 31(1), 22–33.
- Valente, T. W. (2012). Network interventions. *Science*, 336(6090), 49–53.
- Van de Werfhorst, H. G., & Mijs, J. J. B. (2010). Achievement inequality and the institutional structure of educational systems: A comparative perspective. *Annual Review of Sociology*, 36, 407–428.
- van de Werfhorst, H. G. (2011). Skill and education effects on earnings in 18 Countries: The role of national educational institutions. *Social Science Research*, 40(4), 1078–1090.
- Woolf, K., Potts, H. W. W., Patel, S., & McManus, I. C. (2012). The hidden medical school: A longitudinal study of how social networks form, and how they relate to academic performance. *Medical Teacher*, 34(7), 577–586.