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ORIGINAL ARTICLE



Same-Sex Friendship, School Gender Composition, and Substance Use: A Social Network Study of 50 European Schools

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ABSTRACT

Background: Other-sex friendship (girls with boy friends, boys with girl friends) has been associated with substance use, but how the gender composition of schools influences substance use has not been known. **Objectives:** We analyzed the influence of other-sex friendship on substance use and took into account the proportion of each gender group at the schools, and hypothesized that other-sex friendship is associated with higher levels of substance use and that schools with a majority of males have higher levels of use than female-majority schools. **Methods:** In 2013, a social network survey was carried out in six European cities. In each city, schools were selected and 11,015 adolescents (aged 14–16) were recruited (participation rate = 79.4%). We collected data on smoking, binge drinking, cannabis use, and peer group composition. **Results:** Other-sex friendship was associated with smoking, binge drinking, and cannabis use for girls and with smoking for boys. Substance use was more frequent in schools with a majority of males. **Conclusions/Importance:** Adolescent girls are best protected from substance use if they are in gender-balanced schools, but in same-sex friendship. This offers new perspectives on gender mixing at school. In schools with a majority of boys, more attention should be paid to girls, and gender-specific health promotion programs should be implemented. This European study is the first to take into account both individual (other-sex friendship) and contextual (gender composition of schools) gender interactions. It confirms previous studies on other-sex friendship, while shedding light on the influence of gender-normative contexts on substance use.

KEYWORDS

Other-sex friendship; same-sex friendship; gender; high school; substance use; tobacco; alcohol; cannabis; adolescents; binge drinking

Same-sex friendship



Since the 1970s, gender co-education (mixing boys and girls in school) has been the norm in most European schools (Bereni, Chauvin, Jaunait, & Revillard, 2012, 2011). Despite this mixing, however, same-sex friendship (SSF) is still predominant in peer groups at school from as early as three years of age up to adolescence: most children and early adolescents have most of their friendship ties with same-sex children or adolescents (Bereni et al., 2012).

SSF is an important pattern of gender socialization, which promotes gender-specific leisure activities and peer preferences (Bereni et al., 2012; Stockard, 2006). Whereas most boys play sports in larger groups, girls generally prefer more intimate relationships in a smaller and more exclusively same-sex peer group (Bereni et al., 2012; Ridgeway & Smith-Lovin, 1999). However,

adolescence disrupts this trend toward SSF in the form of puberty and romantic interest in the other sex (Arnold & Stormshak, 2008; Bearman, Moody, Stovel, & Thalji, 2004; Kreager, Haynie, & Hopfer, 2013). As a consequence, other-sex friendship (OSF), i.e., having most friendship ties with other-sex children, increases during adolescence (Connolly, Craig, Goldberg, & Pepler, 2004; McDougall & Hymel, 2007). Later in this article, the terms “SSF” and “OSF” are used in the specific senses that are defined on page 3, Measurements, section 2 “gender social homophily: Same-sex and OSF”, in order to facilitate statistical analysis.

Peer influence and substance use

At the time when they first engage in OSFs, adolescents also start to experiment with substances such as tobacco

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and alcohol (Malow-Iroff, 2006; Poulin et al., 2011). At 12 years of age, 14% of adolescents have tried smoking and 8% have used alcohol in the last month (Van Lier, Huiznik, & Crijnen, 2009). Alcohol and tobacco were traditionally used more by males than females; in recent decades, however, gender differences in alcohol and tobacco use have narrowed (Hublet et al., 2006; Mehta, Alfonso, Delaney, & Ayotte, 2013). For example, data from the HBSC (Health Behavior in School-aged Children) study has shown that girls now have similar smoking rates to boys in one out of every two European countries (Inchley et al., 2016). Nevertheless, boys still experiment with tobacco at a younger age than girls (Inchley et al., 2016).

Adolescent friendship has long been identified as a key factor in adolescent substance use, whether in the form of peer selection or peer influence (Malow-Iroff, 2006; Mathys, Burk, & Cillessen, 2013). Having a best friend who smokes or having half of one's peer network who smoke are both associated with more frequent smoking. As peers are so important in substance use, their gender may also play a role. Several studies have reported that boys had more influence than girls and that girls were more easily influenced than boys (Dick et al., 2007; Gaughan, 2006). This could lead girls in OSFs to be particularly influenced by their male friends. For Mrug, Borch, and Cillessen (2011), girls with other-sex friends were five times more likely to smoke cigarettes than girls with same-sex friends. Gaughan (2006) found that girls with other-sex friends were influenced by their male friends' drinking behavior, but that, on the contrary, boys with OSFs were not influenced by their female friends. Poulin and colleagues (2011), who tested whether OSF might influence boys toward less substance use, could not find any protective effect of OSF for boys. According to Arndorfer and Stormshak (2008), however, OSF was associated with substance use among girls, while SSF was more related to substance use among boys.

The early work of the Chicago school of sociology showed that substance use was traditionally more frequently a male behavior (Shaw & Moore, 1931) and recent studies have found that substance use was still associated with male gender roles (Iwamoto & Smiler, 2013; Mahalik, Lombardi, Sims, Coley, & Lynch, 2015); (Kulis, Margisiglia, & Hecht, 2002; Schulte, Ramo, & Brown, 2009). This tradition would explain why boys influence their peers toward greater substance use and why girls in OSFs and boys in SSFs are influenced to engage in higher levels of substance use (Mehta et al., 2013).

In boys' peer groups, substance use may be a way to express masculine identity (Dempster, 2011; Mullen, Watson, Swift, & Black, 2009): boys will adopt their male friends' behavior in order to fit in.

Girls, on the other hand, may adopt boys' substance use behavior for other reasons: OSF may be a prelude to dating (Connolly et al., 2004). On the one hand, for Poulin et al. (2011), girls tend to date older boys, who would have more experience of, and opportunity for, substance use and may thus initiate girls' substance use. On the other hand, according to Malow-Iroff (2006), substance use may help girls to achieve self-disclosure and to attract boys. In another study, girls' drinking was described as a way of facilitating contact with the opposite sex, as alcohol consumption may provide an excuse for approaching a potential partner (Mullen et al., 2009).

School gender composition

If girls in OSFs are more influenced by male behavior than same-sex-friendship girls, then the larger gender context of schools should also be considered. The gender composition of schools has been found to influence substance use behavior. In a study of alcohol use among Irish high-school students, Barry (1993) found that girls in co-educational schools were more likely to drink alcohol than girls in single-sex schools (Barry, 1993). Girls in co-educational schools were also more likely to show early onset of alcohol and tobacco use than girls in single-sex schools (Curtin, 2004). Lorant and Nicaise (2015) has shown that the gender composition of a university faculty influences the relationship between binge drinking and gender. Girls in the mostly male faculty of Engineering were more likely to binge drink than girls in the mostly female faculty of Psychology. Among boys, sex-segregated schools, as an extension of sex-segregated peer groups, could also lead to more substance use behaviors (Mehta & Strough, 2009). These schools have been found to reinforce traditional views of male and female in society, which may include more traditional attitudes to male and female substance use (Leaper, 1994).

In this study, we analyzed the influence of OSF on substance use among adolescents in 50 schools in six European countries. In the analysis, we took into account the proportion of each gender group at the schools. It is very important to consider school gender composition, as it may help to disentangle two explanations of the effect of OSF on substance use among girls.

On the one hand, OSF may result from competition for the attention of the other gender. Substance use may help students of the majority gender group to attract the attention of students of the minority gender group. For instance, where there are few boys (female-majority schools), girls would need to make greater efforts to be noticed by them and substance use might be one way to achieve this goal. On the other hand, substance use may result from the adoption of the substance use behavior

of the majority gender group, with girls in male-majority schools adopting boys' substance use behavior, as a normative effect.

Hypothesis

We hypothesized that girls in OSFs and boys in SSFs have higher levels of substance use (hypothesis 1). We then tested two competing hypotheses on the effect of OSF on substance use among girls. If the risk of substance use arising from OSF is much higher where girls are the *majority* gender group, then it is more likely that it results from competition for the attention of boys (hypothesis 2a). However, if OSF has a stronger effect on substance use where girls are the *minority* gender group, the risk of substance use arising from OSF is more likely to result from boys' normative pressure (hypothesis 2b).

Method

Study design

In 2013, the SILNE (Smoking Inequalities: Learning from Natural Experiments) study was carried out in six European cities: Tampere (Finland), Hanover (Germany), Latina (Italy), Amersfoort (The Netherlands), Coimbra (Portugal), and Namur (Belgium). In each city, six to eight schools were recruited. All students registered in the two grades corresponding to 14–16 years of age were invited to participate and to fill out a questionnaire about their health behavior and friendship ties at school. In total, 11,015 adolescents from 50 schools completed the paper-and-pencil questionnaire (79% participation rate) and we were able to include 10,932 in our analysis, after excluding respondents with too many missing values. Details of the survey design are available elsewhere (Lorant et al., 2015).

Measurements

Friendship ties

To define friendship ties, each student had to identify up to five best and closest friends from a directory of the school's students, which was handed to him or her during the survey. The list contained all adolescents from the two grades corresponding to 14–16 years of age. The wording of the question was similar to that in the Add Health survey (Harris, Halpern, & Whitset, 2009): "Could you identify the name of your best and closest friends on the list (maximum 5) and write their codes below. Boys may include girls who are friends or girlfriends; girls may include boys who are friends or boyfriends."

Gender social homophily: Same-sex and OSF

Gender social homophily is defined as having ties to friends of the same sex. The gender distribution in a school may be uneven, so that a higher proportion of SSF ties may occur just by chance. For example, girls in a school with a majority of males are more likely to be in OSFs than girls in female-majority schools. In these cases, gender social homophily status is influenced, at least partially, by the gender composition of the school. So it is important to standardize gender social homophily according to the gender composition of each school. To do this, we measured gender social homophily by the Coleman index, ranging from -1 to 1 (Bojanowsky & Corten, 2011). For each student, we counted the number of same-sex friends in his or her friendship group (max five friends) and compared it with the gender composition of a random group of five students in the same school. If a student's friendship group was more same-sex than that of a random selection in the particular school, his/her Coleman index was > 0 . On the other hand, having a Coleman index < 0 meant that he or she had more OSFs. Students who had a positive Coleman index were then classified as same-sex-friendship students, while those with a negative Coleman index were classified as other-sex-friendship students.

Substance use

Three types of substance use behavior were analyzed: regular tobacco use, binge drinking, and cannabis use; students were regarded as regular tobacco users if they smoked one or two cigarettes per week. Weekly smoking is used by the HBSC study to characterize tobacco use among the 15-year-old European population (Inchley et al., 2016; Moor et al., 2015). Binge drinkers were characterized by having drunk more than five drinks on at least two occasions in the last month (Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). Cannabis use was estimated by at least one cannabis use in the student's lifetime (Wechsler et al., 1994).

Socio-economic deprivation (SES status)

In the questionnaire, we measured the socio-economic status of students (SES) via several indicators. The first was parents' education and employment; the second was FAS (Richter et al., 2009); the third was the MacArthur Scale (Goodman, 1999). We then computed a composite indicator of deprivation that counted the number of times a student was in the lower socio-economic category on parental education and employment, FAS, and

MacArthur (Lorant et al., 2016). A student whose parents had a low educational level, were unemployed, and were in the lowest category of the FAS scale and in the lowest category of the MacArthur scale received the highest score (5). Students with highly educated and employed parents who scored high on the FAS and MacArthur scales received the lowest score (0).

Household composition

It is important to consider household composition in relation to substance use, as shown by Covey and Tam (Covey & Tam, 1990). To measure it, we computed a binomial variable with students living with both parents on the one hand and students living with one parent (mother = 21.7% of the sample, father = 3.9%) or without either of their biological parents (2.4%) on the other hand.

Gender balance of schools

To measure school gender balance, we looked at the gender composition in the two grades corresponding to ages 14–16. Schools were then classified in three groups, according to the gender distribution of their students in these grades. Gender-balanced schools had a 45 to 55% gender distribution ($n = 25$ (50% of schools)). Male-majority schools had more than 55% males ($n = 11$ (22%)) and female-majority schools had more than 55% females ($n = 14$ (28%)).

Statistical analysis

After describing the study population in terms of gender social-homophily status (Table 1), substance use, and school gender balance (Table 2), we created six different logistic regression models of substance use, according to gender and substances used (Figure 1). For each model, we looked at the gender social-homophily status and school gender balance as independent variables and controlled by the age, household composition, country, and socio-economic status of students. We finally stratified our previous models according to school gender balance and gender social-homophily status and reported the results in Table 3. All statistical analyses were performed with SAS EG 5.1.

Results

Descriptive statistics

Compared with boys, girls were slightly younger, by 0.1 years (Table 1, $\chi^2 = 39.5$; $p < 0.0001$), and more likely to have a lower socio-economic status. Gender distribution was more unbalanced in Italy (more female). Overall, girls had a significantly lower prevalence of substance use than boys. For example, one boy out of five had tried cannabis, as against one girl out of eight. The difference in prevalence for smoking, however, was very small (17.8% for girls, 19.2% for boys), but significant ($\chi^2 = 4.8$; $p = 0.03$).

The proportion of other-sex-friendship adolescents was higher among boys (21%) than among girls (13.2%),

Table 1. Descriptive statistics according to gender and gender social-homophily status, proportion, χ^2 , SILNE, 2013, $N = 10,932$.

	Gender		Ch ² /F	Gender social homophily status		
	Girls (%)	Boys (%)		Other-sex friendship (%)	Same-sex friendship (%)	Ch ² /F
Gender						120.1**
Male				21.2	78.8	
Female				13.2	86.8	
Age (mean)	15.2	15.3	39.5**	15.5	15.2	131**
City-Country			58.2**			277.7**
Namur-Belgium	51.2	48.9		19.2	80.8	
Tampere-Finland	50.2	49.8		8.5	91.5	
Hanover-Germany	51.0	49.0		15.4	84.6	
Latina-Italy	62.0	38.0		22.3	77.7	
Amersfoort-Netherlands	51.0	49.0		8.7	91.3	
Coimbra-Portugal	50.1	49.8		23.6	76.4	
Student SES (mean)	1.4	1.3	17.2*	1.6	1.3	82.7**
Household composition			2.9			9.1*
Single-parent family	54.3	45.7		18.6	81.4	
Both parents	52.3	47.7		16.2	83.7	
Coleman Index of Homophily (mean, -1 to 1)	0.7	0.6	35.3**	-0.4	0.8	21503.1**
Regular smoking (%)	17.8	19.2	4.8*	24.4	17.3	48.2**
Binge drinking (%)	15.7	23.5	101.4**	23.8	18.5	22.9**
Ever used cannabis (%)	12	19.7	117.1**	20.8	14.5	39.1**
All	52.8	47.2		16.9	83.1	

* $p < 0.05$ ** $p < 0.001$.

¹This extreme value shows a strong correlation between the continuous and bivariate measure of gender social homophily status.

Table 2. Proportions of regular smokers, binge drinkers, and cannabis users according to gender social homophily and gender balance of schools¹, SILNE, 2013, N = 10796.

	Gender-balanced schools (%) (n = 6138)	Female-majority ² schools (%) (n = 3160)	Male-majority schools (%) (n = 1498)	All (%)
Regular smoking				
Other-sex-friendship girls (n = 736)	19.8	25.0	28.9	23.6
Same-sex-friendship girls (n = 4843)	13.2	21.1	27.7	17.3
All girls	14.1	21.8	27.8	18.1
Other-sex-friendship boys (n = 1073)	19.7	24.3	26.4	22.3
Same-sex-friendship boys (n = 3993)	16.4	17.5	21.3	17.7
All boys	17.1	19.1	24.4	18.6
Binge drinking				
Other-sex-friendship girls (n = 736)	16.9	19.7	27.8	19.8
Same-sex-friendship girls (n = 4843)	14.2	16.9	21.0	15.7
All girls	14.6	17.4	22.1	16.2
Other-sex-friendship boys (n = 1073)	23.9	19.6	26.0	23.5
Same-sex-friendship boys (n = 3993)	19.6	23.3	31.6	22.6
All boys	20.6	22.1	30.0	22.8
Cannabis use				
Other-sex-friendship girls (n = 736)	14.2	15.4	21.6	15.8
Same-sex-friendship girls (n = 4843)	8.9	14.3	17.9	11.6
All girls	9.7	14.6	18.5	12.1
Other-sex-friendship boys (n = 1073)	20.4	18.8	25.0	21.2
Same-sex-friendship boys (n = 3993)	14.9	24.0	25.0	18.4
All boys	15.9	22.6	25.1	19.0

¹Results have been controlled by age; all chi² tests were significant at $p < 0.0001$ levels.

²"Female-majority", "Male-majority" and "gender-balanced" are used as defined in this article, p. 3, Measurements, section 6 "Gender balance of schools".

chi² = 120.1; $p < 0.0001$), higher in older than in younger students, higher in adolescents living in single-parent homes, and higher in adolescents of a lower socio-economic background (Table 1). The proportion of OSF ties was also different across countries (chi² = 277.7; $p < 0.0001$), with the lowest proportion in Finland

(Tampere) (8.5%) and the highest in Portugal (Coimbra) (23.6%). Compared with same-sex-friendship adolescents, other-sex-friendship adolescents were more frequently regular smokers (24.4% as against 17.3%, chi² = 48.2; $p < 0.0001$), binge drinkers (23.8% as against 18.5%, chi² = 22.9; $p < 0.0001$),

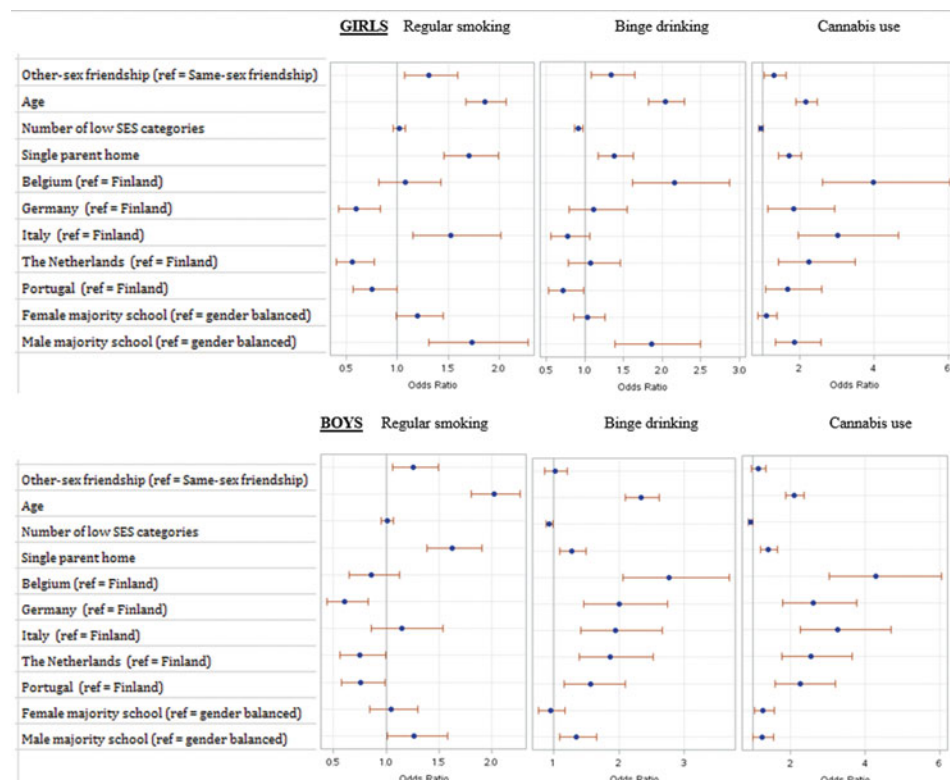
**Figure 1.** Odds ratios and 95% confidence intervals of substance use according to gender social-homophily status. SILNE, 2013, N = 10,932.

Table 3. Stratification analysis of gender social-homophily status and school gender balance among girls and boys for each substance use¹, Odds ratio and 95%IC, SILNE, 2013, N = 10932.

	Regular smoking		Binge drinking		Cannabis use	
	OR	95%IC	OR	95%IC	OR	95%IC
GIRLS						
Female-majority ² school (ref = gender-balanced) in OSF	0.9	(0.6–1.3)	1.1	(0.7–1.7)	0.7	(0.4–1.2)
Female-majority school (ref = gender-balanced) in SSF	1.3*	(1.0–1.5)	1.0	(0.8–1.3)	1.2	(0.9–1.5)
Male-majority school (ref = gender-balanced) in OSF	1.1	(0.6–2.0)	2.3*	(1.2–4.2)	1.4	(0.7–2.7)
Male-majority school (ref = gender-balanced) in SSF	1.9*	(1.4–2.5)	1.8*	(1.3–2.4)	1.9*	(1.4–2.8)
BOYS						
Female-majority school (ref = gender-balanced) in OSF	1.3	(0.9–1.9)	0.7	(0.5–1.1)	0.7	(0.5–1.1)
Female-majority school (ref = gender-balanced) in SSF	1.0	(0.8–1.2)	1.0	(0.8–1.3)	1.5*	(1.2–1.9)
Male-majority school (ref = gender-balanced) in OSF	1.2	(0.8–1.8)	0.9	(0.6–1.2)	0.9	(0.6–1.3)
Male-majority school (ref = gender-balanced) in SSF	1.3*	(1.0–1.6)	1.5*	(1.2–1.9)	1.4*	(1.1–1.8)

¹Results have been controlled by age, socio-economic status, country, and household composition.

* $p < 0.05$.

²"Female-majority", "Male-majority" and "gender-balanced" are used as defined in this article, p. 3, Measurements, section 6 "Gender balance of schools".

and cannabis users (20.8% as against 14.5%, $\chi^2 = 39.1$; $p < 0.0001$).

Table 2 describes substance use according to school gender balance, OSF, and gender. Regardless of the school gender balance, OSF was associated with more frequent smoking, binge drinking, and cannabis use among girls and boys. Substance use was consistently more frequent in male-majority schools and less frequent in gender-balanced schools. Among girls, the group with the lowest smoking prevalence was made up of same-sex-friendship girls in gender-balanced schools, whereas the girls with the highest risk were other-sex-friendship girls in male-majority schools. Among boys, smoking rates were highest among other-sex-friendship boys, in all types of school. Nevertheless, as far as cannabis and binge drinking were concerned, risks depended on the gender balance of the school. In gender-balanced schools, other-sex-friendship boys had higher levels of use than same-sex-friendship boys. However, in both male- and female-majority schools, same-sex-friendship boys reported more binge drinking and cannabis use than other-sex-friendship boys.

Multivariate analysis

Figure 1 shows odds ratios and 95% confidence intervals of substance use according to gender social-homophily status.

Regular smoking

OSF was associated with more frequent regular smoking in both boys and girls, even after controlling for confounders (OR = 1.31 (95%IC 1.07–1.59) for girls; OR = 1.34 (95%IC 1.09–1.65) for boys). Male-majority schools were associated with a greater risk of regular smoking, particularly among girls.

Binge drinking

OSF was associated with more binge drinking among girls. Boys and girls in male-majority schools were also more frequently binge drinkers (OR = 1.86 (95%IC 1.38–2.49) for girls; OR = 1.34 (95%IC 1.09–1.65) for boys).

Cannabis use

Patterns were similar to those for binge drinking. Among girls, OSF correlated with cannabis use, but not among boys. Male-majority schools were also associated with more cannabis use among both girls and boys (OR = 1.31 (95%IC 1.04–2.64) for girls; OR = 1.13 (95%IC 0.95–1.35) for boys), but boys were also at greater risk in female-majority schools.

Table 3 presents odds ratios for the stratification analysis according to gender, other-sex-friendship status, and school gender balance. Girls were more likely to use substances in a male-majority context, whatever their gender social-homophily status. Boys used more cannabis and binge drank more frequently in male-majority schools, especially same-sex-friendship boys.

Discussion

Adolescents' social ties matter for their health behavior and gender becomes an increasingly important component of those social ties as they get older (Mehta & Strough, 2009). Our study is among the first to investigate the role of gender social homophily in substance use, using an international social network survey capable of separating the effect of school composition from the effect of friendship composition.

This article hypothesized that other-sex-friendship girls and same-sex-friendship boys were more likely to engage in substance use (hypothesis 1). This hypothesis

was found to be true for girls, but not for regular smoking among boys, which was more frequent among other-sex-friendship boys. Our study thus revealed different patterns according to student gender and the substance used. As far as binge drinking and cannabis use were concerned, other-sex-friendship girls and same-sex-friendship boys were more at risk. However, OSF was associated with tobacco use for both genders.

Tobacco use among other-sex-friendship students

There are two possible ways of explaining these associations between substance use and OSF (Mcdougall & Hymel, 2007; Park, Behrman, & Choi, 2013; Poulin et al., 2011).

First, tobacco use may cause OSF (explanation 1a). As they smoke, students may group together, independently of gender, using tobacco to support an interaction that contributes to group dynamic construction. For example, new friendships may occur when students meet outside school doors or in other public places to smoke.

Alternatively, OSF may cause smoking (explanation 1b). In this case, other-sex-friendship students would have particular group dynamics and interactions that contribute to risky behavior (Furman & Collins, 2009). For example, in other-sex-friendship peer groups, adolescents may ask for a cigarette in order to engage in conversation with someone they find attractive. As Connolly et al. (2004) observed contacts with the other gender help one to meet potential romantic partners. Consequently, adolescents may adopt risky behavior in order to attract a peer they want to be noticed by (Park et al., 2013; Poulin et al., 2011).

Alcohol and cannabis use

The two explanations (1a and 1b) mentioned above of the association of OSF and tobacco use may also apply to other substances as far as girls are concerned. A study by Mullen (2009), for example, found that drinking alcohol was a way for girls to “boost their own confidence” and “make a move on a guy” (Mullen et al., 2009). In this study, drinking was mentioned as a tool in girls’ romantic processes: it allowed them to become more emotional and thus reveal their feelings to the person they were attracted to.

Among boys, however, the situation was different: our results indicate that SSF was associated with binge drinking and cannabis use, which matches the part of our first hypothesis (hypothesis 1) that refers to boys. As mentioned earlier, boys have traditionally been greater users of all kinds of substances. But, unlike tobacco smoking, of which there are now similar levels of use by both genders,

binge drinking and cannabis use are still more frequent among boys (HBSC study, (Inchley et al., 2016)). This may be because these behaviors are still associated with male identity. In a recent study, Mahalik et al. (2015) reported that boys with the highest score on a male-identity scale were 70% more frequent users of alcohol and 79% more frequent cannabis users than boys who scored lowest on that scale.

Contextual influences: School gender balance

Our study also hypothesized that school gender composition matters (hypothesis 2). There was indeed a greater risk of substance use, both for boys and girls, in male-majority schools. However, no clear pattern emerged from female-majority schools.

Our results indicated a significant association between substance use and the gender balance of schools, which has not been explored elsewhere. In the literature, however, the gender balance of schools is associated with different outcomes. For example, Choi, Park and Berhman (2015) showed that same-sex schools have higher Body Mass Index levels than schools with students of both genders. Sullivan, Joshi, and Leonard (2010a) have shown that girls in same-sex schools perform better in school than those in co-educational schools. Park et al. (2013), after a random assignment of schools, also identified better entrance exam results and college attendance among students from same-sex schools.

All regression models showed a positive effect of male-majority schools on substance use. These school contexts are thus associated with substance use, which would help make a case for more balanced gender co-education in order to limit substance use among adolescents. In the introduction, we raised two different hypotheses that may explain the influence of gender-unbalanced schools on girls’ substance use: the competition hypothesis (hypothesis 2a), in which the minority gender group in OSFs will be keener to use substances; and the normative hypothesis (hypothesis 2b), in which substance use behavior will follow the trend of the majority group.

On the assumption that substance use helps students to seduce other-sex peers (Kreager & Haynie, 2011), gender-unbalanced schools would be a particularly competitive environment. For instance, other-sex-friendship girls in predominantly female schools would be particularly engaged in substance use, in order to seduce one of the few boys in the school. However, our stratification analysis did not corroborate this assumption. Indeed, whatever the model, no gender majority group (e.g. other-sex-friendship girls in female-majority schools) was particularly at risk of substance use. On the contrary, predominantly male schools, but not predominantly

female schools, were places where substance use was significantly more frequent.

This rather pleads in favor of our second hypothesis (hypothesis 2b): the role of norms: where males are outnumbered, their traditional attitudes to substance use influence both boys and girls. As far as boys are concerned, we have known for a long time that risky behaviors are key elements in the process of manhood identification (Shaw & Moore, 1931). In France, Sauvadet (2006) and Aquatias (1999) have collected qualitative data on young male adolescents living in a poor suburban area. They both point out the important role of health risk behavior, such as cannabis use, in that male environment. Girls in predominantly male schools may thus be influenced by this norm. Iwamoto and Smiler (2013) found a positive effect of male norm identification on girls' alcohol use. Indeed, according to tokenism theory, in male-dominant environments, girls are pushed toward male norms.

Limitations

Our study is cross-sectional: this makes it difficult to ascertain causality or to discard confounding factors. Longitudinal social network surveys may help to disentangle the different hypotheses mentioned above.

Another limitation is that we did not request information on age of puberty, which is known to mediate the relation between OSF and substance use among girls, in that girls who experience early puberty have more other-sex friends and are more likely to engage in substance use (Poulin et al., 2011; Sullivan et al., 2010a, b).

We did not ask about friendship outside school; we may thus have underestimated OSF, especially for girls, who have more other-sex friends outside school than boys (Poulin et al., 2011).

An additional limitation is that the gender balance of schools was not measured within the whole school, but only within the two participating grades. The overall gender balance of schools may, accordingly, differ slightly from the balance we present. However, we could reasonably expect that students would be more influenced by their own age and grade contexts than by the whole school (Shrum, Cheek, & Hunter, 1988).

Finally, we should mention that predominantly male schools may have other characteristics that may lead to more substance use, such as a lower socio-economic background. Male-majority schools have a traditional orientation toward vocational education and are thus attended to a significantly greater extent by students with a low socio-economic status (Rathmann, 2016). Nevertheless, this particular pattern of male-majority schools persisted even after controlling for students' socio-economic status.

Conclusion

In this article, our contribution to the literature lies in the addition of a new dimension to the relationship between peer gender and substance use: our conclusions underline the role of gender balance at school. Adolescent girls are best protected from substance use if they are in gender-balanced schools, but in SSF.

This implies a need to adapt substance-use prevention programs to gender, peer gender, and the gender balance of schools, as this gender context influences school norms in relation to substance use. Mixing boys and girls at school seems to have particularly affected girls in a predominantly male context, which may lead to the future deterioration of those girls' health status. As far as prevention is concerned, in those schools, we suggest having resort to substance use strategies that particularly focus on deconstructing the male norm in relation to substance use. More particularly, prevention programs might be aimed at girls in OSFs and should help to prevent boys' behavior from influencing them in relation to substance.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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Contribution of authors

AG: conceived the study, performed the statistical analysis, and coordinated and drafted the manuscript. AK: participated in the design of the study and helped to draft the manuscript. MK: participated in the design of the study and helped to draft the manuscript. MR: participated in the design of the study and helped to draft the manuscript. AR: participated in the design of the study and helped to draft the manuscript. BF: participated in the design of the study and helped to draft the manuscript. VL: conceived the study, participated in its design and coordination, and helped to draft the manuscript. All authors have read and approved the final manuscript.

Ethical approval

"All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards".

Informed consent: "Informed consent was obtained from all individual participants included in the study."

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