

Social gradient in intermediary determinants of oral health at school level in Finland

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Objective: An adapted framework for oral health inequalities suggests that structural determinants cause oral health inequalities through socio-economic position (SEP) and intermediary determinants. We applied this framework to examine whether there is a social gradient in the intermediary determinants at the school level, even when adjusted for school size, geographical location and teaching language. **Basic research design:** Cross-sectional survey. **Methods:** This study combined data from two independent studies focusing on Finnish upper comprehensive schools (N=970): the School Health Promotion study (SHPS) and the School Sweet Selling survey (SSSS). All schools that took part in the SSSS and whose pupils answered the SHPS were included in the analysis (n=360, response rate=37%). From the questions of the SHPS and the SSSS suitable for the theoretical framework, attitudes and access to intoxicants, school health services, school environment, home environment, the school's oral health-related actions and the pupil's own behaviour were selected as the intermediary determinants and as the factors determining the school-level SEP. The social gradient in the intermediary determinants of oral health was investigated with Pearson's and Spearman's correlation coefficients between those and the school-level SEP. In the multivariable analysis, the General Linear Model with manual backward elimination was used. **Results:** A social gradient was observed in the intermediary determinants 'home environment' and 'the pupils' tooth brushing frequency' and an inverse social gradient in 'attitudes and access to intoxicants' and 'school health services'. **Conclusions:** Social gradient between schools could increase Finnish adolescents' oral health inequalities.

Key words: Diet, Health promotion, Inequalities, Oral health behaviour, Schools, Socio-economic factors

Introduction

Oral diseases are still a global problem and oral health inequalities can be seen within and across countries (Petersen and Kwan, 2011). Unfavourable health behaviours such as poor diet, hygiene and smoking strongly relate to some of the most common oral diseases: dental caries, periodontitis and oral cancer (Baelum, 2011). Instead of the traditional, victim-blaming preventive care and lifestyle approach, upstream actions such as legislative measures and healthy public policies are needed to achieve more sustainable changes in oral health, as well as to reduce inequalities (Watt, 2007). Downstream actions have not succeeded in reducing health inequalities, and may even increase them (Watt *et al.*, 2015). Upstream actions can address the causes behind inequalities, i.e. the social determinants that affect health and oral health. Of our daily environments, schools are important places where a healthy choice should be an easy choice (Watt and Sheiham, 2012).

Schools are great places to promote oral health: at the global level, 80% of children attend primary schools in influential stages of their lives for adopting sustainable oral health-promoting habits (World Health Organization, 2003). The school environment should be healthy: with no smoking or selling of sweet products, and food of good nutritious value. In addition, schools should also educate pupils on oral health and on the health services available to them (World Health Organization, 2003).

Schools have been a very popular target for interventions in the field of general and oral health promotion (Weichselbaum *et al.*, 2011).

In Finland, closing the gap in health inequalities has been included in public health policies for several years (Melkas, 2013). Despite multiple efforts to reduce inequalities in health and income, Finnish national public health programmes have not been successful in reducing them (Palosuo and Sihto, 2016). Absolute inequalities have decreased in most European countries, except Finland and Norway (Mackenbach *et al.*, 2016). The school system in Finland has elements that could narrow social and health inequalities: they are publicly funded with compulsory education for 6–17-year-olds, and offer a healthy hot meal during the school day free of charge (Kankaanpää, 2014). In most cases, it is not possible to choose between upper secondary schools, and pupils attend the school determined to their area of residence, thus leading to a more heterogeneous social intake (Karvonen *et al.*, 2001). Finnish schools have decreased the sale sweet products (Anttila *et al.*, 2015). However, there are still differences in schools' oral health-promoting actions according to the district and the number of pupils (Kankaanpää, 2014). In addition, morbidity in Finland is distributed unevenly, being higher in Eastern and Northern than in Western and Southern Finland (THL, 2016). The Swedish-speaking minority is healthier than the Finnish-speaking majority (Suominen, 2014).

The WHO social determinants framework combines structural and intermediary determinants of health inequalities leading to health or ill-health (Solar and Irwin, 2010). Structural determinants include governance, macroeconomics and social/welfare policies, whereas intermediary determinants include material and social circumstances, behaviours and biological factors, psychosocial factors and health services. Unequal distribution of intermediary determinants is associated with different amounts of exposure to health-compromising conditions, generating health inequalities (Solar and Irwin, 2010). According to the framework for oral health inequalities (Watt and Sheiham, 2012) adapted here, structural determinants cause oral health inequalities through the socio-economic position and intermediary determinants.

In this study, we applied this theoretical framework to oral health inequalities. The aim was to study whether there is a social gradient in the intermediary determinants of oral health in Finnish upper comprehensive schools, when also taking into account the national district, school size and teaching language.

Method

This study combined data from two independent studies focusing on Finnish upper comprehensive schools (N=970). The first dataset was secondary analysed and the second was collected by the present research team. The first dataset on pupils' perceived daily environment and oral health-related behaviours was collected as part of the School Health Promotion study (SHPS), which has been implemented every two years (for half of the schools every year) among all eight and ninth grade pupils (i.e. children aged 14–15 and 15–16 years old, respectively) in Finland since 1996. The study was implemented in Southern, Eastern and Northern Finland in spring 2006 and 2008, and in Western and Central

Finland in spring 2007 and 2009. The questions concerning pupils' perceived daily environment and oral health-related behaviours were part of a larger questionnaire, which included over a hundred questions on how the pupils felt about their living conditions, school conditions, health, health-related behaviour and school health services. School-level means were determined on the basis of the pupils' answers.

Of the questions of the School Health Promotion study, we selected those that were applicable to the present theoretical framework, i.e. 29 questions in total. Instead of individual responses, only school-level means were available. If a question included multiple items (a, b, c,...k), the overall mean for the question was calculated from the item means. Since, traditionally, there are no social class divisions in Finland (Karvonen *et al.*, 2001), five questions were chosen to describe the school-level socio-economic position (SEP). The questions covered parental unemployment or lay-off (range 1–3), family structure (range 1–7), highest education level the mother and the father have achieved (range 1–4) and the amount of spending money available to the pupil per week (range 1–6). The mean value was calculated to describe the school-level SEP; the lower the value, the better was the school-level SEP.

Explorative factor analysis (EFA) with varimax rotation was used for the remaining 24 questions to form the intermediary determinants of oral health inequalities. The EFA revealed the following four factors: attitudes and access to intoxicants (F1), school health services (F2), school environment (F3) and home environment (F4) (Table 1, Figure 1). 'Attitudes and access to intoxicants' describes the attitudes towards intoxicant use and the availability of intoxicants. It includes questions such as is smoking allowed at the school, how closely possible restrictions are monitored and how easy it is to get alcohol or drugs in the pupil's area of residence. 'School health services'

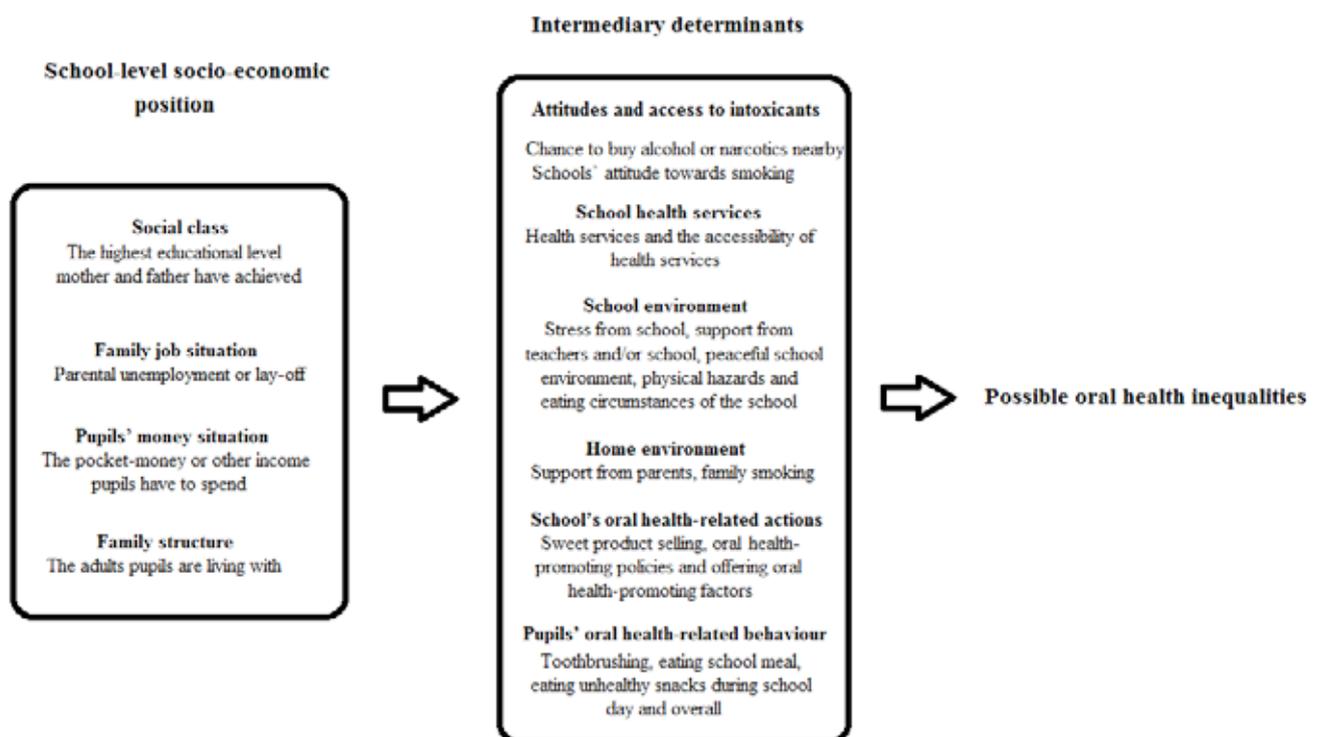


Figure 1. The variables applied to the framework for oral health inequalities

includes questions such as how easy it is to get help if needed from a school nurse, physician, social worker or psychologist and how easy it is to get an appointment. ‘School environment’ describes how burdening the pupil feels going to school and whether the school environment is supportive and safe. It includes questions such as does the pupil feel stress from school work, does the pupil receive support and help from teachers, is the classroom discipline good, are there any factors that can disturb the school work (e.g. hurry, crowded teaching spaces, noise, inappropriate lighting, bad indoor air, temperature, dirt) and what is the mealtime environment like. ‘Home environment’ describes the level of support and the atmosphere at home. It includes questions such as if the pupil has difficulties at school, do they get help at home, does the family have family dinners, do the pupil’s parents know most of their friends, do the parents know where the pupil spends weekend nights and do the parents talk about things the pupil is concerned about. These factors explained 67.73% of the common variance. We calculated the factor scores as mean values of the items in each factor; the lower the mean, the better the pupil’s perceived daily environment.

Of the oral health-related behaviours in the School Health Promotion study, we chose four questions as the intermediary determinants of oral health tooth brushing frequency (how often does the pupil brush their teeth), eating the school meal (which parts of the school meal does the pupil eat), eating unhealthy items (such as sweets or sugar-sweetened beverages) at school outside the school canteen (and apart from the school meal), and eating unhealthy items (such as sweets or sugar-sweetened beverages) overall during the last seven days.

The second dataset, the School Sweet Selling survey (SSSS), was collected from an online questionnaire sent by email to every Finnish upper comprehensive school. The questionnaire included 32 questions and answering took approximately 15 minutes. The school principal or other school personnel answered the questionnaire. In a previous study, three sum variables, exposure, enabling and policy, were formed of the nine items in the questionnaire by weighting the response categories (Anttila *et al.*, 2015). *Exposure* (range 0–10 points) included the actions that put the pupils’ oral health at risk (what kinds of sweet products are sold and where). *Enabling* (range 0–10 points) included the actions that protected the pupils’ oral health (are healthy products sold, does the school provide fresh drinking water or xylitol products during the school day). *Policy* (range 0–12 points) included the decisions behind the actions

(are pupils allowed to leave the schoolyard, does the school have guidelines concerning sweet products, who are the policy decision makers). The lower the score, the better was the school’s level of oral health promotion. These variables were applied to the present theoretical framework as intermediary determinants to describe the schools’ oral health-related actions (Figure 1).

Due to the different data collection periods, we produced a combined data set. For this combined data, we chose the schools whose pupils had answered the questionnaire both in 2006 or 2007 and in 2008 or 2009 and whose staff had completed the questionnaire in 2007 and in 2008 or 2009 (n=360) (Figure 2). In this study, we evaluate only the baseline data cross-sectionally.

The social gradient in the intermediary determinants of oral health was investigated with Pearson’s or Spearman’s correlation coefficients between those and the school-level SEP. In addition, correlations between different intermediary determinants were evaluated. Differences in the school-level SEP according to background variables (the school’s geographical location, school size and teaching language of the school) were analysed using one-way ANOVA to see if these background variables should be included in the multivariable analysis. For the multivariable analysis, the General Linear Model (GLM) was used to determine the independent contribution of each intermediary determinant to the school-level SEP, when controlling for background variables. The dependent variable was the school-level SEP and the independent variables were all the intermediary determinants of oral health: factors F1–F4, the school’s oral health-promoting actions (the exposure, enabling and policy variables) and the pupils’ oral health-related actions (tooth brushing, eating the school meal, eating unhealthy snacks at school and eating unhealthy snacks overall). The confounding factors were the school’s geographical location, school size and teaching language. The model was conducted with manual backward elimination: those independent variables for which $p \geq 0.05$ were excluded from the model to get a parsimonious fitting model. For the final model, beta and Partial Eta Squared coefficients were reported. Since all the variables were coded in the same direction (the lower, the better), a positive beta coefficient indicates a positive association. Partial Eta Squared is a measure of effect size and describes the proportion of variance in the dependent variable explained by that independent variable.

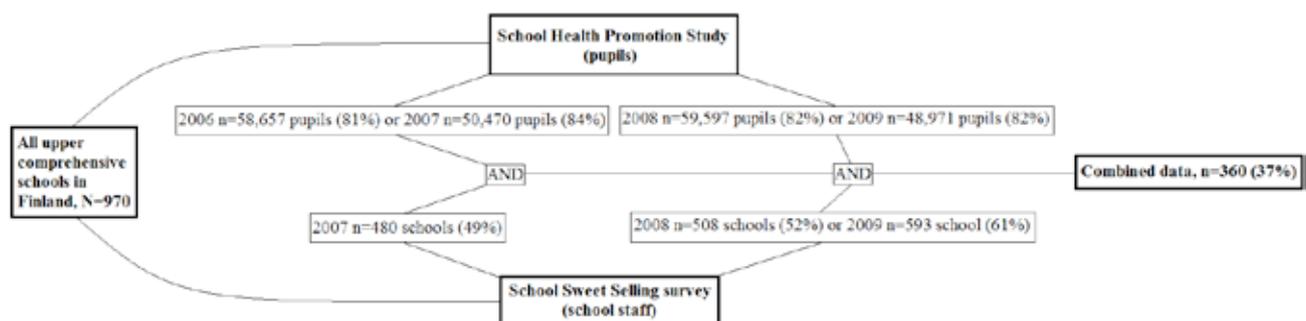


Figure 2. The datasets, the number of respondents and response rates

Results

A social gradient was observed in several intermediary determinants. The school-level SEP was strongly and negatively correlated with attitudes and access to intoxicants (Table 1). It was positively correlated with pupils' tooth brushing frequency and negatively correlated with exposure to sweet products at school and eating the school meal and unhealthy snacks during the school day (Table 2).

There were several correlations between the intermediary determinants. There was a strong positive correlation between the pupils' perceived school and home environments (Table 1). In addition, the pupils' perception about attitudes and access to intoxicants and the school health services correlated strongly and positively with pupils' perceived school and home environment. There was a slight negative correlation between the pupils' perception about the attitudes and access to intoxicants and the school health services. The school's oral health-promoting actions were correlated with the pupils' perception about attitudes and access to intoxicants and the school health services, as well as with the pupils' oral health-related behaviour (Tables 1 and 2). Most often, the exposure to sweet products at schools correlated with other intermediary determinants. School policies on sweet products were positively correlated with pupils' unhealthy snacking during the school day. Pupils' oral health-related behaviour correlated with all the other intermediary determinants (Table 2).

A social gradient was also observed in all the background variables. The school-level socio-economic position (SEP) differed according to the school's geographical location (from the highest to the lowest): Southern Finland, Western Finland, the Oulu Region, Eastern Finland and Lapland (2.16, 2.23, 2.32, 2.34 and 2.36, respectively). School-level SEP also differed according to school size (from the highest to the lowest): large (<500 pupils), medium-large (300–499 pupils), medium-sized (100–299 pupils) and small (<99 pupils) schools (2.16, 2.19, 2.29 and 2.37, respectively). School-level SEP was 2.24 and 2.05 when the language was Finnish and Swedish, respectively. All the differences were statistically significant ($p < 0.001$).

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Table 1. Factor structure, loadings and mean values (SD) of pupils' perceived daily environment and school-level SEP, and correlations between school-level SEP and school oral-health-promoting actions.

	Loadings	Mean	SD	Min	Max	Correlation			
						$r_{\text{Pearson SEP}}$	$r_{\text{Spearman Policy}}$	$r_{\text{Spearman Exposure}}$	$r_{\text{Spearman Enabling}}$
F1: Attitudes and access to intoxicants (32.05%)		1.90	0.16	1.41	2.36	-0.60	0.02	0.27	-0.10
Chance to buy alcohol nearby	0.81	2.42	0.26	1.44	3.05	-0.61	-0.03	0.28	-0.14
Chance to buy drugs nearby	0.77	1.51	0.16	1.14	2.00	-0.45	-0.01	0.26	-0.07
School's attitude towards smoking	0.35	1.78	0.21	1.42	2.48	-0.31	0.10	0.14	-0.04
F2: School health services (18.40%)		2.32	0.19	1.95	3.55	0.08	-0.08	-0.23	0.07
Health services of the school	0.96	2.38	0.20	1.91	3.90	0.01	-0.08	-0.21	0.07
Access to school health services	0.79	2.25	0.21	1.70	3.20	0.14	-0.07	-0.21	0.08
F3: School environment (9.14%)		2.05	0.08	1.78	2.28	-0.10	-0.11	0.05	-0.09
Physical hazards of the school	0.69	2.11	0.15	1.72	2.54	-0.13	-0.04	0.07	-0.04
Peaceful school environment	0.68	2.31	0.13	1.76	2.92	-0.14	-0.10	0.15	-0.12
Support from teachers and/or schools	0.43	2.47	0.09	1.96	2.77	0.09	-0.13	-0.09	-0.06
Stress from school	0.42	2.01	0.10	1.69	2.49	0.08	-0.12	-0.08	-0.06
Eating circumstances in school	0.39	1.35	0.09	1.06	1.70	-0.21	0.01	0.12	-0.03
F4: Home environment (8.14%)		1.59	0.07	1.40	2.20	0.10	-0.08	0.06	-0.02
Parental support	0.81	1.78	0.08	1.36	2.35	-0.10	-0.08	0.05	-0.02
Family smoking	0.45	1.40	0.07	1.19	1.97	0.30	-0.06	0.03	0.01
School-level SEP	N/A	2.23	0.17	1.70	2.68		0.04	-0.22	0.14

Correlations between factors: F1 ↔ F2: $r = -0.06$; F1 ↔ F3: $r = 0.38$; F1 ↔ F4: $r = 0.35$; F2 ↔ F3: $r = 0.27$; F2 ↔ F4: $r = 0.27$; F3 ↔ F4: $r = 0.49$ (all other p -values < 0.001 except for F1 ↔ F2 $p = 0.299$)

Bold figures are statistically significant ($p < 0.05$).

Table 2. Correlation matrix of pupils' reported oral health-related behaviour, school-level SEP and other intermediary determinants.

	Tooth brushing frequency	Eating school meal	Unhealthy snacking at school	Unhealthy snacking overall
School-level SEP	0.47	-0.31	-0.24	-0.06
F1: Attitudes and access to intoxicants	-0.36	0.49	0.33	0.20
F2: School health services	0.19	-0.03	-0.07	0.02
F3: School environment	0.03	0.34	0.18	0.32
F4: Home environment	0.11	0.35	0.11	0.27
Policy	0	-0.04	0.28	0.08
Exposure	-0.13	0.21	0.19	0.12
Enabling	0.11	-0.09	-0.03	-0.02

Bold figures are significant ($p < 0.05$)

The multivariable General Linear Model revealed that there is a social gradient in pupils' perceptions of attitudes and access to intoxicants, school health services and home environment and in the pupils' tooth brushing frequency, when adjusted for the school's geographical location, size and teaching language (Table 3). The higher the school-level SEP, the worse were the attitudes and access to intoxicants and the school health services and the better the home environment and the pupils' tooth brushing frequency. 'Attitudes and access to intoxicants' had the strongest and 'home environment' had the second strongest association with the school-level SEP, explaining 24% and 10% of the variance respectively. Overall, the model explained 55% of the variance in the school-level SEP.

Table 3. Contribution of attitudes and access to intoxicants, school health services, home environment and tooth brushing frequency to school-level socio-economic position (General Linear Model).

	Beta	Partial Eta Squared	<i>p</i>
F1: Attitudes and access to intoxicants	-0.531	0.242	<0.001
F2: School health services	-0.091	0.020	0.008
F4: Home environment	0.689	0.102	<0.001
Tooth brushing frequency	0.169	0.069	<0.001

$R^2=0.551$.

The model is adjusted for the school's geographical location, school size and teaching language of the school.

Discussion

There is a social gradient in the following intermediary determinants of oral health in Finnish upper comprehensive schools: the home environment and the pupils' tooth brushing frequency. There is also an inverse social gradient in the intermediary determinants of 'attitudes and access to intoxicants' and 'school health services', meaning that the better the school-level SEP is, the worse are the attitudes and access to intoxicants and the school health services. As far as we know, this is the first study to support the theoretical framework of oral health inequalities by Watt and Sheiham, showing that there is a social gradient in the intermediary determinants of oral health at the school level.

The strength of the study lies in the two independent datasets. The pupils answered the first questionnaire, and the school principal or personnel answered the second, independently of each other. Therefore, the combined data make the study more valid at the school level. Another strength is that the School Health Promotion study is traditional and respected among upper comprehensive schools in Finland, leading to an excellent response rate every year. Even though the total response rate was quite small, there is plenty of variation within schools. One weakness was that the first dataset included only school-level means. On the other hand, public schools in Finland are relatively homogenous, which means that differences between schools are relatively small compared to examining individuals. Furthermore, the questionnaires' self-report nature could lead to potential bias. The

cross-sectional design meant we could not study causalities. In both datasets, the geographical distribution of the responding schools was similar to the geographical distribution of all the schools in Finland. The study population can be considered to be representative enough for the results to be generalised to all Finnish upper level comprehensive schools.

Another limitation was that the first dataset used data from the School Health Promotion study. We could not include the questions we wanted to in that study but could only use those already available to form the school-level SEP and the factors describing the intermediary determinants of oral health inequalities. In addition to the strongest key marker of socio-economic position, parental education, we felt it appropriate to include income-related measures to describe the school-level SEP, as it has been established that social class is no longer a strong predictor for health behaviour (Karvonen *et al.*, 2001). Income-related measures, such as parental lay-off, family structure (one-parent families often have less money available for their children) and the amount of pocket-money, could describe the possibilities these adolescents have and are supposed to reinforce the measurement of the school-level SEP than when only measuring parental education. Even though factor analysis is a data driven approach, it was chosen to diminish the number of variables in the study and to find sets of variables (factors) that measure intermediary determinants of oral health and which form a logical, conceptual entity.

Because of the proportionally equal school system in Finland, we did not expect to find clear social gradients at school level. However, we found social gradients in two and inverse gradients in two intermediary determinants of oral health, even after adjusting for background variables. The socio-economic position is highest in Southern schools, in large schools and in those whose teaching language is Swedish. The geographical gradient in the school-level SEP is similar to the morbidity related to people's place of residence (THL, 2016). It seems that the social gradient in Finland extends through the course of life from early years to the very end, depending on where people live.

It is interesting that the pupils' perception of attitudes and access to intoxicants and to the home environment are positively associated (Table 1), but more strict attitudes and access to intoxicants contribute negatively and a better home environment contributes positively to the school-level socio-economic position (Tables 1 and 3). A study of sixth to 12th grade US students showed that sharing a family dinner protected adolescents from high-risk behaviour (such as substance use, depression, violence and binge eating), and remained significant even after demographics and family factors were adjusted (Fulkerson *et al.*, 2006). These studies at the individual level support our school level findings that the home environment and attitudes and access to intoxicants are positively associated.

Adolescents from higher socio-economic position families have more pocket money available to spend, which they could use on products that are not good for their health. In Southern California, eighth grade students with more pocket money were at increased risk of smoking (Unger *et al.*, 2007). In our study, one question forming the school-level SEP indicated how much pocket money the pupils received per week. The school-level SEP was also negatively associated with the pupils' perception of attitudes and access to intoxicants, which was determined with three questions

about opportunities to buy alcohol or drugs nearby and the school's attitude towards smoking. In certain school areas, pupils have more money to spend and could use it to buy alcohol products or drugs, potentially leading to a negative association between the school-level SEP and the attitudes and access to intoxicants. At the individual level, and also in Scandinavia, this was demonstrated in ninth graders from Stockholm: there was a higher risk of alcohol and drug use in more advantaged school settings (Olsson and Fritzell, 2015).

In the US, a better home environment manifested by parental support decreased students' alcohol use, especially in private schools where students are from richer backgrounds (Andrade, 2013). It seems that at the high school level, SEP could be associated with pupils' alcohol or drug use but, at the same time, a better home environment could protect against high-risk behaviour. A UK longitudinal birth cohort showed that alcohol drinking was more common among adolescents from high-income households but less common with higher levels of maternal education (Melotti *et al.*, 2011). The pupils' school-level mean concerning the tooth brushing frequency was also associated with the home environment, and tooth brushing also explained part of the school-level socio-economic position (Tables 2 and 3). At the individual level, high family affluence and a higher socio-economic position are both associated with better odds for twice-a-day tooth brushing (Levin and Currie, 2010).

Conclusions

The framework for oral health inequalities was applicable to the school context, at least in Finland. The social gradient in the intermediary determinants of oral health at the school level suggests that Finnish upper comprehensive schools have elements that could increase inequalities in Finnish adolescents' oral health, despite Finland being a society providing free, tax-funded equal education to all. More studies are needed to increase our knowledge of which upstream actions enhance pupils' everyday environment and reduce the social gradient in schools' intermediary determinants of oral health.

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