Adolescent alcohol use
The role of family, school, community and country

PhD thesis
Pernille Bendtsen
2013
Adolescent alcohol use
The role of family, school, community and country
Preface

The thesis aims to investigate the role of the social context in adolescent alcohol use. My curiosity was guided by the wish to understand why Danish youth have such a high prevalence of drunkenness and furthermore to analyse factors associated with drunkenness. My research was guided by an epidemiological approach, which is reflected in the aims, analyses and results of this thesis. To fully understand the complexity of adolescent alcohol use, I believe that perspectives other than the epidemiological are needed. Therefore, I have tried to integrate a sociological approach in the epidemiological studies. My sociological background has contributed to the understanding of social processes connected with adolescent alcohol use. The academic work of this thesis is based on research carried out from 2009 to 2013 at the National Institute of Public Health.

First and foremost, I wish to thank my supervisors Mogens T. Damsgaard, Janne S. Tolstrup and Bjørn E. Holstein. Mogens—thanks for your amazing methodological and theoretical support. I am grateful for all our interesting discussions; they all taught me a lot. Thanks for sharing your expertise, thoughts and advices with me during the years. Janne— you were the one that introduced me to the epidemiological field when I was still a student, and I am thankful for this. Bjørn— you have been my mentor in this field. Thanks for your encouragement, your continuous faith in me, your always open door, and for reading numerous drafts, texts and e-mails.

I would also like to thank Pernille Due for letting me join the HBSC group and for letting me use the data. Additional thanks to all my co-authors; Annette K. Ersbøll deserves special thanks for her inspiration and statistical guidance.

My time as a PhD-student has been a great time. I have had the pleasure to get to know great colleagues at the Department of Social Medicine at Copenhagen University, the National Institute of Public Health at the University of Southern Denmark, and the Centre for Health and Outcomes Research and Evaluation at Massey University in Auckland. I would like to thank each and every colleague at the National Institute of Public Health for creating such a good and inspiring working environment. Also a special thanks to Mathilde and Line for constructive feedback – and to Camilla, Lotus and Katrine for being such good “office mates” and for sharing good times, laughs and coffee with me.

Finally, I wish to thank my family for their love, support, and patience – A special thanks to Tobias for being the best man I could ever wish for. I am looking forward to spending my time with you again.

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Pernille Bendtsen
Copenhagen, July 2013
LIST OF PAPERS

The thesis is based on four studies, of which will be referred to in the text by the following Roman numerals:


Study II: Bendtsen P, Damsgaard MT, Denny, S, Tolstrup JS, Ersbøll AK, Holstein BE. Does a positive school-climate buffer the effect of weak parental support? School climate and alcohol use among adolescents. Submitted to: Journal of Adolescence (in review)


Academic advisors:

Associate professor Mogens Trab Damsgaard, Mag.scient.soc.
Professor Bjørn E. Holstein, Mag.scient.soc.
Research Programme Director, Janne S. Tolstrup, PhD, DMSci
National Institute of Public Health,
University of Southern Denmark
The thesis at a glance

Adolescence is the transition from childhood to adulthood where numerous developmental changes occur. It is also a period where most people initiate alcohol use and where the foundations for later drinking habits are laid. In this thesis, I used a social ecological approach as the overarching analytical framework. This framework combines individual and contextual factors to gain greater insight into the development of adolescent alcohol use. Most studies on adolescent alcohol use focus on individual level risk factors—this thesis goes beyond existing research and aims to analyse how features in the social context, including families, schools, communities and countries are related to adolescent alcohol use.

The thesis is based upon four empirical studies:

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<td>Does adolescent alcohol use differ between schools?</td>
<td>The Danish HBSC study 2006, 11-, 13- and 15-year-olds, n= 10,801</td>
<td>There were large variations across schools in the prevalence of adolescents who had tried alcohol, who drank weekly, and who had experienced drunkenness</td>
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<td>II</td>
<td>School and family</td>
<td>Is drunkenness associated with parental support, school connectedness and school climate?</td>
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<td>Low parental support, low school connectedness, and a poor school climate were associated with higher odds of drunkenness</td>
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<td>Family and community</td>
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<td>Adolescents who lived in communities with high levels of adult drinking had higher odds of drunkenness than their peers in communities with lower levels of adult drinking irrespective of parental alcohol use</td>
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<td>IV</td>
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<td>How are adolescent drunkenness and frequency of drinking associated with adult drinking patterns and alcohol control policies?</td>
<td>The International HBSC study 2009/10, 13- and 15-year-olds, n=144,788</td>
<td>Limited alcohol control policies and high levels of adult drinking were associated with drunkenness and weekly drinking among adolescents</td>
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The thesis contains seven chapters. Following the short introduction in the first chapter, the aim of the thesis is presented in chapter 2. Chapter 3 elaborates on the theoretical framework while the fourth chapter outlines the empirical studies used in the thesis and describes which measures and methods I have used. Chapter 5 presents the main results, while chapter 6 is a general discussion of the findings, strength, limitations and policy implications. Finally, the seventh chapter is the conclusion.
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English summary

Danish Summary

References
1. Introduction

1.1 Adolescent alcohol use

From a public health perspective it is important to understand the processes involved in young peoples’ alcohol use. Adolescence is an important period of life characterized by growing autonomy and by physical, psychological and social changes. It is also the period where many young people initiate alcohol use and where the foundations of later drinking habits are established.

During transition into adulthood adolescents learn about and experiment with new behaviours such as smoking and alcohol drinking [1]. By the late-teens, the majority of European adolescents have tried alcohol. Most of them consume alcohol at least monthly, and about one quarter of adolescents drink heavily on occasions. Alcohol consumption is perceived as a positive and pro-social activity by young people and it is a part of social life for many adolescents [2]. Drinking to intoxication can symbolize freedom and autonomy and it can contribute to pleasure, enjoyment, confidence and the building and maintenance of friendships [3, 4]. Nevertheless, excessive alcohol use in adolescence is associated with a range of adverse effects, including brain damage; academic failure; violence; injuries; unprotected sexual intercourse; and later excessive use, alcoholism and early mortality [1, 5-13].

The Danish drinking culture has been characterized by its lack of alcohol control policies, the high accessibility, and the general, positive expectancies about alcohol use in the population [14]. The high level of availability of alcohol and the drinking norm may contribute to the high rate of drunkenness among Danish adolescents aged 15–16 years [15, 16]. Compared to other countries, Denmark has one of the highest prevalences of drunkenness among adolescents, and drinking to intoxication is common even among young teenagers. Cross-national studies have shown that the alcohol consumption of young Danes, and especially their experience with drunkenness, is the highest in Europe [15-17], which puts them at risk for alcohol-related problems throughout adolescence and into adulthood [1, 11, 18, 19]. This stresses the need to investigate factors related to high alcohol intake in youth. Risk factors for adolescent alcohol use are typically conceptualized as individual and interpersonal factors such as drinking motivations and peer influences. However, individual factors do not fully explain adolescent drinking behaviour. Alcohol consumption is an inherently social practice and we need to take the social context into account in research and health promotion.
1.2 The social context

Bronfenbrenner’s [20] concept of the micro-, meso-, exo-, and macrosystem emphasizes the need to focus on the relations between individuals and their social context. In this thesis, I analyse the relationship between adolescent alcohol use and contextual influences at the family, school, community and country level.

1.2.1 Family

Connection to caring adults is one of the key factors that promotes healthy adolescent development [21]. Although there has been a strong focus on the importance of peers regarding adolescent alcohol use, parents and family also play an important role [22]. Studies have hypothesized that alcohol use among adolescents reflects alcohol use of their parents [23]. Parents can influence their adolescent’s drinking behaviour by their own use, which is known as modelling [23-25] or by their parenting practices [22, 26, 27]. Parenting practices affect adolescents’ developmental processes in several ways. Lack of parental support can serve as a risk factor for adolescent drinking [28-30]. Positive parent-adolescent communication and parents’ support have been associated with delay in the initiation of alcohol use and lower consumption by adolescents who do drink [30]. There is a large body of research that focuses on parenting practices and parent-adolescent relations; however, few studies have examined these factors across different social contexts.

1.2.2 School

The importance of the school context is obvious because adolescents spend much of their time at school. School constitutes an arena for social interactions and the development of friendships, which can both positively and negatively influence alcohol-related behaviours and attitudes [31-33]. Schools therefore have a potentially large influence on adolescent alcohol use. A previous review of multilevel studies, which examined a range of health outcomes, found school-level differences in alcohol use and suggested that school effects appear to influence various health outcomes including adolescent alcohol use [33]. Knowledge of how adolescents’ alcohol use varies across schools is useful in the planning of interventions against high alcohol intake in adolescence [32, 34, 35]. Furthermore, it is important to consider in which degree the school variations are a result of a true school-level effect or whether the variations are due to differences in the socio-demographic composition of schoolchildren across schools. Most studies that include school populations have focused on drinking patterns at the individual level, leaving school differences relatively unexplored, as a nuisance to control for rather than a unit of interest [36, 37].
Multilevel modelling enables us to distinguish between school-level and individual-level variation, whereby the contextual effects of the school on adolescent alcohol use may be captured [33]. Adolescents who belong to the same school may develop similar drinking behaviours because they share similar individual characteristics (compositional explanation) or because they share the same psychosocial and physical environment (contextual explanation). There is, however, limited empirical evidence in this area of alcohol research.

1.2.3 School class

The school class also plays a central role in relation to adolescents’ alcohol use. First, from a conceptual point of view, alcohol use is considered a social phenomenon and the school-class represents an important social context for understanding and tackling it. Second, in Denmark, students attending primary and lower secondary schools remain with the same classmates for the entire nine years of compulsory education [38]. The school class is therefore especially important in Danish adolescents’ lives. A positive school climate and connectedness to school during adolescence have emerged as key areas for building protective factors for positive educational outcomes and lower rates of health-risk behaviours [39, 40]. The school’s social climate has been referred to as the heart and soul of a school [41]. Bronfenbrenner’s framework posits that positive connection in one system may compensate for or offset a bad connection in another [20]. To my knowledge no studies have examined whether school climate act as a buffer, protecting adolescents with weak child-parents relations from alcohol use. To sum up, characteristics of the school class are expected to have consequences for the school class members regardless of their own specific characteristics, but this association lacks research in relation to adolescent alcohol use.

1.2.4 Community

Studies have found that adolescent alcohol use is influenced by characteristics of the community [42, 43], which suggests that the community plays an important role in shaping adolescent behaviour. In recent years, research related to social influences on adolescent alcohol use has expanded beyond the sphere of family and peer networks to investigate the role of the larger community. This prior work has suggested that adolescent alcohol use varies across communities [34, 42, 43]. Studies have generally described such area variations with compositional explanations that focus on the individual characteristics of the population in the area or contextual explanations that stress the characteristics of the surroundings, e.g. number of alcohol outlets in an area, average income, access to sport facilities, and number and quality of schools in the community. Macintyre et al. [44] and Frohlich et al. [45, 46] suggest collective explanations
as a third way to understand area variations in health. Collective explanations emphasize the importance of the shared norms and behaviours in a community such as the prevalence and acceptance of alcohol use. In line with this, Skog states that the distribution of alcohol consumption moves up or down as a whole and that individual alcohol use reflects consumption patterns in the social context [47-49]. If so, adolescent alcohol use may reflect the general patterns of alcohol consumption in the community. To my knowledge, no study investigated this issue.

1.2.5 Country

The country is another important context to study in relation to adolescent alcohol use. Drinking patterns and drinking norms vary between countries which has been demonstrated in international studies about both adolescents [4, 15-17] and adults [50]. It is possible that adolescent alcohol use reflects the national drinking culture, e.g. the adult drinking pattern in a country. For example, if alcohol use is an integrated part of the culture, adolescents may also be more likely to engage in drinking. This issue has received little attention in international research on young people’s alcohol use, however, there is some empirical evidence supporting this hypothesis. A couple of studies have demonstrated a positive relationship between adult and adolescent drinking patterns across countries [51, 52]. An example is the ecological study by Fuhr & Gmel [52], which used per capita alcohol intake as a proxy for the adult drinking pattern and reported a strong correlation between per capita alcohol consumption and the prevalence of youth drinking across the world (Figure 1).

![Figure 1: The relation between adult drinking and adolescent drinking [52].](image-url)
However, other aspects of the adult drinking patterns, such as rate of alcohol abstinence, may also be associated with adolescent alcohol use. Across countries there are large variations in rates of alcohol abstinence. In Denmark, 0.8 per cent of the population are lifetime abstainers and the corresponding percentage in Portugal are 26% [53].

Another potential explanation for the variation in adolescent drinking is country differences in alcohol control policies. Although many young people succeed in buying alcohol despite age limits [54, 55], the general observation is that comprehensive alcohol control policies reduce the proportion of young people who buy and drink alcohol frequently [56-59] and reduce the proportion of young people who encounter problems from their alcohol use such as injuries and drunk driving [60-62]. A review including studies published between 1960 and 1999, found that higher minimum purchasing age reduced alcohol consumption. However, the finding was not entirely consistent with a few studies showing positive relationships and some studies showing no relationship [63].

Alcohol control policies, such as restrictions on advertising and availability, have also been used to reduce alcohol consumption among adolescents [64]. If alcohol is easily accessible, consumption will generally be higher than when its accessibility is limited [65, 66]. Studies conducted in a single country can provide some insight into the relationship between adult and adolescent drinking cultures, but such studies lack the comparison level needed to specify the relationship in a cross-cultural perspective [67]. Therefore cross-national studies can make an important contribution to knowledge of the association between alcohol control policies and adolescent alcohol use. Only few studies have addressed this issue.
2. Aim of the thesis

As shown in the introduction, there are multiple social contexts that are important in relation to adolescent alcohol use. A social ecological perspective suggests that different social contexts and the interdependencies among contexts must be considered to understand the processes associated with adolescent alcohol use. Therefore, the overall aim of the present thesis was to gain a better understanding of adolescent drinking and further, to analyse how features in the social context were related to adolescent alcohol use. The thesis addressed the following questions.

2.1 Research questions

Study I aims to examine the association between a primary social context of adolescents—school—and adolescent alcohol use by addressing the following research questions:

Does adolescent alcohol use differ between schools in Denmark?
If so, is school-level variation in adolescent alcohol use then due to differences in the socio-demographic composition of students?

Study II uses a multilevel approach to analyse the association between adolescent drunkenness and the school-class climate by addressing the two research questions:

How is drunkenness and school-class climate associated?
Does a positive school-class climate buffer the impact of low parental support on adolescent drunkenness?

Study III contains data from three different surveys and aims to address two research questions:

Does drunkenness among Danish adolescents reflect adult drinking behaviours in the community?
Does parental drinking explain the association between community-level adult alcohol consumption and adolescent drunkenness?

Study IV takes an international approach and aims to address these two research questions:

How are adolescent drunkenness associated with adult drinking patterns and alcohol control policies?
How are adolescent frequency of drinking associated with adult drinking patterns and alcohol control policies?
3. Conceptual framework

3.1 Background

"Where you live matters for health, although probably not as much as who you are" [44].

Recent studies tend to underestimate the importance of environmental influences on health and health behaviours [42, 68-71]. Most behavioural theories have focused on individual determinants of risk factors such as beliefs, expectancies, self-efficacy, personality, motivations, and perceived personal control. This also applies to alcohol research, which has been particularly focused on individuals’ personality traits, motivations and expectations. More recently, the role of context has been acknowledged by many researchers. It has been argued that individuals’ health behaviours cannot be understood without taking into account the characteristics and processes occurring at the levels of the proximate and broader environment [72]. Thus, proponents of individual-oriented behaviour strategies that emphasize the individual’s choice and lifestyle have been accused of supporting a victim-blaming ideology, which ignores the connection between individual behaviour and social norms and structures [73]. One conceptual framework that stresses behaviour and its individual and environmental determinants is the ecological perspective proposed by Bronfenbrenner [20, 74].

3.2 Adolescent alcohol use in an ecological framework

Bronfenbrenner’s ecological framework introduced in the 1970s (1974, 1979) views children’s development from an ecological perspective where development takes place through processes of complex reciprocal interactions between the child and his or her social context. In short, he posits that individuals are influenced by interrelated factors from the micro-, meso, exo, and macrosystems [20]. Bronfenbrenner named his original framework "Ecological Systems Theory". Through this framework he identified the need to focus on the relation between the social context and the individual. My thesis focuses on the influence of family, school, community and country on adolescent alcohol use.

1) The microsystem is the innermost layer of Bronfenbrenner’s model. Microsystems are the principal and immediate socialization contexts in which human development takes place. These contexts are closest to the individual and encompass interpersonal relationships and direct interactions with immediate surroundings. In this thesis, the school and family are considered as important parts of the microsystem in relation to adolescent alcohol use. 2) The mesosystem includes interrelations between various aspects of the microsystem based on the idea that processes that operate in different systems are dependent on each other. Bronfenbrenner suggests examining interrelations among social contexts by positing that “In ecological research, the principal main effects are likely to be interactions” [74](page 518). Individuals are
part of multiple systems; accordingly, he stresses the importance of researchers investigating joint effects and interactions between these systems (e.g. home and school). A relationship between an adolescent’s family and his or her school can be considered part of the mesosystem because these two microsystems may interact. In this thesis, I analyse the interaction between school and family factors on adolescent alcohol use. 3) The exosystem comprises more remote social environments, e.g. communities, in which microsystems are embedded. Study II addresses factors in the exosystem and examines the association between adult alcohol consumption in the community and adolescent alcohol use. 4) The macrosystem is the outermost layer of Bronfenbrenner’s model. This system includes social or cultural ideologies and beliefs that affect an individual’s environment. It refers to the overall patterns of ideology and organization that characterize a given society or social group. In this thesis a country’s alcohol control policies and alcohol culture are considered part of the macrosystem.

3.3 Conceptual framework in this thesis

Based on Bronfenbrenner’s framework, I analyse the relationship between adolescent alcohol use and family, school (microsystems), communities (exosystem) and country (macrosystem). It goes beyond the scope of this thesis to build a complete analytical model explaining all relevant determinants related to adolescent alcohol use. Instead, variables were operationalized at each level of influence based on the theoretical framework and previous research. The empirical variables in the different systems are illustrated in Figure 2.
Figure 2. The ecological framework used in the thesis based on Bronfenbrenner’s framework [20].

The empirical variables in the microsystem are: school connectedness, school-class climate, and alcohol education at school (school) and parental drinking and parental support (family). The mesosystem illustrates the interplay between the systems. These interrelations can take several forms and are studied in different ways throughout the thesis. As an example, Study II examines interaction between two factors in the microsystem by analysing whether a positive school climate buffers the effect of lack of parental support. Study III focuses on the relation between community-level drinking and adolescent drunkenness and analyses whether parental drinking at the family level explains the association. I thereby examine whether the effect of a factor at a higher ecological level (exosystem) can be explained by a factor at a lower ecological level (microsystem). The next layer in the model is the exosystem, which in the present thesis includes structures in the community such as adult alcohol use, availability of alcohol, and the degree of youth-friendly activities in the area. The macrosystem is the fourth layer and includes country-level factors such as the national adult drinking pattern and alcohol control policies (Study IV). The effects of the macrosystem also trickle down to the exosystem, mesosystem, and microsystem.

3.4 Drinking as a social practice

The central principles of Bronfenbrenner’s framework are that human development takes place within a set of nested and changing environments and that complex relations within and between those nested
environments shape behaviours. His framework posits that human behaviour is influenced by, and influences, the structures of the physical and sociocultural context. A sociological approach to reciprocal processes between context (structure) and behaviour (action) is given by Anthony Giddens [75].

Giddens’ Structuration Theory provides a perspective with which to view the interaction between the individuals and their environment. Giddens sees social structure as ‘rules and resources’ that constitute the conditions of individual behaviour. Structure is always both constraining and enabling and Giddens develops the concept of “duality” to emphasize structure's nature as both the medium and the outcome of social practices. In this way structure and action are recursive and co-dependent. Structure is not possible without action because the action reproduces the structures. In other words, individuals shape structure, and structure shapes behaviour: “structure is what gives form and shape to social life, but it is not itself that form and shape ... structure only exists in and through the activities of human agents”[75] (p.256).

Following Giddens’ idea, an alcohol drinking practice could be seen as a structure that influences adolescent drinking behaviour by providing norms and rules for drinking. To the extent that such a practice is generally acknowledged it could be termed a drinking culture.

Frolich and colleagues [44, 45, 68, 76] introduced Giddens’ theory to the epidemiological field. They argue that lifestyle should be seen as collective behaviour and thereby reject the biomedical conceptualization of health-related behaviours as individualistic. In this approach they rely on the understanding of behaviour as social practices reflecting shared norms, patterns of behaviours, and traditions [45, 68]. The analysis of behaviours as social practices situates the behaviour in its social context. Drawing on this theoretical approach, I conceptualize adolescent drunkenness not just as individual health behaviour, but rather as a social practice that reproduces the structure in their context, e.g. the shared patterns of drinking.

The concept of shared patterns of alcohol consumption has also been introduced and investigated by Skog in the 1980s. He argues that drinking behaviour is a group phenomenon that reflects consumption patterns and social norms in the community. At the group level, one might therefore expect individual drinking patterns to reflect consumption patterns and norms in the social context [47-49]. Shared patterns of behaviour are analysed as key in this thesis. Following Skog’s idea, I analyse whether adolescents’ alcohol use reflects the general pattern of alcohol consumption in the social context. The general pattern of alcohol consumption is operationalized at different ecological levels—at the family, community and country level.

In Paper II the concept is analysed at the family level (parental drinking) and at the community level (adult alcohol consumption). In Paper IV the concept is measured as country-level adult drinking practices.
4. Methods

4.1 Materials

4.1.1 The Health Behaviour in School-aged Children study

The thesis is based on data from the cross-national WHO collaborative study “The Health Behaviour in School-aged Children (HBSC) study” [16]. HBSC is a cross-sectional survey study that monitors quality of life indicators, health status, and health behaviours among 11-, 13- and 15- year old schoolchildren from randomly selected schools in each participating country. The aim of the HBSC study is to describe young people’s health and health behaviours and to gain further understanding of how these conditions relate to different social contexts. Further, HBSC aims to inform and influence health promotion and health education policy aimed at schoolchildren. The HBSC study was initiated in 1982 and has been carried out at four-year intervals with a continuously growing number of countries. The thesis used data from three HBSC surveys: the Danish HBSC study 2006, the Danish HBSC study 2010, and the International HBSC study 2009/10.

The Danish samples from 2006 and 2010

In Study I and Study II about school variations and school-class climate I used data from the Danish contribution to the HBSC survey in 2006. From a complete list of all schools in Denmark 100 randomly selected schools were invited of which 80 accepted to participate. Further, two local samples, a sample of 27 schools in Sønderjylland and ten schools in Ballerup, which all accepted to participate, were included (total school-level participation 85%). The data collection comprised all schoolchildren at the fifth, seventh and ninth grade in these schools. The mean age in the three grades was 11.8, 13.8 and 15.7 years, respectively. There were 12,122 schoolchildren in the participating classes of which 10,801 were present at the day of data collection and submitted a completed questionnaire (participation rate 89%). The schoolchildren answered the internationally standardized HBSC questionnaire in the classroom [77].

Study III is based on data from the Danish contribution to the HBSC survey in 2010. Out of a total sample of 137 schools, 73 agreed to participate (school-level participation 53%). Non-participating schools were replaced by new schools sampled in the same way. The school-level participation was lower than in 2006. The most common reason to decline participation was that the school recently had participated in other health surveys. Some classes within the participating schools declined participation due to time-pressure or head-teachers sick leave. The participation rate was lower among large schools (>300 students) and schools in the Capital Region of Denmark. The response rate was 86.3% of the students enrolled in the participating classes.
The study complies with the Helsinki II declaration. There were no official agency for ethical evaluation and approval of school surveys in Denmark. The schools decide autonomously whether to participate in such surveys. Approval was obtained from all school leaders, the board of students, and the board of parents in each of the participating schools. The survey was conducted under full anonymity, informed consent and voluntary participation.

**The international HBSC Survey**

*Study IV* is based on the latest international HBSC survey which was collected in 2009/2010 and includes 41 countries. Adolescents were selected using a clustered sampling design, with an initial sampling unit of either classes or schools. Schools were selected to ensure that samples were representative for the participating countries, with variations in sampling criteria permitted to fit country-level circumstances. I excluded 11-year-olds and countries with missing information on adolescent alcohol use or country-level indicators and ended up with 144,788 schoolchildren in 36 participating countries. The study complies with the ethical standards and guidelines within the participating countries. In all countries, the survey was conducted under full confidentiality, informed consent, voluntary participation, and in accordance with the Helsinki II declaration.

**The HBSC School Leader Survey 2010**

In addition to the HBSC study I used information from the Danish HBSC School Leader Survey 2010 to measure school-level characteristics (*Study III*). In 73 participating schools in 2010, 69 school leaders completed a questionnaire about the school setting (response rate 69/73= 94.5%). HBSC data at student-level were subsequently merged with the school leader data.

### 4.1.2 The Danish National Health Survey 2010

Information on community-level adult alcohol consumption was obtained from the online database www.sundhedsprofil2010.dk which includes a broad range of health indicators obtained from the Danish National Health Survey 2010. In all, 177,639 individuals completed the questionnaire. The participation rate in the Danish National Health Survey 2010 was 59.5% and varied from 52.3% in the Capital Region of Denmark sample to 65.5% in the North Denmark Region sample. Non-respondents were more likely to be young men and elderly women, unmarried and having a non-Danish background [78].
4.1.3 The Country-level database

In *Study IV*, I examined the associations between adolescent alcohol use and country-level factors. For this purpose I constructed a country-level database with information on adult drinking pattern and alcohol control policies in the 41 participating HBSC countries. Data was obtained from the Global Information System on Alcohol and Health (GISAH) [79] and the WHO reports 1) Alcohol in the European Union: Consumption, harm and policy approaches [53], 2) European and Status Report on Alcohol and health 2010 [80]. Overall, I collected data on 23 country-level variables. To facilitate the interpretation and to avoid overlap in the measures only nine of these variables were included in the final study. The choice of variables was based on the applied conceptual framework, on previous research and on the quality of data.

4.2 Measures

Throughout the thesis I used different measures of which some are analysed at the individual-level by adolescent self-reports while other are conceptualized as contextual variables and analysed at school-class, school, community, or country level. In relation to contextual measures, useful distinctions have been made between aggregated variables, which summarise the characteristics of individuals, and integral/global variables, which describe features that are not reducible to characteristics of the individual, such as national alcohol control policies or the number of alcohol outlets in the area [81].
Table 1. Data source, study population, data structure, outcome measures and main determinants used in the four studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Data source</th>
<th>Study population</th>
<th>Data structure</th>
<th>Outcomes</th>
<th>Main determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>HBSC 2006</td>
<td>11-, 13- and 15-year-olds, n= 10,801</td>
<td>10,801 students nested in 116 schools (Level 2)</td>
<td>Tried drinking, Experienced drunkenness (once or more vs. never) Weekly alcohol use</td>
<td>Student level: Age, Sex, Family structure, Migration status School level: Proportion who had tried alcohol, experienced drunkenness, and who drank habitually</td>
</tr>
<tr>
<td>II</td>
<td>HBSC 2006</td>
<td>11-, 13- and 15-year-olds, n= 10,540</td>
<td>10,540 students nested in 601 school classes and 116 schools (Level 3)</td>
<td>Experienced drunkenness (once or more vs. never)</td>
<td>Student level: Parental support, School connectedness School level: School-class climate</td>
</tr>
<tr>
<td>III</td>
<td>HBSC 2010, The HBSC School Leader Survey 2010, The Danish National Health Survey 2010</td>
<td>13- and 15-year-olds, n= 2,911</td>
<td>2,911 students nested in 175 school classes and 51 schools (Level 3)</td>
<td>Experienced drunkenness (twice or more vs. never) Binge drinking</td>
<td>Student level: Parental drinking, School level: Youth-friendly environment, Exposure to alcohol, Alcohol education Community-level: Adult alcohol consumption</td>
</tr>
<tr>
<td>IV</td>
<td>The International HBSC study 2009/10, Country-level database</td>
<td>13- and 15-year-olds, n=144,788</td>
<td>144,788 students nested in 37 countries (Level 2)</td>
<td>Experienced drunkenness (once or more vs. never) Weekly alcohol use</td>
<td>Country-level: Abstainers, Per capita consumption, Per capita among drinkers, Male binge drinking, Pattern of drinking score, Minimum purchasing age, Alcohol Policy Index, Availability, Advertising</td>
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</tbody>
</table>

4.2.1 Measures of alcohol use

The main outcome measure in this thesis is self-reported lifetime drunkenness. Other alcohol measures included were binge drinking, weekly alcohol use, and having tried drinking.

Drunkenness was measured by the item: “Have you ever been really drunk?” (no, never; yes, once; yes, 2–3 times; yes, 4–10 times; yes, more than 10 times). Studies have used different cut-offs for drunkenness [82-84] which I also do in this thesis. In Study I and II adolescents are categorized into those who had been drunk once or more, versus more seldom, while Study III and IV used two or more times as the cut-point to capture young people who have started to show signs of excessive alcohol use. Sensitivity analyses were performed with cut-points at four or more times and ten or more times in all studies.

Have you ever had so much alcohol that you were really drunk? Please tick one box for each line.

| In your lifetime | ❑ | ❑ | ❑ | ❑ | ❑ |

Figure 3. Measure of lifetime drunkenness used in the HBSC study
To measure **tried alcohol** participants were asked at what age they had their first alcohol drink and I categorized them into those with alcohol experience and those without.

**Weekly alcohol use/Habitual alcohol use** was measured by the question: "At present, how often do you drink anything alcoholic, such as beer, wine, or spirits?" with separate items about beer, wine, spirits/liquor, alcopops or anything else. The response key was never; rarely; every month; every week; every day. I defined habitual drinking as drinking at least one of these kinds of alcohol at least weekly.

**Binge drinking** was operationalized as drinking five or more units of alcohol in one episode during the last month. The question was: “During the last 30 days: How many times have you had five or more drinks in a row? A drink could be a glass of wine, a bottle of beer, a shot glass of distilled spirits or a mixed drink”. Respondents who had five or more drinks in a row during the last 30 days were contrasted with respondents who did not report binge drinking in the past.

**Study I** also applies aggregated variables expressing proportion within the school who had tried drinking, experienced drunkenness and proportions that drank weekly. The proportion was calculated separately for each grade.

### 4.2.2 Individual-level co-variates

Individual-level covariates were based on adolescents’ self-reported data. The analyses in this thesis included measures of sex, age, family structure, migration status, parental drinking, parental support and school connectedness.

The adolescents reported their month and year of birth which were used to calculate their age. In **Study II and III**, grade was used as a proxy for age and adolescents were grouped into 5th (11 years), 7th (13 years) and 9th (15 years) grade. In the Danish school system the age distribution remain fairly homogenous by grade, since students are rarely held back or promoted. To measure **family structure**, participants answered questions about who they lived with at home. I categorized the participants in two groups: 1) Those living with both biological parents, and 2) those living in other family types. Students with missing information on family structure (n=170) showed similar characteristics as the group who reported they lived with both biological parents and were therefore categorized in this group in **Study III**. **Migration status** was measured by the students’ own and parents’ country of birth. I categorized students who were born and raised in Denmark by Danish parents as ethnic Danes. Those reporting being born in a foreign country and with neither a Danish born mother nor a Danish born father were scored as immigrants. Those reporting that he or she was born in Denmark and that neither of his or her parents was born in Denmark
were scored as descendants of immigrants. **Parental drinking** was measured by two questions in the student questionnaire about mother’s and father’s frequency of alcohol intake (responses were: daily, weekly, monthly, rarely/never and do not know), categorized as “both drinking daily”, “one drinking daily” or “less”. **Parental school support** (referred to as parental support) was measured by the question “If I have a problem at school my parents are ready to help” assessed on a 5-point Likert scale ranging from strongly agree (1) to strongly disagree (5), categorized as “high parental support (1)”, “medium parental support (2)” and “low parental support (3-5)”. An index of **School connectedness** was constructed from items previously used [85]. The index was based on three items which addressed the same concept: A: “How do you feel about school at present”, B: “Our school is a nice place to be” and C: “I feel I belong at this school”. The response key for A was: I like it a lot (1), I like it a bit (2), I don't like it very much (4), I don't like it at all (5). Responses for B and C were: Strongly agree (1), Agree (2), Neither agree or disagree (3), Disagree (4), Strongly disagree (5). Responses were summed and range from 3 to 15. Subsequently, school connectedness was group-mean centred at the school-class mean to avoid collinearity and students were categorized into three equal-sized groups; low, medium and high school connectedness. The centred variable ranged from -6.3 to 9.3. The Spearman’s correlation coefficients between the three items varied between 0.50 and 0.66, and the Cronbach’s α was 0.81.

### 4.2.3 School class and school-level measures

**Aggregated data**

The contextual measure of **school-class social climate** (referred to as school climate) was assessed by taking the mean of the school connectedness index in each school-class (range 3.5—10.5). I categorized school-classes into three equal groups: as having a school climate above average (range 3.5—6), average (6—7.1) or below average (7.1—10.5). There were approximately 200 school-classes in each of the three groups. In this thesis, school-class climate and school connectedness are measured at the same level by individual student reports. At the conceptual and analytical level they are, however, treated as two distinct concepts. School connectedness is analysed and conceptualized as an individual level variable where school climate is conceptualized as a characteristic of the school class.

**Integral or global measures**

The variable **youth-friendly environment** was based on the school leaders’ perceptions of whether the school was located in a youth-friendly environment with good possibilities to participate in leisure-time activities. Two categories were constructed with “strongly agree” and “agree” versus “neither agree or
disagree” and “disagree”. Exposure to alcohol outlets was measured by the item “Are there any shops near school selling alcohol? (no; yes, one; yes, two or more; do not know)”. Responses were dichotomized into “two or more shops” versus “none or one shop” selling alcohol near school. Alcohol education was categorized into schools who had implemented a strategy for alcohol education versus those who had not.

4.2.4 Community-level measures

Information on community-level adult alcohol consumption (AAC) was obtained from The Danish National Health Survey 2010. AAC was measured at community-level as proportion of the adult population with high alcohol consumption. The participants were asked to report their current weekly alcohol consumption of beer, wine and spirits and the total weekly alcohol consumption was calculated by summing up the consumption. According to the recommendation from the National Board of Health high alcohol consumption was defined as drinking 14 units or more a week for women and 21 drinks or more a week for men (a unit of alcohol is defined as 12 gram of pure alcohol). Community was defined by the administrative concept municipality of which there are 98 in Denmark. The participating schools in the HBSC study were distributed across 38 municipalities, and I used information on the proportion of adults (aged 16 years or older) who drank above the recommendations in each of these 38 municipalities. Subsequently, community-level AAC was trichotomized in the most drinking quartile (n=10) and in the least drinking quartile (n=9). The remaining 50% were categorized as medium-drinking communities (n=19).

Figure 4. Shows the proportion of adults in each municipality with high alcohol consumption.
4.2.5 Country-level measures

At the conceptual level I was interested in measuring alcohol culture and how socially accepted alcohol use is in a given country. Alcohol culture was operationalized by five measures of adult drinking based on data from WHO [53, 79, 80]. These variables were seen as proxies for the general alcohol culture. **Rate of lifetime abstainers** was calculated from the male and female rate of lifetime abstainers measured in 2005 and 2009. **Patterns of drinking score (PDS)** was assessed in 2004/2005 by WHO based on heavy drinking occasions, proportion of daily drinkers, drinking with meals and drinking in public places, ranging from one to five. Data on total **alcohol per capita consumption (APC)** of adults (aged ≥15) was measured in litres of pure alcohol. Total APC measures the consumption of pure alcohol per person per country and included estimated unrecorded alcohol intake in 2005 and the average recorded alcohol intake from 2003-2005. **Alcohol per capita consumption among drinkers (APCD)** was measured as litres of pure alcohol consumed only by the adult drinking population in 2005. Prevalence of heavy episodic drinking among males, referred to as **male binge drinkers** was measured from 2003-2005 as those who had at least 60 grams or more of pure alcohol on one occasion during the past 7 days.

I included four country-level variables about alcohol control policies. **Minimum purchase age (MPA)** was derived from WHO [53, 79] and measured in 2008. If a country had different age limits for buying beers and spirits the lowest legal age limit for buying any type of alcohol was chosen. Three categories were used: no age limit, 16-18 years, and 20-21 years. No age limit was used as the reference group.

To measure the comprehensiveness of the alcohol control policy I used the Alcohol Policy Index (API) developed by Brand and colleagues [64]. I included 1) **Total API** (ranged 0-68 in this study), 2) **Availability Index** (ranged 0-24); e.g. minimum purchase age, hours of sales, and 3) **Advertising Index**; e.g. number of different media with advertising restrictions. Total API and Availability were split in to approximate tertiles and categorized from one to three with three indicating countries with the most comprehensive alcohol control policies. The Advertising Index ranged from 0 to 3, but Finland was the only country with a score of 2 and was therefore grouped with countries scoring 1. The UK average for country-level data was applied to Scotland, England and Wales, since country-specific data was not available for the time period.
Table 2: Adult drinking patterns and alcohol control policies in the 37 countries included in Study IV

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<th>Region</th>
<th>Abstainers</th>
<th>PDS&lt;sup&gt;a&lt;/sup&gt;</th>
<th>APC&lt;sup&gt;b&lt;/sup&gt;</th>
<th>APCD&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Binge male&lt;sup&gt;d&lt;/sup&gt;</th>
<th>MPA, years&lt;sup&gt;e&lt;/sup&gt;</th>
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<td>(5.7)</td>
<td>(7.2)</td>
<td>(14.8)</td>
<td>(1.3)</td>
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<sup>a</sup>Patterns of drinking score ranging from 1 to 3 with 3 indicating the most harmful drinking pattern, <sup>b</sup>Based on recorded alcohol consumption and estimations of unrecorded alcohol measured in litres of pure alcohol consumed by the adult population (aged 15 years or more), <sup>c</sup>Alcohol per capita consumption among drinkers measured as pure alcohol consumed by the drinking population, <sup>d</sup>Having at least 60 grams or more of pure alcohol on one occasion during the past 7 days, <sup>e</sup>Lowest minimum purchasing age for any type of alcohol, <sup>f</sup>Missing information
4.3 Statistical methods

4.3.1 Analyses

All analyses were performed by the author in SAS version 9.2 and 9.3 (SAS Institute, Cary NC, USA). Preliminary procedures involved examining descriptive statistics of predictors and outcomes (including contingency tables and calculations of mean, standard deviation, and range). As a start most associations were analysed by correlation analyses and univariate analyses. The multivariate analyses of adolescent drinking (dichotomous outcome) were conducted by logistic regression analyses and associations were expressed by adjusted odds ratios (OR) with 95% confidence intervals (CI). Study II, Study III and Study IV included variables that were technically continuous (e.g., school-class climate, community-level adult alcohol consumption, country-level adult per capita consumption). These variables were categorized when included in most of the analyses. The categorisation was preferred when the assumption of linearity was violated or to facilitate interpretation. Since loss of information is a drawback of categorising continuous variables, I performed all the analyses with different cut-points and when linearity was evident these results are reported together with the results of the categorized variables (Study II and Study III).

4.3.2 Multilevel analysis

Multilevel modelling was used in all four studies. First, the research questions in the thesis involved analyses of associations between an individual outcome and contextual exposures. When assuming that individual drinking behaviour is affected not only by individual level factors but also by contextual factors it is essential to use measures that explore the influence of context. Multilevel models provide solutions that enable simultaneous assessment of contextual and individual influences on adolescent alcohol use. Second, the sampling unit in the Danish HBSC study was schools. Since responses of students from the same school are likely to be dependent on each other non-interdependence affects the data. Ignoring the clustered nature of the data and the dependency among the observations would result in biased estimates [86]. Therefore data were analysed by using a multilevel model which takes the hierarchical data structure into account. The analyses were run as either two- (Study I and IV) or three-level (Study II and III) models using PROC GLIMIX in SAS. Theoretically data could be considered as being hierarchically structured in four levels with students (Level 1) nested in school classes (Level 2), schools (Level 3), and communities (Level 4) in Study III. However, there were communities with only one school in and it would therefore not be possible to consider community as a third level. As a consequence communities and schools were included at the same level in Study III. I applied a significance level of p<0.05 for random effects.
4.3.3 Intraclass correlation coefficient (ICC) and median odds ratio (MOR)

Adolescents in the same school may be more similar to each other than individuals in other schools, as they share the same physical and social context. The degree of resemblance between students in the same school can be expressed by the ICC. ICC is the proportion of variance that is accounted for by the school level. To quantify how much of the variation in adolescent alcohol use that was conditioned by differences between schools, I calculated ICC. More technically, the ICC is a variance partition coefficient that indicates the proportion of the total variance that is accounted for by the second-level variance [87]. ICC ranges from 0 to 1. A value of 0 suggests no dependency between students within the same school.

In this thesis the median odds ratio (MOR), as proposed by Larsen and Merlo, was used to quantify school- and country-variance in adolescent drinking behaviour [88]. The MOR quantifies the variation between clusters, such as schools or communities by comparing two persons from two randomly chosen, different clusters. The MOR is the median odds ratio between the person of higher propensity and the person of lower propensity. A MOR of 2 indicates that if we compared two students with the same co-variates who belonged to two different schools, one with high odds of being drunk and one with low, the odds of being drunk would, on average be doubled for the student in the school with higher odds of drunkenness. If the MOR is equal to one, there would be no differences in the probability of getting drunk between the two individuals with similar individual characteristics but in different schools.

4.3.4 Missing data

Overall there were very low rates of missing data with less than 5% missing for all items except family structure. I used different procedures to deal with missing information. In Study I and Study III where family structure was included, students who had missing information on the item (5.8%) showed similar characteristics as the group who reported they lived with both biological parents. They were therefore categorized in this group. Additionally analyses were performed without inclusion of this group which hardly changed the estimates. In Study III, where the sample is smaller than in the other studies I assigned students with missing information about age (N=244) with the mean age in their grade.
5. Summary of Results

5.1 School variations in adolescent alcohol use (Study I)

The aim of Study I was twofold. First, I aimed to analyse whether the risk for adolescent alcohol use varied across schools. Second, I aimed to analyse whether the school-level variation in adolescent alcohol use was due to differences in the socio-demographic composition of students.

The study demonstrated a significant variation across schools in adolescents having tried alcohol, adolescents having experienced drunkenness and in adolescents’ habitual alcohol use. The school proportions of adolescents’ drinking ranged from 0 to 100%. Alcohol use increased with age and it seemed clear that the alcohol behaviour was developed from fifth to ninth grade (from age 11 to 15 years). Among the 15-year-olds the majority of adolescents had tried alcohol and had experienced drunkenness.

The figure illustrates two of the main findings from Paper I. First, it illustrates the large school variation in drunkenness rates across schools. Second, it shows how the experience with drunkenness is initiated from age 11 to 15 years.

![Figure 5. Distribution of schools by proportion of adolescents who had experienced drunkenness](image-url)

The highest median odds ratio (MOR) was found among 15-year-olds who had tried alcohol (MOR = 2.12) and among 13-year-olds who drank habitually (MOR = 2.01). In this case, MOR expresses how much higher the odds for having tried alcohol would be if the student had been in a school with a higher risk of alcohol use. Adjusted analyses showed that 4–16% of the total variation in alcohol use was situated at the school level. A substantial part of the school-level variation in adolescent alcohol use was due to school differences in the composition of students, e.g. age, sex, family structure and migration status. Nevertheless, the school variation remained significant and the ICC and MOR remained high even after
adjustment of individual-level characteristics such as age, sex, family structure and migrations status. Migration status was the socio-demographic factor that explained most of the school-level variation in having tried alcohol. Adding migration status to the model reduced the MOR by 53% from 2.12 to 1.53 among 15-year-olds.

5.2 School climate and drunkenness (Study II)
In this study, I aimed to analyse the relation between school-class climate and adolescent drunkenness and whether a positive school-class climate buffered the impact of low parental support. Low parental support, low school connectedness and a poor school-class climate were significantly associated with drunkenness. Adolescents in school-classes with a poor school-class climate had an elevated odds ratio (OR) of 1.52 (95% CI 1.27-1.82) compared with students in classes with a positive school-class climate. Low parental support was more strongly associated with adolescent drunkenness among younger adolescents (OR=3.56, 2.69-4.71) than among older adolescents (1.34, 1.10-1.63).

The age stratified analyses revealed that a positive school-class climate buffered the association between low parental support and drunkenness, but only among 11-year-olds. Those with the highest odds for drunkenness were adolescents in school classes with a poor climate (OR=4.08, 2.59-6.42) as seen in Figure 6.

![Figure 6. Adjusted odds ratios for drunkenness with the combined variable for school climate and parental support among 11-year-olds](image-url)
5.3 Does adolescent drinking reflect adult drinking in the community? (Study III)

The purpose of Study III was to analyse the relationship between adolescent drunkenness and community and school-level factors. The main question of interest was to examine whether drunkenness among adolescents reflected the drinking behaviour in their community, and whether the association was found irrespectively of parental drinking.

The findings suggest that adolescents’ alcohol use reflects drinking patterns in their community. I found a statistically significant association between community-level adult alcohol consumption (AAC) and adolescent drunkenness that was robust against different cut-points for AAC and different measures of drunkenness. Students who lived in communities where more than 10.5% of the adult population had a high risk alcohol consumption (defined as 14 units a week for women and 21 units a week for men) had elevated odds for drunkenness (OR=1.94, 1.21-3.11) compared with students in communities where adults had a lower alcohol intake. Unexpectedly, there was no association between the school-level variables: youth-friendly environment, alcohol education, exposure to alcohol outlets and adolescent drunkenness. The ORs for drunkenness among students in which one parent drank daily or both parents drank daily were 1.47 (1.10-1.96) and 2.42 (1.66-3.53), compared with those having parents who drank less than daily. However, the association between community-level AAC and adolescent alcohol use was not attributable to parental drinking, as shown in Table 3.

Table 3. OR (95% CI) for drunk twice or more among students by individual-, school-, and community-level variables

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual-level</td>
<td>Fixed effect</td>
<td>OR (95% C.I.)</td>
</tr>
<tr>
<td>Parental drinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both drinking daily</td>
<td></td>
<td>2.42</td>
</tr>
<tr>
<td>One drinking daily</td>
<td></td>
<td>1.47</td>
</tr>
<tr>
<td>Less than daily</td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>School-level/community-level variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Youth-friendly environment</td>
<td>Yes</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1.00</td>
</tr>
<tr>
<td>Exposure to alcohol outlets</td>
<td>One or none</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>Two or more</td>
<td>1.00</td>
</tr>
<tr>
<td>Alcohol education</td>
<td>Yes</td>
<td>1.11</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1.00</td>
</tr>
<tr>
<td>Community-level AAC</td>
<td>High</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>1.00</td>
</tr>
</tbody>
</table>

a Adjusted for all factors except parental drinking, b Adjusted for all factors including parental drinking
5.4 International variations: the influence of country-level factors (Study IV)

Using international data from 37 countries, I aimed to analyse how adult drinking patterns and alcohol control policies were associated with weekly drinking and drunkenness among adolescents. In the sex and age-adjusted model high country-level per capita consumption (OR=3.35, 2.28-4.93), high per capita consumption among drinkers (OR=2.64, 1.79-3.87), high proportion of heavy drinking (OR=1.92, 1.15-3.20), risky drinking patterns in the adult population (OR=1.57, 1.14-2.18), and fewer restrictions on availability (OR=1.90, 1.25-2.89) were significantly associated with drunkenness. In the mutually adjusted models, high per capita alcohol consumption and risky drinking pattern in the adult population were associated with drunkenness. For weekly drinking, there were significant associations with not having a minimum purchasing age (OR=3.93, 1.66-9.28), fewer restrictions on availability (OR=3.16, 1.95-5.13) and with having a less comprehensive alcohol control policy (1.93, 1.13-3.28) in the sex-and age adjusted models. In the mutually adjusted models, limited restriction on availability and advertising were significantly associated with weekly drinking (Table 4 and 5). Generally, adult drinking patterns seemed to be more strongly associated with girls’ drunkenness than with boys’ drunkenness, while alcohol control policies seemed to be more strongly associated with boys drinking. As an example, a 10% increase in the country-prevalence of abstainers was significantly associated with lower odds of drunkenness among girls (OR=0.79, 0.61-0.90) but not among boys (OR=0.91, 0.74-1.12).

Overall, I found substantial variations in drunkenness and weekly drinking across countries with median odds ratios (MOR) above 1.69 for drunkenness and above 1.79 for weekly drinking. Per capita consumption accounted for more than 50% of the country variance in adolescent drunkenness and reduced the ICC from 8.0% to 3.7%. Including abstainers, drinking pattern, and minimum purchasing age further reduced the ICC to 3.2% among girls and 2.7% among boys. Availability policies accounted for most of the variation in weekly drinking and reduced the ICC from 10.5% to 6.5% in the sex and age-adjusted models.

Some of the country-level measures in my analyses measures similar construct and it was therefore not suitable to include them in the same model. As an example minimum purchasing age and availability API were significantly related to higher odds of weekly drinking among adolescents in the sex and age-adjusted model. However, when both variables were included in the mutually adjusted model only one of the measures turned out to be significant. The same was seen for the relation between APCD and drunkenness. When adding APC to the model the association between APCD and drunkenness became insignificant. This indicates that the measures to some degree were overlapping and explained the same underlying construct [89].
Table 4. OR (95% CI) for drunkenness among boys and girls by adult drinking pattern and alcohol control policies (only significant associations are shown)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Drunkenness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls (n=71,319)</td>
</tr>
<tr>
<td>Age&lt;sup&gt;a&lt;/sup&gt;</td>
<td>OR (CI)</td>
</tr>
<tr>
<td>Adult drinking pattern Abstainers&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.02 (1.99-2.06)**</td>
</tr>
<tr>
<td>Per capita Low</td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>Medium</td>
<td>2.00 (1.38-2.89)**</td>
</tr>
<tr>
<td>High</td>
<td>2.44 (1.57-3.80)**</td>
</tr>
<tr>
<td>Pattern of drinking score Low risk</td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>Medium</td>
<td>1.76 (1.17-2.66)*</td>
</tr>
<tr>
<td>High</td>
<td>1.61 (1.18-2.18)*</td>
</tr>
<tr>
<td>Policies Minimum purchasing age 20-21 years</td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>16-18 years</td>
<td>1.69 (1.07-2.69) *</td>
</tr>
<tr>
<td>No age limit</td>
<td>1.27 (0.69-2.34)</td>
</tr>
<tr>
<td>Random MOR&lt;sup&gt;c&lt;/sup&gt;/ICC&lt;sup&gt;c&lt;/sup&gt; (crude)</td>
<td>1.72/ 9.0</td>
</tr>
<tr>
<td>MOR/ICC</td>
<td>1.37/ 3.2</td>
</tr>
</tbody>
</table>

<sup>a</sup> Assessed as a one unit (1 year) increase, <sup>b</sup> Assessed as a 10% increase in per cent of abstainers, <sup>c</sup> adjusted age, *P< 0.05 ** p < 0.001

Table 5. OR (95% CI) for weekly drinking among boys and girls by adult drinking pattern and alcohol control policies (only significant associations are shown)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Weekly drinking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls (n=53,148)</td>
</tr>
<tr>
<td>Age&lt;sup&gt;a&lt;/sup&gt;</td>
<td>OR (CI)</td>
</tr>
<tr>
<td>Policies</td>
<td>1.88 (1.82-1.93)**</td>
</tr>
<tr>
<td>Availability policy</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Weak</td>
</tr>
<tr>
<td>Advertising policy</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Weak</td>
</tr>
<tr>
<td>Random</td>
<td>MOR (crude)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>MOR/ICC</td>
</tr>
</tbody>
</table>

<sup>a</sup> Assessed as a one unit (1 year) increase, <sup>b</sup> adjusted age, *P< 0.05 ** p < 0.001
5.5 The relation between socio-demographic factors and adolescent alcohol use

Age, sex, family structure and migration status were included as co-variates in most of the analyses. Older age was significantly associated with higher odds of alcohol use in all studies. Sex was significantly associated with drunkenness in Study I, Study II and Study IV. In all three studies, boys had higher odds of drunkenness (OR ranged from 1.21 to 1.51) than girls. There were no differences between boys and girls in Study III (OR=1.00, 0.84-1.21). The findings were consistent for migration status and family structure. Migrations status was significantly related to adolescent alcohol use in Study I-III where the variable was included. Ethnic Danes had a threefold odds ratio for drunkenness compared to immigrants. Family structure was included in Study I and Study II, which found that adolescents from single parent families had higher odds of being drunk than adolescents living with both biological parents.
6. Discussion

6.1 Main findings
I applied a socio-ecological framework and examined the importance of factors in the micro, exo, and macrosystem. The analyses showed that family, school, community, and country were important contexts in relation to adolescent alcohol use. The main results of the four studies were:

- There were large variations across schools in the proportion of adolescents who had tried alcohol, experienced drunkenness, and who drank weekly, also when the socio-demographic composition of students was taken into account *(Study I)*
- Low parental support, low school connectedness, and a poor school climate were associated with higher odds of drunkenness. A positive school climate buffered the effect of low parental support among 11-year-olds *(Study II)*
- Adolescents who lived in communities with high levels of adult drinking had significantly higher odds of drunkenness than did their peers living in communities with low levels of adult drinking. The association persisted after adjusting for parental drinking and student socio-demographic factors *(Study III)*
- The international comparative study with 37 countries showed that weak alcohol control policies and high per capita alcohol consumption were associated with drunkenness and more frequent drinking among adolescents *(Study IV)*

Figure 7 gives an overview of the main findings in relation to Bronfenbrenner’s model and the four contexts that are found to be important in relation to adolescent alcohol use.
In Study I and Study II, I focused on the microsystems family and school. Study I, showed large school variation in adolescent alcohol use. The role of school was therefore further addressed in Study II, which found that low school connectedness and a poor school climate were associated with adolescent drunkenness. As seen in Figure 6, the study also addressed the mesosystem and found that a positive school climate buffered the relation between low parental support and adolescent drunkenness. Study III addressed the next layer in Bronfenbrenner’s model—the exosystem—and demonstrated that community-level adult alcohol consumption was associated with adolescents’ drunkenness. Finally, Study IV focused on the last layer in the model, namely the macrosystem. I found that weak alcohol control policies and high per capita consumption in the adult population were associated with weekly drinking and drunkenness among adolescents.
6.2 Comparison with previous studies

6.2.1 Family

Parental drinking
Having one or two parents who drank daily was associated with higher odds of drunkenness (Study III). This supports findings from other cross-sectional [25] and longitudinal [90] studies. Two other studies have found weekly and daily drinking to be related to adolescent drinking [23, 91]. The association between parental drinking and adolescent alcohol use has been explained directly by social learning theory [24] which emphasizes the modelling of behaviour [27]. This theory asserts that much behaviour is learned by observing and modelling the behaviour of others; parental drinking will therefore influence adolescents’ behaviour [92]. In addition, the influence of parental drinking can be explained indirectly. Parents with high alcohol use have been found to have less stringent rules regarding their adolescent’s alcohol use [29] which in turn can lead to higher risks of adolescent alcohol use [26].

Parental support
In agreement with other studies, low parental school support was associated with adolescent alcohol use in Study II. Numerous studies have documented a relation between close contact with parents and reduced risks of adolescent alcohol use [28-30]. The relationship between low parental support and drunkenness was attenuated by age. A likely explanation is the increasing autonomy through adolescence in the transition between childhood and adulthood [29]. Another plausible explanation is that parental support protects against deviant behaviour but not against mainstream behaviour—and having experienced drunkenness once or more is mainstream behaviour among 15-year-old Danes [93], but not among 11-year-olds [94].

6.2.2 School

School variations
The results confirm that there is significant variation in adolescent alcohol use across schools. I used MOR and ICC to quantify how much of the variation in adolescent alcohol use was situated at the school level. When studying school variations in alcohol use, an important question is to what degree the school variations are a result of students’ individual demographic characteristics, i.e. compositional factors [95]. Compositional explanations are due to the individual characteristics of adolescents concentrated in a particular school [44]. The MOR and ICC changed only slightly after inclusion of individual factors (Study I,
Study II and Study III), which suggests that the variation in adolescent alcohol use was not due solely to student composition. After controlling for individual-level socio-demographic factors, there was still significant school-level variation. ICC ranged from 3 to 13% and the MOR ranged from 1.35 to 1.96. Few other studies have examined school variations in alcohol use [96]. An American study of secondary schools, found that about 3–7% of the variance in binge drinking and alcohol use in the previous 30 days lay between schools [96]. Other school-based studies from the US, New Zealand and Canada, which were not directly aimed at exploring variation in adolescent alcohol use, have also reported significant school variation in adolescent alcohol use [37, 97-99]. The reported ICCs in these studies were generally lower (range 3.7—7.3) than those reported in Study I. The lower ICCs may reflect a generally lower prevalence of adolescent alcohol use in these countries [37]. Overall, the school variations suggest that school is an important context in relation to adolescent alcohol use. Our findings add to the growing body of literature demonstrating school-level differences in health related behaviours such as alcohol use [33].

School connectedness

I found a relation between a low level of individual-perceived school connectedness and a high level of drunkenness. This finding is in line with results from other cross-sectional studies [32, 83, 100]. There are few longitudinal studies in this area, but those that exist have demonstrated that students’ school connectedness predicted later alcohol and drug use [39, 101, 102]. In general, poor school connectedness has been shown to be an important modifiable risk factor that affects a range of undesirable outcomes, such as physical and mental health problems [39, 103], substance use [39], and low academic performance [39]. The social development model [104] has been used to explain these relationships proposing that connectedness to family, schools, peers, and community, combined with experiences of positive socialization is protective against risk behaviours [105].

School climate

Few studies have examined the relation between adolescent alcohol use and school social climate analysed at the school or school-class level [32, 99, 106]. These studies suggest that school climate may exert an influence on health-risk behaviours above and beyond the individual-level effects [32, 106, 107]. In support of these studies, I found an association between poor school climate and adolescent drunkenness in Study II. There may be various explanations for the observed association between school-class climate and adolescent alcohol use. Social development theories state that adolescents who have strong ties to schools
will adopt the school’s norms and values, and for this reason, will abstain from engaging in deviant behaviours that are inconsistent with the school’s expectations [104, 108], such as getting drunk.

Is school climate a protective factor for drunkenness?

Consistent with Bronfenbrenner’s notion about interacting microsystems [20], I found that a positive school climate buffered the harmful effects of low parental support among younger adolescents. This finding highlights the role of school’s social climate and contributes to the sparse research on the protective effects of school climate. Few studies have addressed this issue. To my knowledge, no studies have examined the buffering effect of school climate analysed at the school level, but one study examined the buffering effect of individual school connectedness. This study among American Indian adolescents found that school connectedness buffered the effect of peer alcohol use among younger adolescents [109].

6.2.3 Community

Adult drinking patterns

Does adolescent alcohol use reflect drinking patterns in the community and country? Few studies have addressed this question, but according to the findings in Study III and Study IV, this seems to be the case. Study IV demonstrated that country-level adult drinking pattern, was associated with adolescent drunkenness. The finding was consistent across different cut-points of drunkenness (e.g. having been drunk one, two or four or more times) and the finding was supported by Study III, which demonstrated an association between adult drinking patterns and adolescent drunkenness at the community level. The findings from these two studies suggest that adult drinking patterns in the social context are important in relation to adolescent alcohol use as also suggested in other studies [110]. A small number of, mostly, ecological studies have also found a positive relationship between adult alcohol consumption and adolescent drinking behaviour on aggregated data [52, 82, 111, 112].

Alcohol education, availability, youth-friendly environment

Study I found a significant school variation in adolescent alcohol use which lead to the inclusion of school and community-level variables in Study III. It was therefore unexpected that I did not find adolescent drunkenness to be associated with alcohol education, youth-friendly environment and number of alcohol outlets. The non-significant results regarding alcohol education could be explained by numerous factors.
First, it could be that schools with a high level of alcohol use are more likely to introduce alcohol health education than are schools with a low level of alcohol use. Second, it could be that the quality of the school's alcohol education is more important than the actual formulations of a policy. This aspect is not considered in my study [113].

In contrast to other findings [65, 66, 114, 115], I did not find an association between higher outlet density and adolescent drunkenness in the community. This may be due to inadequate operationalization of the variable. The measure was based on school leader reported data, and school leaders may not have sufficient knowledge about alcohol availability in the school's vicinity. A second problem was that availability in the school vicinity may be less important than availability in the area where the student lives. I asked about shops near the school, but since alcohol is rarely consumed in the school this may not be sufficiently. Third, there was little exposure contrast in alcohol availability. Only three schools had no shops in the school vicinity selling alcohol and this category was therefore collapsed with those reporting one shop selling alcohol.

The association between youth-friendly environment and drunkenness went in the expected direction, suggesting that a youth-friendly environment is associated with lower odds of drunkenness, but the association was non-significant. I have not been able to identify any similar studies. It is therefore difficult to determine whether the lack of significance reflects a lack of association between the variables or whether it was due to lack of power in the study (I had data on only 51 schools).

6.2.4 Country

Policies

Restrictions on availability and advertising policies at the country level were associated with less frequent drinking among adolescents. The result that restrictions on availability may reduce frequency of adolescent drinking corresponds with other studies [51, 82, 116]. Although many young people succeed in buying alcohol despite age restrictions [54, 55, 117], the general observation is that a higher minimum purchasing age is associated with decreases in the proportion of adolescents buying and drinking alcohol frequently [56-59]. A review including studies published between 1960 and 1999 found that the majority of studies suggest that restrictions on availability, such as higher minimum purchasing age, reduce alcohol consumption [63]. I also found an association between limited advertising restrictions and higher odds of weekly drinking. The findings from a review including data from seven prospective cohort studies suggest
there is an association between exposure to alcohol advertising and alcohol consumption among adolescents [118].

6.2.5 Socio-demographic factors

Age, sex, family structure and migration status were included as individual co-variates in all studies. Older age and being a boy were significantly associated with drunkenness. In line with previous findings documenting gender convergence in alcohol patterns and consequences among adults [119-122] and adolescents [17], the gender differences found in my studies were rather small. Drunkenness is generally viewed as more socially acceptable for males than for females and as more consistent with traditional male gender [123]. Therefore, males who identify with traditionally masculine attributes would be expected to drink more heavily and females who identify with traditionally feminine attributes would be expected to drink less heavily than their respective less conventional counterparts. In line with this, it has been suggested that greater gender equality in a country is associated with smaller gender differences in drinking behaviour [124]. In this perspective, the small gender differences found in my studies may reflect less traditional gender roles and relatively high gender equality among adolescents in Denmark. Generally, there were differences in alcohol use between migrants, descendants and ethnic Danes. Ethnic Danes had a threefold odds ratio for drunkenness compared with immigrants, which suggests that drinking culture may vary across country of origin. Adolescents from single parent families had a higher likelihood of being drunk than adolescents living with both biological parents, as found in other studies [67, 125]. The effects of family structure on adolescent alcohol use have been suggested to operate primarily through weakened relations between adolescents and their parents [67]. Biblarz and Raftery’s [126] review suggests that the experiences associated with single parenthood, divorce, remarriage and widowhood can lead to inconsistent parenting, less supervision over adolescents, and more peer-like relationships with the children with an associated loss of supervision and authority.

6.3 Adolescent alcohol use as social practice

Inspired by Frohlich [46], Giddens [75] and Skog [47], I found support for the idea that adolescent alcohol use is a social practice reflecting social norms and consumption patterns in the society. In my analyses adolescent alcohol use reflected consumption patterns and drinking behaviour in their family, community and country.
Frolich sees lifestyle as a set of social practices formed by choices and chances. She thereby understands behaviour as influenced by structure and choice, as does Giddens. Structure enables and constrains individual behaviour. Norms and rules about alcohol use could be seen as a part of this social structure that is reproduced in adolescent alcohol use. In the thesis, these norms for behaviour were operationalized by measuring adult drinking patterns at the community and country level. If we acknowledge the duality between agency and structure, the high prevalence of drunkenness among Danish adolescents should not just be seen as a result of adolescents’ free choices. It should also be seen as a reflection of the rules and norms for drinking. The high prevalence of drunkenness among Danish youth could thereby be interpreted as a reproduction of a general drinking practice, i.e. drinking culture in Denmark.

I found that adolescents’ alcohol use was associated with drinking culture, measured as adult drinking behaviours, in the family (Study II), community (Study III) and country (Study IV). These results support the idea that alcohol use could be seen as a social practice. In this perspective, drinking alcohol is not only a personal choice based on individual motivation and expectancies in relation to alcohol; it is also strongly influenced by, and at the same time maintaining, the structure, such as norms and drinking behaviour in the context.

To some extent the thesis confirms Skog’s notion about collective drinking patterns—alcohol use in adolescence has to be considered not only as an individual behaviour, but also as a social behaviour. The variation in alcohol use across schools, communities and countries, and the association between adult drinking and adolescents’ drinking suggest that—among Danish youth—drinking alcohol is a group phenomenon with a strong collective element as proposed by Skog [47].

6.4 Methodological considerations

6.4.1 Strengths

The major strengths of Study I and II were the use of multilevel models and the hierarchical data structure with more than 10,000 students nested in 116 schools. The design allowed me to estimate the school variations across a large sample of students and to examine the complex interrelationships that exist among family social support and school climate regarding adolescent alcohol use.

In Study III, I had access to data on the community level, which I merged with the HBSC student data. The use of two national, representative surveys added to the strength of the study by eliminating the risk of same-source bias [127] and by making it possible to analyse the link between adolescent drunkenness and community-level adult drinking patterns.
The obvious strength of Study IV was the use of a large and representative sample of students in many countries. The standardized measures and methods used in the international HBSC study provide a unique opportunity to examine cross-national differences and similarities in adolescent alcohol use in a large number of countries. The international research protocol has detailed instructions and guidelines on sampling procedures to assure representativity of the samples drawn in each country and to obtain international comparability of the data [77]. Another marked advantage was the link with country-level data, which was used to carry out comprehensive analyses of the association between youth drinking, adult drinking patterns and alcohol control policies. Last, the study included two outcome measures, drunkenness and weekly drinking, which allowed us to analyse differences and similarities between these two outcome measures and country-level predictors.

6.4.2 Design issues

All studies in the thesis were based on HBSC data. The cross-sectional design generally hinders establishment of causality. Cross-sectional data can establish that a variable correlates with alcohol use but cannot determine the direction of influence between the two variables. As an example, I cannot confirm that low school connectedness led to adolescent drunkenness. The causality could potentially be in the opposite way, where drunkenness led to low school connectedness or there could be no causality at all (Study I). I face a similar problem in Study IV, where it may be relevant to ask: did youth drinking or policy come first? Alcohol control policies are sometimes reactive and sometimes reflective [128], and I cannot determine whether strict policies reduce the level of youth drinking or whether a high level of youth drinking causes strict policies. Ideally, one would conduct a cluster randomized trial in which countries are randomly assigned either to a group that implements a strict and consistent alcohol control policy or to a group that does not. However, in practice this would be virtually impossible to do. Other associations are more easily interpreted. As an example, it would be unlikely to expect that parental drinking, family structure, migrations status or country-level prevalence of abstainers were influenced by adolescent alcohol use but still I have no evidence of causality.

6.4.3 Selections bias

Selection bias could have biased my results. The individual response rate was 85% in Study I, calculated as the proportion of students who answered the questionnaire from the students who were formally enrolled in the participating classes. Non-participating students may show higher rates of alcohol use compared with
those present at school [129]. Since alcohol use has been related to truancy [102, 130], this potential selection bias would most likely result in an underestimation of the school-level prevalence of alcohol use.

In Study II, which was based on the same survey as Study I, I found that low school connectedness was associated with higher odds of drunkenness. Low school connectedness and drunkenness have been linked to absence from school [39, 102, 131]. It is therefore likely that non-participants would have lower school connectedness and a higher prevalence of drunkenness compared with participants. If selection bias was present, the association between school connectedness and drunkenness should differ among participants and non-participants. Since my finding was in line with others [83, 100], I have no reasons to believe that this should be the case. Nevertheless, I cannot rule out this possibility, since I did not have information on non-participants.

Study III analysed the association between community-level adult alcohol consumption (AAC) and adolescent drunkenness. I used data from the Danish National Health Survey 2010 to estimate community-level AAC. The response rate varied from 52.3% in the Capital Region of Denmark sample to 65.5% in the North Denmark Region sample [78]. This could potentially result in an underestimation of the alcohol use in municipalities with low response rates since non-participants tend to drink more alcohol than participants. However, since the highest AAC was found in areas with the lowest response rates (e.g. the Capital Region of Denmark had the lowest response rates combined with the highest AAC), this bias is not considered a major concern. Further, the Danish National Health Survey 2010 had unique personal identification numbers on respondents and non-respondents, which meant that all participants and non-participants could be linked to different central registers [78]. Hence, to a certain extent it was possible to statistically allow for the non-response by using information from Statistics Denmark’s registers. As part of the sensitivity analyses, I therefore performed the analyses with weighted and un-weighted AAC, which gave nearly similar estimates. Another concern in this study was the low school participation in HBSC 2010. The response rate at the individual level was relatively high (86%) but at the school level only 53% of the schools participated. Most schools refused to participate because of reasons not related to the study population such as recently participation in another health survey. Unfortunately, a detailed analysis of non-respondent schools was not possible due to the complete anonymity in the HBSC study.

Study IV was based on the international sample and included data from 37 countries. Selection bias would be present if the associations between country-level measures (alcohol control policies and adult drinking pattern) and adolescent alcohol use differed between participants and non-participants. I have no reason to believe that this should be the case [132].
6.4.4 Self-reported measures of alcohol use

Measures of having tried drinking, drunkenness, binge drinking and frequency of drinking were obtained from students’ self-reports, which may imply some misclassification. Participants may tend to under-report or over-report alcohol use according to whether they perceive the behaviour to be socially undesirable or desirable [133, 134]. In a Danish context where the attitude towards drinking is generally positive [4, 15], it is feasibly to expect that some adolescents will exaggerate their alcohol experiences. As an example, information bias could have occurred if students in communities or countries with high levels of adult drinking over-reported drunkenness. This may not be of importance if overestimation is equal across municipalities or if the overestimation is the same for school-aged children and adults within municipalities, i.e. if there is no differential bias between adolescent reports of drunkenness and volume of drinking reports of adults.

In general, the validity of self-reported alcohol consumption among adolescents is sparsely investigated. A review by Brener et al. [135] concluded that although self-reports are affected by both cognitive and situational factors, this does not threaten the validity. Other studies have also found that self-reported data on alcohol use are highly accurate under conditions of confidentiality and privacy [136, 137]. The HBCS study used simple questions and ensured anonymity to help generate reliable and valid data.

6.4.5 Unmeasured confounders

A substantial body of literature in Denmark and other countries has examined social inequalities in adolescent alcohol use [11, 35, 138-140]. While some studies have identified a higher risk of excessive adolescent drinking among lower socio-economic groups [140], others have found no [138] or even inverse social gradients in adolescent alcohol consumption [139, 141, 142]. In Study I, Study II, and Study III, parental occupation was included as a measure of parental socio-economic position (SEP) in the preliminary analyses. In the final thesis, however, the variable does not appear in any of the results. There were several reasons for this. First, the prevalence of alcohol use showed very few differences across social classes in Denmark [94]. Second, when parental occupation was included in the analyses, the variable turned out to be insignificant and the models showed approximately similar results with and without parental occupation. Third, a relatively large proportion of respondents gave information about parents’ occupation that was insufficient for coding of social class, leaving 19.5% unclassifiable in the 2006 sample and 15.3% unclassifiable in the 2010 sample. Accordingly, I decided to omit this measure. Nevertheless, some of the associations found in the studies may be confounded by unmeasured socio-economic position.
The aim of Study I was to quantify the school-level variation in adolescent alcohol use and to analyse whether the variation was due to the socio-demographic composition of the students. Based on prior studies, I included a large range of socio-demographic variables such as age, sex, migration status, family structure and parental occupation. Hence, I do not consider unmeasured compositional factors to have a large impact on the estimated school variation in this study. Study II analysed whether adolescent drunkenness was associated with school connectedness and school climate. Teacher-student relationship has shown to be associated with adolescent alcohol use and school connectedness [99] but was not included in the analyses because of lack of data. There may, therefore, be a teacher-effect that I did not account for. In Study III I did not have data to control for alcohol-specific parenting practices [22, 143], urbanization [144] or area-level-socio-economic characteristics, which elsewhere have been found to be related to adolescent drunkenness [145]. Study IV may also suffer from unmeasured confounding. As an example, there may be country differences in the extent to which alcohol control policies are enforced [53]. I did not have information on this variable, so policy measures in Study IV reflect legislation rather than practice.

6.4.6 Residual confounding

The validity of my results may be threatened not only by unmeasured confounding as described above but also by residual confounding. The operationalization of the variables may be too crude. In Study I migration status was used to assess ethnic background. Migration status is only one aspect of ethnic background, and it does not capture the acculturative and integration process of non-majority citizens [146]. The measure of school connectedness in Study II was based on Rasmussen et al.’s definition [85], which does not include aspects of the teacher-child relations or students’ feelings of empowerment, which have been used as a proxy for the school climate in other studies [99]. Because school connectedness is a relatively new concept, consensus has not been reached upon how it should be defined, and there are a multitude of overlapping concepts (e.g., school engagement, school commitment, belonging, school satisfaction) [147]. Study III includes a measure of community-level adult alcohol consumption, which was operationalized at municipality level as the proportion of adults with a high-risk alcohol use (above for 21 units/week for men and above 14 units/week for women). This is a simple measure that does not provide information about frequency of drinking or heavy episodic drinking [148]. Another example is the operationalization of parental drinking. This variable was based on information on mother’s and father’s frequency of alcohol use, which does not take the aspect of quantity in to account which may be related to adolescent drunkenness in another way than is frequency of alcohol use [25].
6.4.7 The physical boundary of an area

The concept of community has been identified as key idea in sociology, but the term has been defined in so many ways and used in so many contexts that it has lost much of its meaning. It may be used to refer to the psychological sense of community, a functional spatial unit or an aggregate of individuals in a geographic area [73]. Macintyre points out the need to recognize that areas are not only compositional descriptions of the people who live in them [44]. Instead, there may be a number of social, cultural or economic aspects of the environment that create the experience of what it "feels like" to live in an area. This experience, along with physical and other types of aspects of the context, may promote or inhibit possibilities of leading a healthy lifestyle. When measuring community-level adult alcohol consumption, I rely on census tract boundaries. This census-based measure of community may overlook social processes. Studies of community effects using census data to characterize communities have methodological limitations, as noted by researchers working in the field [127]. Municipalities can be heterogeneous and they do not necessarily reflect individuals' interaction and the sense of identity. Unfortunately, I did not have access to data about geographical districts closer to the neighbourhood in which the participants lived.

In Study IV, I analysed drinking culture and country-level differences in adolescent drinking patterns. The conventional way of addressing cultural differences, especially cultural differences in drinking patterns, refers to countries. "Danish drinking culture" is compared with Spanish drinking culture, or more widely Nordic drinking patterns are compared with Southern drinking patterns. There may, however, be even wider differences within a country than across countries [149], and the country convergence in adolescent drunkenness [17] could indicate that adolescent alcohol use is influenced more by global trends, such as Facebook and Internet use, than by country-level factors. Therefore country may not be an adequate boundary.

6.4.8 Multilevel design - how many levels do we need to include?

The international design of Study IV introduces some methodological biases. For instance, the school systems are different across the participating countries. Therefore, school grade and school class may represent different concepts across participating HBSC countries. As an example, grade represents a homogenous age group in a country such as Denmark where students are rarely promoted or held back. Grade includes more heterogenic age groups in other countries, and students of the same age may attend many grade levels. Further, the sampling procedure introduces some methodological considerations. Depending on the availability of a class-based sampling frame the sampling unit varies and some countries select schools while others select classes. Therefore some countries have schools with few students while
other countries, such as Denmark have a large number of students in each school. Some of the countries that sample classes use data only from some students in the classroom, those students who fit the age categories 11-, 13-, and 15-years-old. Because of the heterogeneity between different countries, the school level was omitted in the multilevel model in Study IV, which may have biased our estimates.

6.5 Implication for research

6.5.1 Future research

Overall, the findings from this study contribute to the literature acknowledging the importance of the school context in relation to adolescent alcohol use. Study I, Study II and Study III showed unexplained variation in adolescent alcohol use at the school and school-class level. That indicates that the variation in drunkenness was only partially explained by the included variables. Future research should therefore further explore the role of school in relation to adolescent alcohol use. I propose collecting more detailed information about school-level factors, such as school climate and alcohol norms to examine and model the relation between school-level factors and adolescent alcohol use more comprehensively, preferable in longitudinal studies. Our findings also demonstrate the need for a more thorough examination of the paths by which community can influence adolescent alcohol use.

6.5.2 An epidemiological perspective on adolescent alcohol use

The thesis aims to investigate the relation between adolescent alcohol use and the social context. My curiosity was guided by the wish to understand why Danes, especially the Danish youth, have such a high rate of drunkenness and furthermore to analyse factors associated with drunkenness. The thesis was driven by an epidemiological approach, which has influenced my aims, analyses, and results, in this thesis. To fully understand the complexity of adolescent alcohol use, I believe that perspectives other than the epidemiological are needed. Therefore, I have tried to integrate a sociological approach in the epidemiological studies. My sociological background has contributed to the understanding of social processes connected with adolescent alcohol use. As an example, I see adolescent alcohol use as a social practice comprising both structure and agency, and in my studies I aimed to analyse adolescent alcohol use in relation to the adolescents’ social contexts.

However, since my studies are based on an epidemiological approach I came short when I try to understand how drinking is embedded in adolescents’ lives and the very different meaning alcohol has among adolescents. Future studies using other methods could further enhance our understanding of adolescent alcohol use and the relation between the social context and adolescent drinking. Qualitatively studies could
help us understand the symbols and meaning attached to adolescents’ experiences with alcohol and further clarify the mechanism behind some of the findings that revealed in this thesis, such as, why do I find a relation between parental drinking and adolescent drinking? Why does adolescent alcohol use differ across schools? What characterizes the social relations, norms and everyday life for adolescents in schools with a low prevalence of youth drinking versus adolescents in schools with a high prevalence of youth drinking?

6.6 Implications for practice

6.6.1 The Danish drinking culture

“Average alcohol consumption among Danish adolescents is high in relation to adolescent drinking in other parts of Europe and North America and being regularly drunk is more the rule than exception” [150](p. 153)

In Denmark alcohol use is a socially accepted behaviour that is strongly embedded in the Danish culture. There is a broad social acceptance of excessive drinking among young Danes and hardly any adolescents view their own alcohol consumption as being too high [150]. As found in this thesis, adolescent alcohol use is in accordance with the drinking culture, e.g. the adult practices in their surroundings and by the cultural and legal rules that determine where, how and when it is appropriate to drink [151]. The minimum purchasing age in Denmark is 16 years for light alcoholic beverages (<16.5 % alcohol) and 18 years for strong alcoholic beverages such as spirits (≥ 16.5% alcohol). This is the case for other European countries, such as Germany, the Netherlands and Belgium, while it is lower than the legal purchase age in the USA or New Zealand. However, alcohol use is widely accepted and it is relatively common for parents in Denmark to provide their adolescent with alcohol [14]. The acceptance of risky alcohol consumption as a part of socially accepted and normal behaviour is one of the challenges that must be faced if we attempt to prevent excessive drinking in youth.

6.6.2 How to change the Danish drinking culture?

The results of this thesis argue for preventive programs that include as many contexts as possible, such as parents, school, communities and countries, to create an overarching context with a drinking culture that does not promote heavy drinking among adolescents [152]. As mentioned earlier, drinking alcohol is not only a personal choice based on individual motivation and expectancies in relation to alcohol, it is also strongly influenced by norms and drinking behaviour in the context. Therefore, when it comes to explaining and preventing adolescent alcohol use, I argue that a strategy that integrates factors from different social contexts is needed [89]. At the school and family level, this includes promoting positive school climates and
good parent-adolescent relations. At community and country level, prevention should be focused on lowering both the adult and adolescent alcohol consumption. Community-based interventions that aimed to reduce the availability of alcohol have shown positive results [153, 154]. Furthermore, countries should pay attention to alcohol control policies because my study and other studies have found that comprehensive alcohol control policies were associated with reduced alcohol use among adolescents.

In line with other studies, I found an association between low school connectedness and higher odds of drunkenness. Hawkins et al [155] reported that interventions, applied during the elementary school years, successfully improved school bonding at age 18 years, suggesting that school connectedness is malleable. I found evidence of the contextual effect of school climate. A positive school climate was linked to lower rates of drunkenness and acted as a buffer against low parental support. This finding suggests that interventions to prevent excessive alcohol use should attempt not only to improve individual school satisfaction but also to enhance the overall school climate [106]. Enhancing the level of school climate and school connectedness might not only have beneficial effects on students’ wellbeing but may also help to lower the level of drunkenness [156]. This approach is supported by the evidence from a recent systematic review of experimental and observational studies, that concluded that modifying the schools’ social environment can significantly reduce substance use, and may be a highly effective complement to existing interventions addressing individual knowledge, skills and peer norms [157].

The fact that the school is important in influencing adolescent drinking behaviour, over and above individual-level socio-demographic factors [33], offers important avenues for prevention and calls for intervention that addresses the broader context of adolescent life. There is a considerable body of research on school-based programmes to prevent excessive alcohol use among adolescents, but empirical evidence of effectiveness of these school-based programmes is rather weak [158, 159]. Student-level educational programmes often show none or very modest effects in changing long-term behaviour [158, 160]. Therefore, interventions that aim to change the drinking culture or drinking environment in schools or communities may be more effective [152]. This may include policies for school events and parties, as well as strict enforcement of rules with respect to alcohol in schools. A couple of school studies confirm this and found a higher prevalence of adolescent alcohol use in schools where drinking was perceived as socially acceptable and commonplace [161], and, conversely, adolescent alcohol use was less likely in schools with high average levels of disapproval regarding substance use in general [36, 96].

The knowledge that a positive school climate can buffer the effect of low parental support among younger adolescents is to some extent an encouraging discovery in relation to social inequalities in drinking patterns. Adolescents from less advantaged families are more likely to suffer from low parental support [162] so a buffering effect of school climate on the relation between low parental support, and
drunkenness may be of particular importance in this group of adolescents. However, it was beyond the scope of this thesis to examine the differential effects of school-class climate among different social groups. This would be relevant to address in future studies.

The findings that adolescent alcohol use varies with community-level context and that adult drinking patterns are reproduced in adolescent alcohol use could potentially be used as a tool to identify which communities to target for prevention [43]. In accordance with other studies, I suggest that prevention efforts to reduce adolescent alcohol use should target adult practices as well as the drinking behaviour among adolescents themselves [67]. The result also suggests that the community is an important social context for prevention of adolescent alcohol use. A number of studies have successfully included community-organizing components and found community-based interventions to be effective in reducing adolescent alcohol use [152-154].

An important finding at the country level was that availability policies were found to be related to drunkenness and frequency of drinking among adolescents. Since availability policies can be controlled by public health policy, this finding holds considerable importance from a public health perspective. Another important finding was that boys seemed to be more influenced by alcohol control policies while girls were more influenced by drinking patterns in the country. This points to the importance of alcohol control policies in relation to reducing boys’ alcohol use while social norm interventions might have a greater impact on girls’ alcohol use. As alcohol use among adolescents is highly prevalent, even modest effects applied to the entire population of youth could potentially result in very large societal benefits.
7. Conclusion and future perspectives

Based on the findings from the present thesis, I conclude that family, school, community, and country are important contexts in relation to adolescent alcohol use. Inspired by Frohlich [46], Giddens [75] and Skog [47], I found support for the idea that adolescent alcohol use is a social practice that reflects social norms and consumption patterns in the society. In my analyses, adolescent alcohol use reflected consumption patterns and drinking behaviour in the family, community and country. The results suggest that the high prevalence of drunkenness among Danish youth could be interpreted as a reproduction of the general drinking culture in Denmark. To some extent the thesis confirms Skog’s notion about collective drinking patterns—alcohol use in adolescence has to be considered not only as an individual behaviour, but also as a social behaviour. The variation in alcohol use across schools, communities and countries, and the association between adult drinking and adolescents’ drinking suggest that—among Danish youth—drinking alcohol is a group phenomenon with a strong collective element as proposed by Skog [47].

The thesis found that adolescent alcohol use was highly rooted in the Danish drinking culture and almost all 15-year-old Danes had tried alcohol. This has implications for the way to approach the problem. Adolescents choose to consume alcohol, not just because of personal characteristics, such as personality type or motivations, but also because it is a part of daily life in their communities and, for many adolescents, in their families. I also found that numerous social and contextual influences were related to adolescent alcohol use, including school connectedness, school climate, parental support, parental drinking, community practices, advertising, and alcohol control policies. Therefore, when it comes to explaining and preventing adolescent alcohol use, I argue that a strategy that integrates factors from different social contexts is needed.
English summary

Introduction: By the late-teens, the majority of European adolescents have tried alcohol. Most consume alcohol at least monthly, and about one quarter of adolescents drink heavily at least occasionally. Compared to other countries, Denmark has a high prevalence of drunkenness among adolescents, and drinking to intoxication is widespread even among young teenagers. Excessive alcohol use in adolescence is associated with a range of adverse effects, including brain damage; academic failure; injuries; risky sexual behaviour; and later excessive use and alcohol dependence. Accordingly, it is important to investigate the processes associated with adolescent alcohol use. Risk factors for adolescent alcohol use are typically conceptualized as individual risk factors; however, these factors do not fully explain adolescent drinking behaviour. In addition to individual factors such as perceptions, drinking motives and beliefs, a second level of influence is found in the social context.

The overall objective of the thesis was therefore to analyse how features in the social context are related to adolescent alcohol use. I used the social ecological paradigm as an overarching analytical framework and analysed the relationship between adolescent alcohol use and contextual influences at the family, school, community and country level.

Aims: Study I analysed how adolescent alcohol use differed between schools and whether the school variations were due to differences in the socio-demographic composition of students. Study II examined the association between school connectedness, parental support, school-class climate and drunkenness, and whether a positive school-class climate buffered the effect of low parental support on adolescent drunkenness. Study III examined whether drunkenness among adolescents was associated with community-level adult alcohol consumption, and if so, whether the association persisted after inclusion of key demographic factors and parental drinking. Study IV, which was a comparative study with 37 countries, examined cross-cultural variations in adolescent alcohol use and the associations between adult drinking patterns, alcohol control policies and adolescent alcohol use.

Method: The thesis included four studies which were based on data from the international research project the “Health Behaviour in School-aged Children (HBSC)”, a WHO collaborative study. The HBSC study is a cross-sectional study that monitors quality of life indicators, health status and health behaviour among 11-, 13- and 15-year-old students from randomly selected schools in each participating country. Study I and Study II were based on national data from the Danish contribution in 2006 (n=10,801). Study III used
national data from 2010 (n=2,911) that were merged with data from the HBSC 2010 School leader survey and the Danish National Health Survey 2010 to explore the influence of school- and community-level factors. Study IV used international HBSC data from 2009/10 (n= 144,788). Country-level factors on adult drinking practices and alcohol control policies were primarily retrieved from WHO. All analyses were performed by using multilevel modelling, which allowed separation of variation at the individual and contextual levels. The thesis used four measures of alcohol use: 1) having tried alcohol, 2) habitual/weekly drinking, 3) lifetime drunkenness, and 3) binge drinking.

**Results:** Study I found large variations across schools in Denmark in the prevalence of drunkenness, weekly drinking and having tried alcohol—even after inclusion of individual-level socio-demographic characteristics. Study II demonstrated that low parental support, low school connectedness, and a poor school climate were associated with higher odds of drunkenness. Furthermore, a positive school climate buffered the impact of low parental support in early adolescence. Findings from Study III showed that adolescents who lived in communities with high adult alcohol consumption (AAC) had significantly higher odds of drunkenness than did their peers in communities with lower AAC. Parental drinking was significantly associated with adolescent drunkenness but did not attenuate the association between community-level AAC and adolescent drunkenness. Last, Study IV found that less restrictive alcohol control policies and high levels of adult per capita consumption were associated with higher odds of drunkenness and weekly drinking among adolescents.

**Conclusion:** A socio-ecological framework is appropriate for examining the importance of social relational, behavioural and policy factors for adolescent drinking in the micro-, exo-, and macrosystem. I found that family, school, community, and country were important contexts in relation to adolescents’ alcohol use. On the basis of this thesis, I conclude that adolescent alcohol use differs between schools in Denmark and that school has the potential to buffer the harmful effect of low parental support. Further, I conclude that family, school, community and country constitute important social arenas in adolescents’ lives and play considerable role in the development of different drinking behaviours among youth.
Danish Summary


data fra HBSC 2010 Skolelederstudiet og data fra Den Nationale Sundhedsprofil 2010, for at undersøge betydningen af skole- og kommunefaktorer for unges alkoholforbrug. **Studie IV** benytter data fra det internationale datasæt. Desuden har jeg opbygget en database med information om alkoholpolitik og alkoholkultur på nationalt niveau. Analyserne er udført ved brug af multilevel-modeller, der tager højde for den hierarkiske datastruktur med elever indlejret i skoler, og som gør det muligt at analysere betydningen af faktorer på flere niveauer simultant. Afhandlingen inkluderer fire mål for alkoholforbrug: 1) at have prøvet at drikke alkohol, 2) hyppighed målt som ugentligt forbrug, 3) fuldskab og 4) rUSDrikkeri (binge drinking).

**Resultater:** Afhandlingens hovedresultater var følgende: Der er store skolevariationer i andelen af unge, som har prøvet at drikke alkohol, har været fulde og som drikker ugentligt — selv når der tages højde for elevsammensætningen på skolerne (**Studie I**). Unge med lav familiestøtte og skoletilknytning, og som går i skoler med dårligt klassemiljø, har øget risiko for at have været fulde. Et positivt klassemiljø kan til dels kompensere for effekten af manglende forældrestøtte (**Studie II**). Unge i kommuner med et højt alkoholindtag, har højere odds for at have været fulde sammenlignet med unge i kommuner, hvor voksenbefolkningen har et lavt alkoholindtag — selv når der tages højde for forældrenes alkoholindtag (**Studie III**). På nationalt niveau var højt alkoholindtag i voksenbefolkningen og lave aldersgrænser på salg af alkohol forbundet med øget risiko for fuldskab blandt unge. I forhold til hyppighed i alkoholforbrug, viste det sig at en restriktiv alkoholpolitik på nationalt plan var forbundet med mindre hyppigt alkoholindtag (**Studie IV**).

**Konklusion:** Resultaterne for studierne bekræfter Bronfenbrenners ide ved at påvise, at familie, skole, kommune og nation alle er vigtige sociale kontekster med betydning for unges alkoholforbrug. Resultaterne understreger dermed, at den sociale kontekst er væsentlig at medtænke i fremtidige studier af unges alkoholforbrug. På baggrund af resultaterne kan jeg konkludere, at unges alkoholforbrug varierer mellem skoler, og at skolen til dels har mulighed for at kompensere for den skadelige effekt af manglende forældrestøtte. Dermed er skolen såvel som familien, kommunen og landet oplagte forebyggelsesarenaer, der alle bør bringes i spil, hvis det skal lykkes at nedsætte alkoholforbruget blandt danske unge.
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Study I

How alcohol use differs among schools: a multilevel analysis of adolescents’ drinking behavior

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Status: Submitted
How adolescent alcohol use differs between schools: a multilevel analysis of adolescents' drinking behaviour

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Abstract

The present study examined and quantified variations in drinking behaviour across schools and analyzed how these variations were related to the socio-demographic composition of the schoolchildren. Cross-sectional nationwide survey data from 10,801 schoolchildren (mean age = 13.6) nested in 116 schools were used to conduct multilevel logistic regression analyses. We found substantial variation in drinking behaviour between schools even after inclusion of individual-level socio-demographic characteristics such as age, sex, family structure and migrations status. This finding suggests that the variation in drinking behaviour between schools were not solely a result of differences in the socio-demographic composition of schoolchildren. Intra class correlation showed that 4–16% of the total variation in alcohol use was at the school-level. This suggests that alcohol use among adolescents could be regarded as a group phenomenon and that schools are important social settings in which adolescents alcohol use are developed.

Keywords: Adolescence; Schools; Alcohol use; Multilevel analysis
Introduction

Excessive alcohol use causes illness and death worldwide (Room, Babor & Rehm, 2005; World Health Organization, 2002) and is a public health problem among adolescents. High and early alcohol use in adolescence can lead to later excessive use, alcoholism (Andersen, Due, Holstein & Iversen, 2003; Casswell, Pledger & Pratap, 2002; Dewit, Adlaf, Offord & Ogborne, 2000) and increased risk of injuries (Bonomo et al., 2001; Danielsson, Wenneberg, Hibell & Romelsjo, 2011; Jiang, Boyce & Pickett, 2008). In order to support less problematic drinking among adolescents it is important to investigate factors related to high alcohol intake in youth. Denmark has one of the highest prevalences of youth drinking, and drinking to intoxication is widespread even among young teenagers (Currie et al., 2012; Hibell et al., 2012; Kunsthøj et al., 2011). Alcohol is regularly consumed by the majority of Danes (Makela et al., 2001), and drinking and partying are part of most adolescents’ everyday life. This leads to a high acceptance of heavy drinking, which is accompanied by a high tolerance of alcohol-related problems (Plant, Plant, Miller, Gmel & Kutsche, 2009).

School-level alcohol use

Individuals’ alcohol consumption reflects the general drinking norm of their social environment and culture (Skog, 1985). Adolescents’ alcohol use is influenced by their school and by the context in which they live (Mrug, Gaines, Su & Windle, 2010; Reboissin, Preisser, Song & Wolfson, 2010; Song et al., 2009). Skog argues that drinking preferences are shaped and reshaped in social interaction with peers and societal institutions (Skog & Rossow, 2006). In Denmark, adolescents’ alcohol use is mainly a social phenomenon—they drink for fun and to belong to a group (Demant & Østergaard, 2007). Schools are important environments in which risk behaviours such as alcohol use are nurtured (Henderson, Ecob, Wight & Abraham, 2008; Sellström & Bremberg, 2006). The school communicates
common cultural values through its social organisation, culture, and through the formal curriculum. Further, it constitutes an arena for social interactions and the development of friendships. Therefore the school has a potentially large influence on adolescents’ alcohol use.

Few studies have examined variations and distributions of aggregated school rates of adolescents’ alcohol use, even though it has been stated that measures of variances are a key topic that conveys essential information to our understanding of contextual phenomena (Merlo, Ohlsson, Lynch, Chaix & Subramanian, 2009; Reboussin et al., 2010). O’Malley et al. (2006) found that about 3–7% of the variance in binge drinking and alcohol use in the past 30 days lies between schools. Kairoz & Adlaf (2003) found that both student-level and school-level variables are important determinants of adolescents’ heavy drinking behaviour. They concluded that 11% of the total variation in heavy drinking could be ascribed to the school-level. Most studies that include variables at the school and community-level have focused on drinking patterns at the individual-level, leaving school differences unexplored (Kumar, O’Malley, Johnston, Schuleenberg & Bachman, 2002; Rountree & Clayton, 1999). Knowledge of how adolescents’ alcohol use varies across schools is useful in the planning of interventions against high alcohol intake in adolescence (Ennett, Flewelling, Lindroth & Norton, 1997; Henry & Slater, 2007; Karvonen & Rimpela, 1996). Furthermore, it is important to consider in which degree the school variations are a result of a true school-level effect or whether the variations are due to differences in the socio-demographic composition of schoolchildren across schools. Heavy drinking is more prevalent among boys than among girls and for older than younger adolescents. Further, the frequency and quantity of alcohol consumption is significantly higher for adolescents not living with both biological parents compared to those living with both biological parents (Barrett & Turner, 2006; Brännström, Sjöström & Andréasson, 2008; Ennett et al., 1997; Henry & Slater, 2007), while ethnic
minorities in western European countries, generally, have a lower alcohol intake (Monshouwer et al., 2007).

The current study

The aim of the study was to investigate and quantify the variation in drinking behaviour across schools, and to examine how school variations were related to the socio-demographic composition of the student population. We analyzed school variations in drinking behaviour using three outcome measures: having tried alcohol, drunkenness, and habitual drinking among 11-, 13-, and 15-year-old schoolchildren. Furthermore, we examined how much school-to-school variation remained after controlling for compositional factors such as sex, age, family structure and migration status.

Methods

Study population

We used the Danish 2006 data from the international research project Health Behaviour in School-Aged Children (HBSC), a WHO collaborative study (Currie et al., 2008). We invited 137 randomly selected schools to participate and 116 accepted. The data collection comprised all schoolchildren at the fifth, seventh and ninth grade in these schools. The mean age in the three grades was 11.8, 13.8 and 15.7 years, respectively. The schoolchildren answered the internationally standardized HBSC questionnaire in the classroom and 10 801 returned a completed questionnaire (Roberts et al., 2009), corresponding to 89% of the schoolchildren formally enrolled in the participating classes.

There is no official institution for ethical evaluation and approval of school surveys or other kinds of population based surveys in Denmark. Therefore, we asked the board of parents, the school leader, and the students’ council in each of the participating schools for their approval of the study. Further, the
schoolchildren received oral and written information about the study including the information that participation was voluntary and anonymous. The study complies with common ethical guidelines. We excluded those with missing information on any of the alcohol measures, migration status or family structure leaving 9 334 respondents for the multilevel analyses.

**Measures**

**Alcohol use**

We used three binary outcome measures to address drinking behaviour: 1) Tried alcohol: participants were asked at what age they had their first alcohol drink and we categorized them into those with alcohol experience and those without. 2) Experienced drunkenness (drunk once or more) was measured by the item: “Have you ever been really drunk?” (no, never; yes, once; yes, 2–3 times; yes, 4–10 times; yes, more than 10 times), categorized into those who had been drunk once or more, versus those who never had been drunk. 3) Habitual alcohol use (weekly or daily alcohol intake) was measured by the question: "At present, how often do you drink anything alcoholic, such as beer, wine, or spirits?" with separate items about beer, wine, spirits/liquor, alcopops or anything else. The response key was never; rarely; every month; every week; every day. We defined habitual alcohol use as drinking alcohol at least weekly.

**Socio-demographic characteristics**

We included sex, exact age, family structure, and migration status as fixed effects in the multilevel model to analyze to which degree the school-level variation in alcohol use could be accounted for by compositional factors. There were two criteria for including these variables: they were linked to alcohol use and their distribution varied across Danish schools (data not shown). Socioeconomic position was
not included as a covariate, because it was not systematically associated with alcohol use in this study. To measure family structure, participants answered questions about whom they lived with at home. We categorized the participants in two groups: 1) Those living with both biological parents, and 2) those living in other family types. Migration status was measured by the schoolchildren’s own and parents’ country of birth. Subsequently, participants were categorized in to ethnic Danes, immigrants, and descendants of immigrants. We categorized schoolchildren who were born and raised in Denmark by Danish parents as Danes. Those reporting being born in a foreign country and with neither a Danish born mother nor a Danish born father were scored as immigrants. Those reporting that he or she was born in Denmark and that neither of his or her parents was born in Denmark were scored as descendants of immigrants.

Statistical analysis

We used SAS version 9.3 and applied frequency tables to describe the distribution and variation in school rates of alcohol use. To quantify the school-level variations in alcohol use we included school as a random effect and analyzed data using multilevel logistic regression modelling (Glimmix procedure) thereby taken into account the hierarchical data structure with schoolchildren (Level 1) nested in schools (Level 2). These analyses were conducted separately for all three alcohol measures. We applied a significance level of $p=0.05$ for random effects.

The multilevel logistic regression analyses included three steps. The analyses in Model 1 were adjusted for sex and age and performed twice. First time we included all schoolchildren, and second time we excluded those without information on family structure and migrations status to see if there were any differences in the results. We found no substantial differences (data not shown). Model 2 was adjusted
for family structure, and Model 3 was further adjusted for migration status to rule out the possibility that the variation in drinking behaviour among schools could be due to school differences in the distribution of these variables. Since the school rates of habitual alcohol use were very low among 11-year-olds, data did not converge when we adjusted for all covariates. Therefore, we omitted this age group from Model 3.

We calculated median odds ratios (MORs) and intra-class correlations (ICCs) from the estimated raw variance components of between-school variance to quantify the contribution of school. MOR translates the school-level variance into the OR scale and is directly comparable with the ORs of individual-covariates: $\text{MOR} = \exp(\sqrt{2 \times \text{between-school variance}}) \times 0.6745$ (Merlo et al., 2006). In this case, it expresses how much a student’s odds of having tried alcohol would (in median) increase if this student had been in a school with a higher alcohol level. If the MOR is equal to one, there would be no differences between the schools in the probability of having tried drinking. The degree of homogeneity between adolescents belonging to the same school can be expressed by the ICC. ICC is the proportion of variance that is attributable to the school-level. In other words, ICCs express how much of the total variance (between-school variance + within school variance) in schoolchildren’s alcohol use that is attributable to between-school variance. A value of 1.0 indicates perfect positive association within schools, meaning that all schoolchildren within the school respond the same, while a value of zero indicates no association within schools. We used the latent variable approach for binary outcomes approximating the within-school variance to 3.29 (Larsen & Merlo, 2005; Merlo et al., 2006). The ICC can vary from zero to one for any prevalence of the outcome.

**Results**
As seen in Table 1, the majority of participants lived in traditional families with two biological parents. A large majority of schoolchildren were of Danish origin (89.9%). There were more boys than girls who had tried drinking, experienced drunkenness and who drank habitually. Schoolchildren in single parent families and reconstructed families were more likely to drink alcohol, while descendants and immigrants were less likely to drink alcohol than ethnic Danes.

*Insert Table 1*

**School-level alcohol use**

Table 2 and Figure 1 show the school prevalences of tried drinking, experienced drunkenness, and habitually drinking. The data revealed a substantial variation across schools for all drinking measures and for most age groups. For example, the percentage of girls who had tried drinking ranged from 0 to 100 among the 13-year-olds.

*Insert Table 2 and Figure 1*

Most of the schools had no schoolchildren among the 11-year-olds who drank habitually or had only low prevalences. In general, school prevalences of alcohol use increased with age; thus, 11-year-olds had the lowest level and 15-year-olds the highest. Among the 15-year-olds, 83.7% of the girls and 86.8% of the boys have started drinking alcohol. In addition, the mean school-level prevalence of drunkenness rose from 0.1% among 11-year-old-girls to 72.4% among the 15-year-old girls (Table 2). We observed gender differences in all three alcohol behaviours. Thus, there were more schools where none of the girls had tried drinking alcohol, experienced drunkenness and had a habitual alcohol use than there were schools where none of the boys showed these behaviours.
For example, in 58.8% of the schools none of the 13-year-old girls drank habitually. For boys, the corresponding number was 35.3%.

*Multilevel analysis: Variance between schools*

Table 3 shows the median odds ratios (MORs) and the intra-class correlations (ICCs) between schools for each of the three outcome measures: tried alcohol, drunkenness, and habitual alcohol use. The first step in the multilevel regression model was to estimate the variance between the schools when adjusting for age and sex.

*(Insert Table 3)*

We found relatively large variations in alcohol use across schools, with MORs ranging from 1.33 to 2.12. The highest MORs were found for tried drinking alcohol among 15-year-olds (MOR= 2.12, \( p < 0.05 \)) and habitual alcohol use among 13-year-olds (2.01, \( p < 0.05 \)). This means that 15-year-olds from a high drinking school had an elevated risk of having tried alcohol on 2.12 compared to 15-year-olds at a low drinking school. ICC calculations showed that 5–16% of the variation in tried drinking, 4–7% of the variation in drunkenness and 3–14% of the variation in habitual alcohol use, could be ascribed to the school-level.

Adjustment for family structure led to minor changes in the MOR and ICC values (Model 2), except for 15-year-olds with habitual alcohol use, where adding family structure to the model reduced the MOR from 1.70 to 1.63. All MORs and ICCs for tried drinking alcohol were lower in Model 3 than in Models 1 and 2, which suggested that a substantial part of the school-level variation in having tried alcohol was due to school differences in the proportion of immigrants and descendants. For example, adding migration status to the model reduced the MOR by 53% from 2.12 to 1.53 among 15-year-olds.
(Models 2 and 3). Migration status also contributed to the school-level variation in drunkenness among 15-year-olds, while it did not change the estimates for the two other age groups or for habitual alcohol use. Schools with a high proportion of immigrants and descendants tended to have lower prevalences of alcohol use (data not shown).

**Discussion**

In this cross-sectional multilevel study of 10 801 adolescents nested in 117 schools, we found significant school-level variations in all three alcohol measures. The MOR values were all above 1.33 and remained high even after controlling for relevant compositional factors. This suggested that school-level variations in drinking behaviour were not solely a result of differences in the socio-demographic composition of schoolchildren.

Distribution of descendants and immigrants across schools contributed to the variation in school rates of alcohol use, however, the magnitude varied by grade and drinking measure. We found that less schoolchildren with an ethnic background had tried drinking, experienced drunkenness and drank habitually, which is consistent with other findings (Monshouwer et al., 2007). For all ages, the school-level prevalences of tried alcohol, drunkenness and habitual alcohol use were higher for boys than for girls. Thus, there were also more schools where none of the girls drank alcohol than there were schools where none of the boys drank alcohol. The gender differences in alcohol use is in line with previous findings showing that despite a decreasing gap between boys and girls, boys still drink more frequently and consume higher amounts of alcohol compared to girls (Kuntsche et al., 2011). Alcohol use increased with older age. Among the 15-year-olds nearly all participants have tried drinking alcohol.
Being a schoolchild at a certain school accounted for a substantial part of the total variation in alcohol use in our study and adolescents within a school were more similar with regard to their alcohol use than other adolescents within the total population. This finding is largely in line with results from other studies, however, these studies are not directly comparable to our study since most of the studies included an older age group, none of them were conducted in a Scandinavian country and none examined school-level variations in the same alcohol drinking measures. A study from US found that 11% of the total variance in heavy drinking among high school students were situated at the school-level (Kairouz & Adlaf, 2003), while a study from the Netherlands found that 8.5% of the variation in episodic heavy drinking could be ascribed to the school-level (Monshouwer et al., 2007). Another study in the US measured frequency of alcohol use and found 10.3% of the variation in mean student alcohol use to be at the school-level (Rountree & Clayton, 1999). All studies found substantial school-level variation, but the size of the variance, and the extent to which the included school-level variables explained the variance varied from study to study. This could be due to differences in the age groups, the context for the study and the included measure of drinking behaviour. Furthermore, it might reflect differences in the inclusion of covariates. For example, individual level variables, such as peer norms and attitudes might be mediators rather than confounders. Adjusting for these variables could therefore lead to a diluted school effect (Sellström & Bremberg, 2006).

Skog suggests that alcohol use among adults reflects a strong collectivism in drinking behaviour. Our results support that this interpretation also applies to schoolchildren. The variation in alcohol use across schools and the clustering of drinking behaviour within schools suggest that drinking alcohol is a group phenomenon with a strong collective element as proposed by Skog (1985). Our findings contribute to
the literature acknowledging the importance of the school milieu in relation to adolescents’ alcohol use (Botticello, 2009).

Our results could be a combination of different factors all contributing to the school-level variations. Macintyre suggest three types of explanations for geographical variations in health: compositional, contextual and collective (Macintyre, Ellaway & Cummins, 2002). Compositional effects are a consequence of the composition of study population, for example according to age, gender, ethnic background and socio-economic-status in a particular area or school. Contextual effects are due to characteristics of the surroundings, e.g. school policies, average income in an area, sport facilities, supermarkets and so on. The final type of explanations is the collective explanations, which could be seen as part of the contextual explanations. Collective effects are due to the historical and socio-cultural features of the area, such as shared norms, values and traditions.

Our aim was to quantify the variation in drinking behaviour across schools. Estimating an unbiased school effect is, however, challenging, because school effects are dependent not only on schools themselves, but also on the composition of students. We controlled our analysis for age, sex, family structure and migration status. Therefore we anticipated that the school-level variations in alcohol use were not due to differences in the socio-demographic composition of the school. Rather, we assume that part of the variation might be due to contextual effects such as shared social values, school policies, availability of alcohol, and drinking norms within schools as also proposed by other studies (Bisset, Markham & Aveyard, 2007; Ennett et al., 1997).

This study is among the few that examines school-level variations in drinking behaviour (Sellström & Bremberg, 2006). The use of multilevel analyses and the use of a large and nation-wide sample add to the strength of the study. Another advantage is the inclusion of three different measures of alcohol use,
and the inclusion of measures of variance and measures of means at the same time. However, the study has some limitations, which should be considered when interpreting the results.

Even though we have a relatively high response rate of 89% in this study it is relevant to address the possibility of selection bias. In total, 11% of the sample did not participate and 10% of the participating schoolchildren did not give valid information on their family structure. Selection bias could be present if alcohol use differs between participants and nonparticipants. Since alcohol use is often related to truancy, this potential selection bias might most likely result in an underestimation of the number of adolescents who have tried alcohol, experienced drunkenness and who drinks habitually (Mounteney, Haugland & Skutle, 2010). Information on alcohol use was obtained by self-reports, which may imply some misclassification. Adolescents may tend to underreport or over report alcohol use according to whether they perceive the behaviour to be socially undesirable or desirable. However, a review study by Brener, Billy & Grady (2003) concludes that although self-reports of alcohol use are affected by both cognitive and situational factors, this does not threaten the validity. In this study, we used simple questions and ensured anonymity in order to help generating reliable and valid data.

Residual individual-level confounding may have caused part of the school-level variations we observed. We used migration status to assess ethnic background. However, migration status is only one aspect of ethnic background, and it does not capture the acculturative and integration process of non-majority citizens. Furthermore, we did not distinguish between descendants and immigrants from westernized and non-westernized countries. This distinction might be relevant when considering adolescents’ drinking behaviour even though the average percentages of immigrants and descendants in the schools were only 8.6%.
Our results suggest that drinking alcohol has a strong collective element which makes it important to regard the schoolchildren not only as individuals but also as participants in the social group to which alcohol behaviour are attached. Further, they indicate that school has a considerable role in the development of different drinking behaviours among youth (Sellström & Bremberg, 2006, Bisset, Markham & Aveyard, 2007; Kairouz & Adlaf, 2003; Rehm et al., 2005). This makes school an important unit to investigate in a study of adolescents’ alcohol use; however, the school is not the only social context in which adolescents are embedded. For instance, also families, school classes and peer groups constitute important social entities in adolescents’ life and future studies should be expanded with contextual variables identifying the mechanism behind the impact of these social groups.
Reference List


European and North American countries. *Archives of Pediatrics & Adolescent Medicine, 165*, 152-158.


Tables

Table 1

Description of the study population. Percentages of schoolchildren having tried drinking, experienced drunkenness and with habitually alcohol use according to sex, age, family structure and migrations status

<table>
<thead>
<tr>
<th>Characteristics of participants</th>
<th>n= 10,801 (%)</th>
<th>Tried drinking (%)</th>
<th>P-value</th>
<th>Experienced drunkenness (%)</th>
<th>P-value</th>
<th>Habitual alcohol use (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>5292 (49)</td>
<td>55.8</td>
<td>&lt;0.001</td>
<td>26.0</td>
<td>&lt;0.001</td>
<td>15.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Girls</td>
<td>5509 (51)</td>
<td>48.0</td>
<td>&lt;0.001</td>
<td>20.6</td>
<td>&lt;0.001</td>
<td>9.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-year olds</td>
<td>3777 (35.0)</td>
<td>22.2</td>
<td>1.8</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-year olds</td>
<td>3880 (35.9)</td>
<td>51.9</td>
<td>13.0</td>
<td>5.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-year olds</td>
<td>3144 (29.1)</td>
<td>87.3</td>
<td>&lt;0.001</td>
<td>61.3</td>
<td>&lt;0.001</td>
<td>34</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Family structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with both biological parents</td>
<td>6395 (59.2)</td>
<td>48.8</td>
<td>20.4</td>
<td>10.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other family type</td>
<td>3252 (30.1)</td>
<td>56.4</td>
<td>&lt;0.001</td>
<td>27.7</td>
<td>&lt;0.001</td>
<td>15.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Missing</td>
<td>1154 (10.7)</td>
<td>55.9</td>
<td>26.3</td>
<td>13.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Migration status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Danish</td>
<td>9709 (89.9)</td>
<td>54.4</td>
<td>24.4</td>
<td>12.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descendants</td>
<td>561 (5.2)</td>
<td>20.7</td>
<td>7.3</td>
<td>2.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immigrants</td>
<td>366 (3.4)</td>
<td>34.6</td>
<td>&lt;0.001</td>
<td>15.5</td>
<td>&lt;0.001</td>
<td>9.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Missing</td>
<td>165 (1.5)</td>
<td>46.2</td>
<td>26.5</td>
<td>14.7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

School-level variables n=117 schools (%)

|                                    |               |                    |         |                              |         |                          |         |
|                                    | > 10% immigrants and descendants | 26 (22.4)          |         |                              |         |                          |         |
|                                    | < 40% living without both biological parents | 70.9 (83)          |         |                              |         |                          |         |
Table 2

Distribution of schools by percentage of schoolchildren: 1) who had tried alcohol, 2) who had experienced drunkenness, and 3) with habitual alcohol use. Absolute number (percentage)

<table>
<thead>
<tr>
<th></th>
<th>11-year-old boys</th>
<th>11-year-old girls</th>
<th>13-year-old boys</th>
<th>13-year-old girls</th>
<th>15-year-old boys</th>
<th>15-year-old girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=111 schools</td>
<td>n=111 schools</td>
<td>n=102 schools</td>
<td>n=102 schools</td>
<td>n=92 schools</td>
<td>n=92 schools</td>
</tr>
</tbody>
</table>

Percent who had tried alcohol in each school

<table>
<thead>
<tr>
<th>Percentage</th>
<th>11-year-old boys</th>
<th>11-year-old girls</th>
<th>13-year-old boys</th>
<th>13-year-old girls</th>
<th>15-year-old boys</th>
<th>15-year-old girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>7 (6.3)</td>
<td>16 (14.4)</td>
<td>2 (2.0)</td>
<td>5 (4.9)</td>
<td>1 (1.1)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>1-20%</td>
<td>29 (26.1)</td>
<td>60 (54.1)</td>
<td>1 (1.0)</td>
<td>1 (1.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>21-40%</td>
<td>46 (41.4)</td>
<td>24 (21.6)</td>
<td>10 (9.8)</td>
<td>17 (16.7)</td>
<td>1 (1.1)</td>
<td>2 (2.2)</td>
</tr>
<tr>
<td>41-60%</td>
<td>23 (20.7)</td>
<td>9 (15.3)</td>
<td>53 (52)</td>
<td>46 (45.1)</td>
<td>2 (2.2)</td>
<td>4 (4.4)</td>
</tr>
<tr>
<td>61-80%</td>
<td>6 (5.4)</td>
<td>1 (0.9)</td>
<td>30 (29.4)</td>
<td>24 (23.5)</td>
<td>11 (12)</td>
<td>18 (19.6)</td>
</tr>
<tr>
<td>81-100%</td>
<td>0 (0.0)</td>
<td>1 (0.9)</td>
<td>6 (5.9)</td>
<td>9 (8.8)</td>
<td>77 (83.7)</td>
<td>67 (72.8)</td>
</tr>
</tbody>
</table>

School-level mean 29.3 17.2 54.2 52.2 86.8 83.7

Percent (SD) 17.8 16.4 15.8 21.0 15.3 17.6

Percent who had experienced drunkenness in each school

<table>
<thead>
<tr>
<th>Percentage</th>
<th>11-year-old boys</th>
<th>11-year-old girls</th>
<th>13-year-old boys</th>
<th>13-year-old girls</th>
<th>15-year-old boys</th>
<th>15-year-old girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>34 (30.6)</td>
<td>60 (54.1)</td>
<td>2 (2.0)</td>
<td>1 (1.1)</td>
<td>1 (1.1)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>1-20%</td>
<td>54 (48.7)</td>
<td>50 (45.1)</td>
<td>19 (18.6)</td>
<td>34 (33.3)</td>
<td>0 (0.0)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>21-40%</td>
<td>22 (19.8)</td>
<td>0 (0.0)</td>
<td>58 (56.9)</td>
<td>46 (45.1)</td>
<td>3 (3.3)</td>
<td>3 (3.3)</td>
</tr>
<tr>
<td>41-60%</td>
<td>1 (0.9)</td>
<td>1 (0.9)</td>
<td>21 (20.6)</td>
<td>9 (8.8)</td>
<td>12 (13)</td>
<td>16 (17.5)</td>
</tr>
<tr>
<td>61-80%</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (2.0)</td>
<td>0 (0.0)</td>
<td>40 (43.5)</td>
<td>40 (43.5)</td>
</tr>
<tr>
<td>81-100%</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>36 (39.1)</td>
<td>31 (33.7)</td>
</tr>
</tbody>
</table>

School-level mean 10.9 4.0 29.8 20.8 72.4 71.3

Percent (SD) 10.7 6.0 14.3 13.3 17 17.9

Percent with habitual alcohol use in each school

<table>
<thead>
<tr>
<th>Percentage</th>
<th>11-year-old boys</th>
<th>11-year-old girls</th>
<th>13-year-old boys</th>
<th>13-year-old girls</th>
<th>15-year-old boys</th>
<th>15-year-old girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>86 (77.5)</td>
<td>105 (94.6)</td>
<td>36 (35.3)</td>
<td>60 (58.82)</td>
<td>4 (4.4)</td>
<td>8 (8.7)</td>
</tr>
<tr>
<td>1-20%</td>
<td>16 (14.4)</td>
<td>5 (4.5)</td>
<td>53 (52.0)</td>
<td>36 (35.29)</td>
<td>13 (14.1)</td>
<td>25 (27.2)</td>
</tr>
<tr>
<td>21-40%</td>
<td>8 (7.2)</td>
<td>1 (0.9)</td>
<td>13 (12.8)</td>
<td>5 (4.90)</td>
<td>23 (25.0)</td>
<td>39 (42.4)</td>
</tr>
<tr>
<td>41-60%</td>
<td>1 (0.9)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (0.98)</td>
<td>38 (41.3)</td>
<td>15 (16.3)</td>
</tr>
<tr>
<td>61-80%</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>12 (13.0)</td>
<td>4 (4.4)</td>
</tr>
<tr>
<td>81-100%</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (2.2)</td>
<td>1 (1.1)</td>
</tr>
</tbody>
</table>

School-level mean 1.8 0.5 7.5 4.5 39.4 27.0

Percent (SD) 4.0 3.0 8.0 8.0 19.9 17.2

23
Table 3

School variations in drinking behavior analyzed by multilevel modeling. Median odds ratios (MOR) and intra-class correlation (ICC) for tried alcohol, drunkenness and habitual alcohol use

<table>
<thead>
<tr>
<th></th>
<th>Model 1&lt;sup&gt;a&lt;/sup&gt;</th>
<th></th>
<th>Model 2&lt;sup&gt;b&lt;/sup&gt;</th>
<th></th>
<th>Model 3&lt;sup&gt;c&lt;/sup&gt;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MOR</td>
<td>ICC</td>
<td>MOR</td>
<td>ICC</td>
<td>MOR</td>
<td>ICC</td>
</tr>
<tr>
<td>Tried alcohol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-year-olds</td>
<td>1.71</td>
<td>0.08</td>
<td>1.70</td>
<td>0.09</td>
<td>1.64</td>
<td>0.08</td>
</tr>
<tr>
<td>13-year-olds</td>
<td>1.47</td>
<td>0.05</td>
<td>1.47</td>
<td>0.05</td>
<td>1.35</td>
<td>0.03</td>
</tr>
<tr>
<td>15-year-olds</td>
<td>2.12</td>
<td>0.16</td>
<td>2.12</td>
<td>0.16</td>
<td>1.53</td>
<td>0.06</td>
</tr>
<tr>
<td>Drunkenness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-year-olds</td>
<td>1.52</td>
<td>0.06</td>
<td>1.48</td>
<td>0.05</td>
<td>1.48 n.s</td>
<td>0.05 n.s</td>
</tr>
<tr>
<td>13-year-olds</td>
<td>1.42</td>
<td>0.04</td>
<td>1.40</td>
<td>0.04</td>
<td>1.36</td>
<td>0.03</td>
</tr>
<tr>
<td>15-year-olds</td>
<td>1.63</td>
<td>0.07</td>
<td>1.64</td>
<td>0.07</td>
<td>1.40</td>
<td>0.04</td>
</tr>
<tr>
<td>Habitual alcohol use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-year-olds</td>
<td>1.33 n.s</td>
<td>0.03 n.s</td>
<td>—d</td>
<td>—d</td>
<td>—d</td>
<td>—d</td>
</tr>
<tr>
<td>13-year-olds</td>
<td>2.01</td>
<td>0.14</td>
<td>1.96</td>
<td>0.13</td>
<td>1.96</td>
<td>0.13</td>
</tr>
<tr>
<td>15-year-olds</td>
<td>1.70</td>
<td>0.09</td>
<td>1.63</td>
<td>0.07</td>
<td>1.61</td>
<td>0.07</td>
</tr>
</tbody>
</table>

<sup>a</sup> Adjusted for sex and age
<sup>b</sup> Adjusted for sex, age and family structure
<sup>c</sup> Adjusted for sex, age, family structure and migration background
<sup>d</sup> This analysis was not performed because the prevalence of habitual alcohol use among 11-year-olds was too low for further adjustment
**Figure 1** Distribution of schools by percentage of schoolchildren who had tried drinking alcohol, experienced drunkenness and with habitual alcohol use.

Distribution of schools by percentage of schoolchildren who had tried alcohol

**11-year-olds, n=111 schools**

**13-year-olds, n=102 schools**

**15-year-olds, n=92 schools**

Distribution of schools by proportion of schoolchildren who had experienced drunkenness

**11-year-olds, n=111 schools**

**13-year-olds, n=102 schools**

**15-year-olds, n=92 schools**

Distribution of schools by percentage of schoolchildren with habitual alcohol use

**11-year-olds, n=111 schools**

**13-year-olds, n=102 schools**

**15-year-olds, n=92 schools**

a The y-axis range from 0-80 in this group, but from 0-60 in the other groups
Does a positive school-climate buffer the effect of weak parental support? School climate and alcohol use among adolescents

Bendtsen P
Damsgaard MT
Denny S
Tolstrup JS
Ersbøll AK
Holstein BE

Status: In review (Journal of Adolescence)
Does a positive school-climate buffer the effect of weak parental support? School climate and alcohol use among adolescents

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Conflict of interest: None

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**Abstract:**

*Background and aim:* Relationships to school and family are associated with adolescent alcohol use, however, few studies have examined the combined influences of school and family. The purpose was to analyze the relationship between adolescent drunkenness, parental support, school connectedness and school-class climate, and further to examine whether school-class climate buffered the association between parental support and adolescent drunkenness.

*Method:* We used data from the Danish 2006 Health Behaviour in School-aged Children survey, a national representative cross-sectional study including 10,540 schoolchildren aged 11–15 years nested within 601 school classes and 116 schools. We performed multilevel logistic regression analysis with drunkenness used as the outcome.

*Results:* High parental support, high school connectedness and a positive school climate were associated with lower prevalence of drunkenness. A positive school climate buffered the impact of low parental support among 11-year-olds. Those at the highest risk for drunkenness were adolescents with low parental support and a school climate below average (OR=4.08, 2.59-6.42).

*Conclusion:* Findings suggest that improvement of the school climate may result in less alcohol use among adolescents.

**Keywords:** alcohol use, school connectedness, school climate, multilevel analysis, parental support
Introduction

Risk factors for adolescent alcohol use are typically conceptualized as individual and interpersonal factors; however, these factors do not fully explain adolescent drinking behaviour (Brenner, Bauermeister, & Zimmerman, 2011). In addition to individual factors such as perceptions, drinking motives and beliefs (Kuntsche, Knibbe, Gmel, & Engels, 2005) a second level of influence is found in the school and family context. Relationships to school and family are associated with adolescent alcohol use but few studies have examined the combined influences of school and family (Mason & Windle, 2001).

The school

The school constitutes an arena for social interactions and the development of friendships which can both positively and negatively influence alcohol related behaviours and attitudes (Henry & Slater, 2007; McLellan, Rissel, Donnelly, & Bauman, 1999; Sellström & Breberg, 2006). Schools therefore have a potentially large influence on adolescent alcohol use. Alcohol use varies across social contexts such as schools and neighbourhoods and students belonging to the same school or school-class tend to have similar drinking behaviours and (Bendtsen, Damsgaard, Tolstrup, Ersboll, & Holstein, 2013; Kumar, O'Malley, Johnston, Schulenberg, & Bachman, 2002; O'Malley, Johnston, Bachman, Schulenberg, & Kumar, 2006; Rehm et al., 2005). According to Manski, there are many reasons to believe that students in the same school or school class will develop similar behaviours (Mansi, 1993). As an example, they share similar individual characteristics, and are exposed to the same school climate. Contextual factors can influence behaviour beyond individual characteristics (Macintyre, Ellaway, & Cummins, 2002). Schools and school-classes, like other social groups, are characterized by social norms that may, implicitly or explicitly, confer varying levels of approval toward alcohol use, affecting the behaviour of group members (Bisset, Markham,
A positive school climate have been associated with less risk-taking behaviours among students and fewer problems related to alcohol use as compared with less favourable climate (Denny et al., 2011; Takakura, Wake, & Kobayashi, 2010). A poor school climate may contribute to alienation from school and dissociation from the current educational norms which might lead to engagement in risk behaviours, such as excessive alcohol use (Henry & Slater, 2007).

The current study

The study of context is inspired by the theoretical frameworks developed by Macintyre and colleagues and by Frolich and others (Frolich, Potvin, Chabot, & Corin, 2002; Macintyre et al., 2002). They focus on the importance of the shared norms, behaviours, and traditions in the study of context and health. Further, Bronfenbrenner’s (Bronfenbrenner, 1977) conception of a multi-layered social context also suggests that layers may interact, e.g. that contextual factors may interact with individual risk factors. Therefore, our study adopts a multilevel perspective and examines how the contextual influence of school climate, students own school connectedness and perceived parental support are associated with adolescent alcohol use. Adolescents with sufficient social support and opportunities within their social context develop assets which enable them to avoid problem behaviours (Guo, Hawkins, Hill, & Abbott, 2001; Kegler et al., 2005; Latendresse et al., 2008; Ryan, Jorm, & Lubman, 2010). We therefore analyze if positive school climate had the potential to buffer the association between lack of parental support and adolescent drunkenness.

To our knowledge, no studies have focused on this aspect and examined the effects of school-class climate in combination with family factors such a parental support. This study addresses these gaps in research and aimed to: 1) examine the relationship between parental support, school
connectedness, school-class climate and adolescent drunkenness, and 2) examine to what extent school-class climate modifies the association between parental support and adolescent drunkenness. Based on empirical and theoretical evidence we expected that alcohol use would vary across schools (Rehm et al., 2005) and that poor school climate and low parental support would be related to higher odds of drunkenness among adolescents (Denny et al., 2011; Ryan et al., 2010). Further, we expected that the relation between parental support and adolescent drunkenness would be influenced by the school climate.

The school class
In this study we measured the social climate in each school-class rather than just using one measure for each school. There are several reasons for considering the school-class as a relevant context in relation to alcohol use among Danish adolescents. First, from a conceptual point of view, alcohol is described as a social phenomenon and the school-classes represent an important context for both understanding and tackling it (Bendtsen et al., 2013; Johansen, Rasmussen, & Madsen, 2006; Skog, 1985). Second, in Denmark students attending primary and lower secondary schools have the same classmates for the entire nine years of compulsory education (Johansen et al., 2006).

Methods
Study population
We used the Danish 2006 data from the international cross-sectional research project Health Behaviour in School-Aged Children (HBSC), a WHO collaborative study (C Currie et al., 2008). We invited 137 randomly selected schools to participate and 116 accepted (school-level participation 85%). The data collection comprised all schoolchildren at the fifth, seventh and ninth grade in these schools. The mean age (SD) in the three grades was 11.8 (0.4), 13.8 (0.4) and 15.7
(0.4) years, respectively. The schoolchildren answered the internationally standardized HBSC questionnaire in the classroom and 10,801 returned a completed questionnaire (Roberts et al., 2009), corresponding to 89% of the schoolchildren formally enrolled in the participating classes.

There is no official agency for ethical evaluation and approval of school surveys or other kinds of population-based surveys in Denmark. Therefore, we asked the board of parents, the school leader, and the students’ council in each of the participating schools for their approval of the study. Further, the schoolchildren received oral and written information about the study including that participation was voluntary and anonymous. The study complies with common ethical guidelines.

We excluded those with missing information on drunkenness (n=148, 1.4%), school-class (n=32, 0.4%), parental support (n=30, 0.4%) and students with more than one missing item on the school climate index (54, 0.5%) leaving 10,540 respondents nested in 601 school-classes and 116 schools for the multilevel analyses. Adolescents with missing information on migration status were coded as ethnic Danes (n=165). We performed the analyses with and without this group which showed almost similar estimates.

**Outcome measure**

We used self-reported lifetime drunkenness (drunk once or more) as the outcome: “Have you ever been really drunk?” (no, never; yes, once; yes, 2–3 times; yes, 4–10 times; yes, more than 10 times), categorized into those who had been drunk once or more, versus those who never had been drunk.

**Individual-level covariates**

We included adolescents’ self-reported data on sex, migration status, parental support and school connectedness as fixed effects in the multilevel model. Migration status was measured by the students’ and parents’ country of birth. We categorized students according to their own and their
parents’ country of birth into ethnic Danes versus immigrants and descendants referred to as immigrants. Parental school support (referred to as parental support) was measured by the question ‘If I have a problem at school my parents are ready to help’ assessed on a 5-point Likert scale ranging from strongly agree (1) to strongly disagree (5), categorized as “high parental support (1)”, “medium parental support (2)” and “low parental support (3-5)".

School connectedness

We used Rasmussen et al.’s (2005) index of school connectedness, a summation of responses to three items: a) ‘How do you feel about school at present’ (‘I like it a lot’(1), ‘I like it a bit’(2), ‘I don't like it very much’(4), ‘I don't like it at all’ (5)), b) ‘Our school is a nice place to be’ (‘strongly agree’ (1), ‘agree’ (2), ‘neither agree or disagree’ (3), ‘disagree’(4), ‘strongly disagree’(5)), and c) ‘I feel I belong at this school’ (responses as in item b). The range was 3—15, the Spearman’s correlation coefficients between the three items varied between 0.50 and 0.66, and the Cronbach's $\alpha$ was 0.81. The index showed approximately the same distribution among boys and girls; however girls provided slightly more positive answers to the item ‘How do you feel about school at present’ than boys did. The individual measure of perceived school-connectedness was centred at the school-class mean and ranged -6.3 to 9.3. Students were categorized into three equal groups with high school connectedness used as the reference.

School climate

The contextual measure of school-class social climate (referred to as school climate) was the mean of the school connectedness index in each school-class (range from 3.5 to 10.5). We categorized school-classes into three equal groups: as having a school climate above average (range 3.5—6), average (> 6—7.1) or below average (>7.1—10.5). There were approximately 200 school-classes in
each of the three groups. In the analyses, we used both the continuous and the categorical version of this variable and observed similar patterns of associations. We decided to present the estimates for the categorical version in order to facilitate communication of the estimates.

**Statistical analysis**

The statistical analyses were performed using SAS version 9.3. Descriptive analysis was presented as frequency distributions (number of students, percentage). We analysed data by multilevel logistic regression modelling (Glimmix procedure in SAS) thereby taking into account the hierarchical data structure. Multilevel modelling enables us to distinguish between school-class-level and individual-level variation, whereby the contextual effects of the school-class climate on adolescent alcohol use may be captured (Sellström & Bremberg, 2006). Drunkenness was used as the outcome measure. A three-level random intercept model was applied with students (level 1, N=10,540) nested with-in school-classes (level 2, N=601), and further with-in schools (N= 116, level 3). Centring of predictor variables has been recommended for obtaining stables solutions in multilevel models and to avoid co-linearity between individual- and group level exposures (Enders & Tofghi, 2007; Suzuki, Yamamoto, Takao, Kawachi, & Subramanian, 2012; Takakura et al., 2010; Torsheim & Wold, 2001). Centring individual school connectedness at the school-class mean implies that the results for school connectedness reflect the effects of deviations from the school-class mean or the relative placement in the school-class while the school-class mean reflect contextual variance (between-school-class). The centred variable ranged from -6.3 to 9.3.

We used logistic regression analyses to examine associations. The analyses comprised three steps. Firstly, a random intercept model including age-group and sex was used to estimate school and school-class level variances in adolescent drunkenness. Secondly, a full model including individual
level predictors, parental support, school connectedness and school-class climate was run to examine the relationship between these variables (shown in Table 2). Thirdly, to examine whether the relation between parental support and drunkenness was modified by school-class climate we included a cross-level interaction term between school-class climate and parental school support. This was done in age specific strata because the association between lack of parental support and drunkenness was stronger among 11-year-olds than among 13- and 15-yr-olds (Table 3). Finally, a combined variable of parental support and school-class climate was constructed to address the combined effect of these two factors among 11-year-olds. This variable included six possible combinations of above average/average/below average school-class climate and high/low parental support.

Random effects (school-class level variance estimates).

We calculated intraclass correlations (ICC) based on prior findings that there is significant school-level variation in early adolescent alcohol use (Bendtsen et al., 2013; Botticello, 2009; Denny et al., 2011). ICC was calculated for drunkenness among pupils within the same class and school as

\[
\text{ICC}_{\text{class}}: \frac{\sigma^2_2 + \sigma^2_3}{\sigma^2_2 + \sigma^2_3 + \sigma^2_1}
\]

where \(\sigma^2_2\) is the variance between school-classes, \(\sigma^2_3\) is the variance between schools, and \(\sigma^2_1\) is the variance between individuals approximated as 3.29 (Goldstein, Browne, & Rasbash, 2002; Merlo et al., 2006). ICC for pupils within different classes belonging to the same school was calculated as \(\text{ICC}_{\text{school}}: \frac{\sigma^2_3}{\sigma^2_2 + \sigma^2_3 + \sigma^2_1}\).

Results

As seen in Table 1, the prevalence of drunkenness was 7.7% among 11-year-olds and 25.2% and 73.7% among 13- and 15-year-olds. More boys than girls had experienced drunkenness, and schoolchildren reporting low school connectedness and low parental support were more likely to
have been drunk while immigrants were less likely to have been drunk than ethnic Danes. The proportion who have been drunk were higher among students in school-classes with average school-class climate (35.9%) or below average climate (47.6%) compared to students in school classes with a climate above the average (17.3%).

Multilevel analysis

Table 2 shows results of the multilevel logistic regression analyses. These analyses showed that boys were more likely than girls to be drunk (odds ratio (OR) = 1.51; 95% confidence interval (CI) =1.36-1.67), and that older age and being ethnic Dane were significantly associated with drunkenness. Lack of parental support, low school connectedness and a school-class climate below average were also significantly associated with drunkenness. The OR for drunkenness among students who reported medium or low school connectedness were 1.29 (CI=1.12-1.47) and 2.21 (CI=1.94-2.52), compared to those who reported high school connectedness. Adolescents in school-classes with a below average school-class climate had an elevated odds ratio of 1.52 (1.27-1.82) compared to students in classes with an above average school-class climate.

Buffering?

The age stratified analyses revealed that the school-class climate buffered against the effect of low parental support, but only among 11-year-olds (p= 0.024). In this group, the relationship between parental support and adolescent drunkenness varied across different school climates suggesting that
low parental support had a stronger impact on adolescent drunkenness in school-classes with a school climate below average (OR=4.08, 2.59-6.42) compared to schools with an above average climate (OR=1.24, 0.71-2.16).

------------------- Please insert Figure 1 around here -------------------------

Figure 1 shows the OR and 95% CI for drunkenness among 11-year-olds by the variable which combines parental support and classroom climate in relation to the reference group: high parental support and above average classroom climate.

Discussion
In this cross-sectional multilevel study of more than 10,000 adolescents, we found a statistically significant relationship between below average school-class climate and drunkenness. Further we found a significant relation between a low level of individual perceived school connectedness and drunkenness. This finding is in line with results from other studies (Denny et al., 2011; Henry & Slater, 2007; Resnick et al., 1997). The study by Denny and colleagues (Denny et al., 2011) found that, student perception of the school climate (sense of belonging to school, having supportive relationships with adults at school, high expectations from people at school, and perceptions of safety at school) was the only consistent school variable associated with less risk-taking behaviours among students.

In keeping with other studies low parental support was associated to adolescent alcohol use in this study (Guo et al., 2001; Latendresse et al., 2008; Ryan et al., 2010). The relationship between low parental support and drunkenness was attenuated among older adolescents which may be explained
by the greater autonomy through adolescence in the transition between childhood and adulthood (Latendresse et al., 2008). Another plausible explanation could be that parental support protects against deviant behaviour but not against mainstream behaviour—and having experienced drunkenness once or more is more or less considered as mainstream behaviour among 15-year-olds Danes (Järvinen & Gundelach, 2007). Compared to other countries, Denmark has a high prevalence of drunkenness among adolescents, and drinking to intoxication is widespread even among young teenagers (Bendtsen et al., 2013; Currie et al., 2012; Hibell et al., 2012; Kuntsche et al., 2011).

Consistent with the Ecological System Theory that stresses the need to understand adolescents within their contexts (Bronfenbrenner, 1977) we found that a positive school climate buffered the impact of low parental support in early adolescence. The effect of low parental support on adolescent drunkenness varied across different school climates and we found a stronger relation between low parental support and adolescent drunkenness in schools with below school climate compared to schools with above average climate. The modifying effect of school climate was, however, only evident in the youngest age group, probably because this age group is more dependent on parental support.

School climate was operationalized as the average sense of connectedness to school in each school-class. We thereby focused on the contextual effects of school-class climate and found a significant relation between the school-class climate and adolescent drunkenness. Other studies have focused on school-class climate and school connectedness as individual attributes but with similar results (Andersen, Holstein, & Due, 2007; Resnick et al., 1997). Various explanations may account for the association between school-class climate and adolescent alcohol use. Social development theories state that adolescents who have strong ties to society and institutional organizations such as schools will adopt the school’s norms, values, and expectations, and for this reason, will abstain from engaging in behaviours inconsistent with the school’s expectations (Catalano & Hawkins, 1996;
Hirschi, 1969), such as getting drunk. These adolescents are therefore less likely to adopt deviant behaviour. At the school level this would imply that students in schools with a generally poor school climate would in average bee more likely to engage in excessive alcohol use because the social norms in schools may, implicitly or explicitly, approve this type of behaviour.

The findings replicate and extend prior research by further demonstrating that the school-class climate has the potential to modify the relation between parental support and school class climate. Our results suggest that the school is a primary socializing influence in the lives of boys and girls and a key factor in relation to adolescent drinking. This makes the school and classroom important units to investigate in studies of adolescents’ alcohol use and calls for intervention that addresses the broader context of adolescent life. Overall, the findings from this study contribute to the literature acknowledging the importance of the school and social climate in relation to adolescents’ alcohol use (Botticello, 2009; Rehm et al., 2005; Takakura et al., 2010).

This study is among the few that examines the relation between school-class climate and alcohol use and the modifying effects of school climate. The use of multilevel analyses, the high participation rate among schools and students, and the use of a large and nation-wide sample add to the strength of the study.

**Limitations**

The study also has some limitations, which should be considered when interpreting the results. However theoretically plausible, it is notoriously hard to estimate empirically the effect of a contextual variable on individual outcomes (Manski, 1993, 2000). Recurrent concerns include the risk of reverse causality (Manski's "reflection problem"), spurious correlations due to omitted
variables or population sorting and inadequate operational definitions of the context in question. Firstly, mechanisms that account for the key finding of this study are necessarily speculative, given the cross-sectional design, which precludes conclusions about directions of influence. Secondly, the study may also suffer from residual and unmeasured confounding. We did not include information on teacher-student relationship, and it was beyond the scope of this study to consider other aspects of the family environment that have been shown to be related to adolescent alcohol use (e.g., alcohol-specific parenting practices, parental monitoring and supervision, and sibling attitudes) (de Looze et al., 2012; Van Der Vorst, Engels, Meeus, Dekovic, & Van, 2005). Thirdly, data was derived exclusively from adolescent self-reports which introduce a possibility of same source bias (Diez Roux, 2007) and social desirability bias. Adolescents may tend to under- or over-report alcohol use according to whether they perceive the behaviour to be socially undesirable or desirable. However, a review study by Brener, Billy & Grady (Brener, Billy, & Grady, 2003) concludes that although self-reports of alcohol use are affected by both cognitive and situational factors, this does not threaten the validity. Also we used simple questions and ensured anonymity in order to help generating reliable and valid data. Fourthly, lifetime-drunkenness was used as the outcome in this paper. Preferably we would have rerun the analyses using a shorter reference period (e.g. past 30 days), but unfortunately such data was not available in this study. Finally, it is relevant to address the possibility of selection bias even though we have a relatively high response rate of 89% in this study. Since alcohol use is often related to truancy, a potential selection bias would most likely result in an underestimation of the number of adolescents who have experienced drunkenness (Mounteney, Haugland, & Skutle, 2010). Despite these limitations, this study contributes to the literature by examining the complex interrelationships that exist among family social support and school context on adolescent alcohol use.
Implications

We have shown that a positive school climate buffers the effect of low parental support. Future research should further explore the role of school in relation to adolescent alcohol use and collect more detailed information about the school climate in order to examine and model the relation between school-level factors and adolescent alcohol use more comprehensively, preferable in longitudinal studies.

Finally, study findings have implications for practice. Enhancing the level of school climate and school connectedness may not only have beneficial effects on students’ wellbeing but may also help to lower the level of drunkenness. This approach is supported by the evidence from a recent systematic review of experimental and observational studies which concluded that modifying the schools’ social environment can significantly reduce substance use, and may be a highly-effective complement to existing interventions addressing individual knowledge, skills and peer norms (Fletcher, Bonell, & Hargreaves, 2008).

Acknowledgement: The authors thank Dr. Pernille Due from the National Institute of Public Health, University of Southern Denmark, for access to the dataset.
Table 1

Description of the study sample and proportion of participants who have been drunk once or more

(n=10,540)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study sample n</th>
<th>Proportion who been drunk once or more %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
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</tr>
<tr>
<td>Boys</td>
<td>5,261</td>
<td>36.9</td>
</tr>
<tr>
<td>Girls</td>
<td>5,489</td>
<td>29.8</td>
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<tr>
<td><strong>Age group</strong></td>
<td></td>
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<tr>
<td>11-year-olds</td>
<td>3,758</td>
<td>7.7</td>
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<tr>
<td>13-year-olds</td>
<td>3,867</td>
<td>25.2</td>
</tr>
<tr>
<td>15-year-olds</td>
<td>3,125</td>
<td>73.7</td>
</tr>
<tr>
<td><strong>Migration status</strong></td>
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</tr>
<tr>
<td>Ethnic Danes</td>
<td>9,833</td>
<td>34.7</td>
</tr>
<tr>
<td>Immigrants</td>
<td>917</td>
<td>17.9</td>
</tr>
<tr>
<td><strong>Parental support</strong></td>
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<tr>
<td>Low</td>
<td>1,093</td>
<td>45.1</td>
</tr>
<tr>
<td>Medium</td>
<td>3,078</td>
<td>39.3</td>
</tr>
<tr>
<td>High</td>
<td>6,549</td>
<td>28.5</td>
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<tr>
<td><strong>School Connectedness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>3,591</td>
<td>41.2</td>
</tr>
<tr>
<td>Medium</td>
<td>3,577</td>
<td>30.3</td>
</tr>
<tr>
<td>High</td>
<td>3,582</td>
<td>28.2</td>
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<tr>
<td><strong>School-class climate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below average (200 classes)</td>
<td>3,322</td>
<td>47.6</td>
</tr>
<tr>
<td>Average (200 classes)</td>
<td>3,826</td>
<td>35.9</td>
</tr>
<tr>
<td>Above average (201 classes)</td>
<td>3,602</td>
<td>17.3</td>
</tr>
</tbody>
</table>
Table 2

OR (95% CI) for adolescent drunkenness by parental support, school connectedness, and school-class climate analysed by multilevel modelling (n=10,540)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
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<tbody>
<tr>
<td>Individual-level</td>
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<tr>
<td>Sex</td>
<td></td>
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</tr>
<tr>
<td>Boys</td>
<td>1.54 (1.39-1.70)**</td>
<td>1.51 (1.36-1.67)**</td>
</tr>
<tr>
<td>Girls</td>
<td>1.00 (ref.)</td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>Age group</td>
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<td></td>
</tr>
<tr>
<td>11-year-olds</td>
<td>0.07 (0.04-0.12)**</td>
<td>0.10 (0.06-0.17)**</td>
</tr>
<tr>
<td>13-year-olds</td>
<td>0.18 (0.14-0.24)**</td>
<td>0.20 (0.15-0.27)**</td>
</tr>
<tr>
<td>15-year-olds</td>
<td>1.00 (ref.)</td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>Migration status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnic Danes</td>
<td></td>
<td>2.99 (2.39-3.74)**</td>
</tr>
<tr>
<td>Immigrants</td>
<td></td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>Parental support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td>1.82 (1.54-2.16)**</td>
</tr>
<tr>
<td>Medium</td>
<td>1.38 (1.23-1.55)**</td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School connectedness&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td>2.21 (1.94-2.52)**</td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td>1.29 (1.12-1.47)**</td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class level</td>
<td></td>
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<tr>
<td>School-class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below average</td>
<td></td>
<td>1.50 (1.25-1.80)**</td>
</tr>
<tr>
<td>Average</td>
<td>1.35 (1.13-1.61)**</td>
<td>1.00 (ref.)</td>
</tr>
<tr>
<td>Above average</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Random effects

|                          |                          |                                  |
| School-class variance (SE)| 0.180 (0.038)<sup>*a</sup> | 0.172 (0.038)<sup>*</sup>        |
| ICC (%)                  | 7.1                      | 5.8                              |
| School variance (SE)      | 0.068 (0.030)<sup>*a</sup> | 0.032 (0.022)                    |
| ICC (%)                  | 1.98                     | 0.92                             |

*p <0.05, **p < 0.001, SE, standard error, <sup>a</sup> age adjusted, <sup>b</sup> mutually adjusted, <sup>c</sup> school connectedness was centred around the school-class mean
Caption for figure

Figure 1: Adjusted odds ratios for drunkenness by the combined variable for school climate and parental support among 11-year olds
References


smoking and drinking also predict cannabis use and early sexual debut. *Prevention Science*, 13, 594-604.


Adolescent Alcohol Use Reflects community-Level Alcohol Consumption Irrespective of Parental Drinking

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Damsgaard MT
Tolstrup JS
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Adolescent Alcohol Use Reflects Community-Level Alcohol Consumption Irrespective of Parental Drinking


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Keywords: Adolescents; Alcohol use; Community; Social context; Multilevel analysis

ABSTRACT

Purpose: Risk factors for adolescent alcohol use are typically conceptualized at the individual level, and school- and community-level risk factors have received little attention. Based on the theoretical understanding of youth alcohol consumption as a reflection of community social practice, we analyzed whether adolescent drunkenness was related to community-level adult alcohol use (AAC), when taking individual and school-level risk factors for drunkenness into account. Furthermore, we investigated whether the association between community-level AAC and adolescent drunkenness was attenuated after inclusion of parental drinking.

Methods: We used data from three sources: data about adolescent drunkenness from the Health Behavior in School-Aged Children 2010 survey (N = 2,911; 13- to 15-year-olds nested in 175 school classes and 51 schools); data about community-level AAC derived from the Danish National Health Survey 2010 (177,639 participants); and data on school-level variables from Health Behavior in School-Aged Children School Leader Survey 2010. We performed multilevel logistic regression analysis with data from students nested within school classes and schools.

Results: Overall, 33.5% of students had been drunk twice or more. High community-level AAC was significantly associated with adolescent drunkenness (odds ratio [95% confidence interval], 1.94 [1.21–3.11]). Parental drinking was strongly related to adolescent drunkenness but did not attenuate the relationship between community-level AAC and adolescent drunkenness. We found no association between adolescent drunkenness and school-level variables (youth-friendly environment, alcohol education, and exposure to alcohol outlets).

Conclusions: Adolescent drunkenness was associated with community-level AAC and was not explained by parental drinking.

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Adolescent drinking is associated with alcohol consumption among adults in their community, even after adjustment for parental drinking. Future research should identify the processes behind this social reproduction of behavior. The findings may inform practice and stimulate alcohol preventive interventions that address not only adolescents but also adults in their community.

Excessive alcohol use among young people is a public health problem that causes injuries and other health and social problems [1-2]. Adolescents’ alcohol use is influenced by the context in which they live [3-4], school characteristics [5-7], access to alcohol outlets [8,9], and motivational [10] and sociodemographic factors [11,12]. Alcohol consumption among adults and adolescents varies considerably across communities and countries [13,14]. These geographical variations in health and health behaviors are often ascribed to either compositional or contextual influences [15]. Compositional explanations focus on the composition of the population in a given area, whereas contextual explanations stress the characteristics of the surroundings (e.g., average income in an area, number and quality of schools, access to sport facilities and
Adolescents' alcohol use, alcohol policies, and adults' drinking pattern: cross-national comparison of 37 countries

Bendtsen P
Damsgaard MT
Casswell S
Huckle T
de Looze M
Hofmann F
Hublet A
Kuntsche E
Arnold P
Simons-Morton B
ter Bogt TFM
Holstein BE

Status: In review (Addiction)
Adolescents' alcohol use, alcohol policies, and adults' drinking pattern: cross-national comparison of 37 countries


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Declarations of interest:

Running head: Adolescents' alcohol use, alcohol policies, and adults' drinking pattern

Word count: 3,425
Abstract:

Background and Aims: The study investigates whether adolescent alcohol use is associated with adult drinking patterns and alcohol control policies in 37 countries and further whether there are gender differences in these associations.

Design, Setting, Participants: Multilevel logistic regression analysis were estimated based on answers from 144,788 adolescents in 37 countries aged 13-15 years who participated in the Health Behavior in School-Aged Children 2010 survey. Data on alcohol control policies were retrieved from Brand et al. (2007) and information on adult drinking patterns were drawn from three WHO reports.

Measurements: Outcome measures were weekly drinking and drunkenness.

Findings: In the sex and age-adjusted model high country-level adult per capita alcohol consumption (APC) (OR: 3.35, 95% CI: 2.28-4.93), high APC among drinkers (OR: 2.64, 1.79-3.87), high proportion of heavy drinking (OR:1.92, 1.15-3.20), risky drinking patterns in the adult population (OR: 1.57, 1.14-2.18), and weak restrictions on availability (OR:1.90, 1.25-2.89) were significantly associated with drunkenness. Weekly drinking were significantly associated with not having a minimum purchasing age (OR:3.93, 1.66-9.28), weak restrictions on availability (OR:3.16, 1.95-5.13) and less comprehensive alcohol control policies (OR: 1.93, 1.13-3.28). In the mutually adjusted models, high APC and risky drinking pattern in the adult population were associated with drunkenness, while weak restrictions on availability and advertising were significantly associated with weekly drinking. Additionally, a low level of abstainers was associated with girls’ drunkenness. Having no minimum purchasing age was associated with boys’ drunkenness.

Conclusions: High levels of adult drinking and limited alcohol control policies were significantly associated with adolescent alcohol use.
Introduction

Within Europe, there are large variations in rates of drunkenness and frequency of drinking among adolescents. With some exceptions, drunkenness is more prevalent in Northern Europe while Southern Europe has a higher prevalence of frequent drinking. Insight into factors associated with these cross-national differences may help understand the etiology of adolescents' alcohol use. Adult drinking patterns and alcohol control policies have been hypothesized to contribute to the cross-country variation in adolescent alcohol use, but few studies have addressed this issue. The aim of the study was therefore to analyze the associations between adult drinking patterns, alcohol control policies and adolescent alcohol use across 37 countries.

Adolescent alcohol use is influenced by the context in which they live. According to Skog’s theory of collective consumption, each person tends to adjust his or her alcohol consumption to other persons within the same culture and the population will therefore to some extent behave collectively. At the group level, one might therefore expect adolescents’ alcohol consumption to reflect the consumption pattern and drinking culture in their country. This possibility has received little attention in international research. The few available studies are mostly based on ecological analyses and most studies have used per capita alcohol intake as a proxy for the alcohol culture. Other aspects of the adult drinking pattern might also be relevant, e.g. the proportion of abstainers and proportion of binge drinkers in each country. Across countries there are wide variations in the rate of alcohol abstinence, for example 0.8% of the Danish population is lifetime abstainers where the corresponding percentage in Portugal is 26%.

A second potential explanation for the variation in adolescent drinking is country-differences in alcohol control policies, such as minimum purchasing age, and restrictions on availability and advertising. Almost all European and North American countries have minimum purchasing ages (MPA) on both off- and on-premises sales of alcohol. MPA typically ranges from 16 to 21 years. Although many young people succeed in buying alcohol despite age limits, the general observation is that age limits for purchasing
alcohol reduce the proportion of young people who buy and drink alcohol frequently \(^{23-26}\) and the proportion of young people who suffer problems from their alcohol use such as injuries and drunk driving \(^{27-30}\). Also restrictions on advertising and availability have been used to reduce alcohol consumption and related harm among adolescents \(^ {23,31}\). Higher outlet density has been associated with higher alcohol consumption and a range of adverse outcomes \(^ {32,33}\). There are considerable variations in alcohol control policies across countries \(^ {17,31,34}\), however, few studies have examined whether the variations are related to alcohol use among adolescents \(^ {9}\). Previous research has mainly been carried out in single countries \(^ {9}\) or with the use of aggregated data \(^ {8,16,31}\), and dichotomous measures (e.g. absent/present) for alcohol control policies. To get a more comprehensive measure of the alcohol control policy, Brand et al. \(^ {31}\) developed the Alcohol Policy Index (API).

In this study, we aimed to analyze how adolescent drunkenness and frequency of drinking were associated with adult drinking patterns and alcohol control policies and whether these variables accounted for any of the country-level variation in adolescent alcohol use. We included two outcome measures: 1) Drunkenness (drunk one or more times), and 2) Frequency of drinking (drinking weekly or more often). Further, we explored gender differences in these associations since alcohol use among boys and girls might be differently associated with country-level factors \(^ {17}\).

**Methods**

*The HBSC study*

We used data from the Health Behaviour in School-aged Children (HBSC study) study 2009/2010 \(^ {1}\). HBSC provides comparable data on young people’s health and health behaviours across different social contexts. The study population is school-children in three age groups, 11-, 13-, and 15-year olds recruited from a nationally representative sample of schools or school classes, i.e. cluster sampling. The students answered the internationally standardized HBSC questionnaire at school. Participation in the survey was voluntary, and students were assured that responses would be confidential. Countries were required to follow the
international research protocol which promoted consistency in sampling plans, survey instruments and data collection. At the student participant level, known response rates at the student-level were >70% in almost all countries. Each participating country obtained approval to conduct the survey from the relevant ethics review board or equivalent regulatory institution.\textsuperscript{1,35}

\textit{Study population}

We used data on 13- and 15-year-olds (\(n=145,671\)). Data on 11-year-olds were not included since few in this age group had been drunk and were weekly drinkers. Countries with no information on alcohol use (Turkey) or missing data on adult drinking pattern (Greenland) were excluded from the analyses (\(n=5,299\)). So was students with missing information on age (1,952) or alcohol measures (\(n=1,810\)) leaving 144,788 students for further analyses. Table 1 shows the 37 countries in the study. The policy analyses were restricted to 27 countries for which API scores were available (\(n=104,676\)).

We merged two datasets: Individual-level data from HBSC on frequency of alcohol use, drunkenness, and individual-level socio-demographic factors\textsuperscript{1}, and macro-level data on country characteristics retrieved from the Global Information System on Alcohol and Health (GISAH)\textsuperscript{36} and two WHO reports\textsuperscript{19,37}.

\textit{Individual-level factors}

We included two measures of adolescent alcohol use: Weekly alcohol use: Students were asked how often they drank beer, wine, alcopops and liquor/spirits. For each alcoholic drink, response options were “never,” “rarely,” “every month,” “every week,” and “every day.” This variable was dichotomized into those who drank less than weekly (coded 0), and those who drank weekly or more often (1). Drunkenness: Students were asked if they ever had so much alcohol that they were really drunk where we dichotomized the responses into “no, never” (coded 0) versus “2 = yes, once,” or more often (coded 1).

Gender (girls as the reference) and age-group (categorized into 13- and 15-year-olds with 13-year-olds as the reference) were also assessed.
Adult drinking pattern

We included five measures of the adult drinking pattern based on data from WHO \(^{19,36,37}\). Rate of *life time abstainers* was calculated from the male and female rate of life time abstainers measured in 2005 and 2009. *Patterns of drinking score (PDS)* was assessed in 2004/2005 by WHO based on heavy drinking occasions, proportion of daily drinkers, drinking with meals and drinking in public places, ranging from one to five. The variable was categorized into low (1), medium (2) and high risk (3-5) with low risk countries used as the reference. Data on total *alcohol per capita consumption (APC)* of adults (aged ≥15) was measured in liters of pure alcohol. Total APC measures the consumption of pure alcohol per person per country and included estimated unrecorded alcohol intake in 2005 and the average recorded alcohol intake from 2003-2005. *Alcohol per capita consumption among drinkers (APCD)* was measured as liters of pure alcohol consumed only by the adult drinking population in 2005. Prevalence of heavy episodic drinking among males, referred to as *male binge drinkers* was measured from 2003-2005 as those who had at least 60 grams or more of pure alcohol on one occasion during the past 7 days.

Alcohol control policies

We included four country-level variables about alcohol control policies. *Minimum purchase age* (MPA) was derived from WHO \(^{36,37}\) and measured in 2008 as the lowest MPA for buying any type of alcohol and categorized into: no age limit, 16-18 years, and 20-21 years. The highest purchasing age was used as the reference group. Three other measures of policy restrictions were derived from the Alcohol Policy Index (API) \(^{31}\): a) *Total API* range in this study 0-68 with a higher score indicating more restrictive policies b) *Availability API* based on minimum purchase age, hours of sales, (range 0—24) and c) *Advertising API* based on number of media with advertising restrictions (0—3). Total API and Availability were split into approximate tertiles and categorized from one to three with three indicating countries with the most restrictive policies.

Analysis
**Sex- and age-adjusted multilevel analysis:** Univariate age- and gender-adjusted multilevel logistic regression models were conducted with SAS Version 9.3 to examine the relationships of adolescent alcohol use with adult drinking patterns and alcohol control policies. The models included two levels: student and country. Separate models were run for each outcome variable adjusted for age and gender. We performed gender stratified analyses when there was significant (p<0.05) interaction on gender (indicated with * in Table 2).

**Multivariate multilevel analysis:** We also examined results for a final multilevel multivariate model including significant country-level measures to assess the strength of each contextual measure in the presence of the others. Only significant associations were kept in the model. These analyses were stratified on gender. To further explore the gender differences, combined variables of country-level variable and gender were constructed. We included interaction terms between age and main effects in the analyses. Non-significant interaction terms were deleted from the model.

**Median odds ratio (MOR) and intra class correlation (ICC)** were calculated to assess the extent to which adult drinking and alcohol control policies accounted for any of the country-level variation in adolescent alcohol. MOR translates the country-level variance into the OR scale and is directly comparable with the ORs of individual covariates. In this study, MOR shows the extent to which the individual probability of drunkenness and weekly drinking are associated with country. If the MOR is equal to one, there would be no differences in the probability of drunkenness and weekly drinking across countries. The country-level ICC measures the proportion of the variance in adolescent alcohol use that is due to country-level variation. To assess to which extent the country-level variables accounted for the variation in alcohol use across countries the MOR and ICC were calculated with and without country-level variables.

**Results**

*Descriptive results*
Table 1 shows individual- and country-level characteristics. Among 13-year olds the overall prevalence of drunkenness and weekly drinking were 18.3% and 7.8%, respectively. The corresponding numbers for 15-year-olds were 46.5% and 21.1%. There were large variations in prevalence of drunkenness and weekly drinking across countries. As an example, 5.6% of the 13-year-olds reported drunkenness in Iceland compared to 34.5% in Wales. Lifetime abstainers varied from 0.8% in Denmark to 40.5% in Macedonia and Israel. APC in the adult population varied considerably from 2.9 l in Israel to 16.5 l was observed in the Czech Republic. APCD was 27.9 l in Ukraine while drinkers in Israel, in the lower end of the spectrum, consumed 5.5 l of alcohol. The average percentage of male binge drinking ranged from 43.4% in Ireland to 2.3% in Sweden. Patterns of drinking score varied between 1 and 3 with a mean of 2.4 and most countries having a score of 3. Across countries mean total API was 40.9 with the lowest score in Luxembourg (14) and the highest scores of 64-67 in Sweden, Norway, Iceland, and Poland. Iceland, USA and Canada had the most restrictive availability policy (score from 21-24) while Austria, Italy, Luxembourg and Portugal had the least restrictive policy. The index on Advertising restrictions ranged from 0 to 3 with most countries having limited restrictions.

---Table 1 about here---

Age-and sex-adjusted multilevel analyses

High per capita consumption, high proportion of heavy drinking, risky drinking patterns in the adult population, fewer restrictions on minimum purchasing age, and high availability showed a significant association with high levels of adolescent drunkenness.

The following measures were significantly associated with high odds of weekly drinking among adolescents: high availability, fewer restrictions on minimum purchasing age, and less comprehensive alcohol control policies (Table 2).

---Table 2 about here---
We found significant gender differences in ten of the associations in the univariate models (indicated with * in Table 2). Level of abstainers and level of male binge drinking were significantly associated with drunkenness among girls, but not among boys. MPA and availability policy were stronger associated with weekly drinking among boys than among girls (Figure 1).

----Figure 1 about here----

Overall, girls’ alcohol use, and especially drunkenness, tended to be more strongly associated with adult drinking patterns, while boys’ alcohol use tended to be more strongly associated with alcohol control policies.

Multivariate multilevel analyses

Multilevel logistic regression models were used to measure the strength of each country-level variable in the presence of the others. High per capita alcohol consumption and risky drinking pattern in the adult population showed significant associations to drunkenness for both genders (Table 3). As an example, boys living in countries with high levels of adult per capita consumption had an increased odds ratio of 3.15 (95% CI:2.13-4.64) for being drunk compared to boys living in countries with low levels of adult per capita consumption. For girls, the level of abstainers was significantly negatively associated with drunkenness. A 10% increase in the number of abstainers in a given country corresponded to a 21% reduction in the risk of being drunk among girls (p=0.001).

----Table 3 about here----

Availability policies and advertising were significantly associated with weekly drinking among boys and girls (Table 4). Girls who lived in countries with few restrictions on alcohol availability had elevated odds of being weekly drinkers (OR=2.00, 95% CI:1.15-3.46), and so had boys (OR=2.82, 95% CI:1.74-4.54). The same tendency was seen for advertising restrictions being associated with lower prevalence of weekly drinking.
MOR and ICC

The sex- and age adjusted analyses showed that per capita consumption accounted for a large part of the country variance in adolescent drunkenness. Adding per capita to the model reduced the ICC from 8.0% to 3.7% (MOR reduced from 1.66 to 1.40) (Table 2). The full model further reduced the ICC to 3.2% among girls and 2.7% among boys (Table 3).

Availability policies accounted for most of the variation in weekly drinking and reduced the ICC from 10.5% to 6.5% (MOR reduced from 1.81 to 1.57) (Table 2). In the full model the ICCs were further reduced to 6.3% and 5.0 % for girls and boys, respectively (Table 4).

Discussion

To our knowledge, this is the first multilevel study that examines the relationship between adolescent alcohol use, gender, adult drinking patterns and alcohol control policies across such a large number of countries. In this cross-national study of more than 140,000 adolescents we analyzed how drunkenness and frequency of alcohol use were associated with country-level policies and adult drinking characteristics.

The relationship between high adult per capita consumption and adolescent drunkenness was consistent across gender groups and persisted even after inclusion of other measures of adult drinking pattern and alcohol control policies. This finding is supported by other studies which found a positive relationship between adult and adolescent alcohol use across cities and countries. Fewer restrictions on minimum purchasing age and a risky drinking pattern in the adult population were also associated with higher risk of drunkenness in the univariate analyses. These associations persisted in the full model and were evident among boys and girls.
Fewer restrictions on the overall alcohol control policy, minimum purchasing age, and availability were significantly associated with *weekly drinking* in the sex-and age-adjusted models. In the full model, weekly drinking was associated with fewer restrictions on availability and advertising policies. The result that more comprehensive alcohol control policies may reduce the frequency of adolescent alcohol use corresponds with other studies \(^8,16,23\).

Our findings suggest that country-level factors associated with adolescent drunkenness are different from those associated with weekly drinking. Generally, adult drinking was more strongly associated with drunkenness while policies were more strongly associated with weekly drinking. It is possible that restrictive alcohol control policies influence the prevalence of weekly drinking more than it influences adolescent drunkenness. This finding may also reflect a correlation between strict alcohol policies and increased prevalence of drunkenness. It may be that countries with a high prevalence of drunkenness among adolescents are more likely to introduce strict policies compared to countries with a low prevalence \(^8\).

The associations went in the same direction for boys and girls but only girls’ drunkenness was significantly related to prevalence of abstainers. The associations between alcohol control policies and alcohol use were generally stronger among boys compared to girls. A plausible explanation for this difference is found in the source used to obtain alcohol. Girls are generally more likely to depend on social sources and boys are more likely to use commercial sources \(^39\). Hence, girls may be more likely to correspond to social norms while boys may be more influenced by prevention policies. Another explanation could be gender differences in the drinking norms \(^40,41\). Despite a declining gender gap in adolescents’ alcohol use alcohol use is still more normative for boys than for girls \(^1,42\). Consequently, girls may be more affected by the ‘normality’ of drinking in a given country which may for example compel them to drink less in conformity with the country’s alcohol culture if living in countries with traditional gender roles \(^17,40\).
The major strengths of this study are its international scope, the use of multilevel models together with comprehensive measures of adult alcohol use and alcohol control policies, and the large study population. Further, the study included two outcome measures, drunkenness and weekly drinking which allowed us to analyze differences and similarities between these two outcome measures and country-level predictors.

Weaknesses include the cross-sectional survey which means that the causal relationship between adolescent alcohol use and country-level variables cannot be inferred. However, longitudinal studies with such a large number of participating adolescents from different countries would be difficult to carry out. Second, we may miss important information such as country-differences in the enforcement of alcohol control policies. Third, the validity of the country-level measures may vary across countries due to differences in data quality. Fourth, the country-level may not be adequate in relation to adolescents’ alcohol use. The suggested convergence in adolescent drunkenness between countries indicates that youth are influenced more by global trends such as Facebook and the Internet than by country-level factors. Fifth, there is a possibility of selection bias from non-participating students who may show higher rates of alcohol use compared to those being at school. Last, our results rely on self-reported data and cross-national differences in perception of drunkenness might have influenced our findings. Information bias could have occurred if students in countries with low levels of per capita consumption systematically under- or overestimated their level of drunkenness compared to students in countries with high levels of per capita consumption. However, anonymous surveys usually provide fairly accurate information about drunkenness.

Despite these shortcomings the present study provides an important step towards the understanding of how adult drinking patterns and alcohol policies are related to alcohol use among boys and girls across countries. The gender differences in the associations between adolescent alcohol use and control policies and adult drinking patterns suggest that girls may be better reached by positive role models while boys may be better reached by restrictive policy measures. Making alcohol less available and banning alcohol
advertising may be effective strategies to reduce frequent drinking among boys, whereas changed norms and drinking patterns in the adult population may help to reduce the prevalence of drunkenness among girls. Although, the study provides valuable information on individual and country-level determinants of adolescent alcohol use we cannot identify the complexity in this study. Therefore, additional research is needed to better understand the mechanisms through which country-level factors affect adolescents’ alcohol use. Further, since all participating countries are located in Europe or Northern America much remains to be learned about the nature of adult drinking patterns and alcohol control policies in countries in the rest of the world.

Conclusion

The article finds an inverse relationship between strict alcohol control policies and frequency of drinking among adolescents and a positive association between level of adult drinking and adolescents’ drunkenness. An important finding was that availability policies were found to be related to drunkenness and frequency of drinking among boys and girls. Since availability policies are able to be controlled by public health policy this finding holds considerable importance from a public health perspective. Another important finding was that boys seemed to be more susceptible to alcohol control policies while girls were more influenced by drinking patterns in the country. This speaks to the importance of alcohol control policies in relation to reducing boys’ alcohol use while social norm interventions might have a greater impact on girls’ alcohol use. Since alcohol use among adolescents is highly prevalent even modest effects applied to the entire population of youth could potentially results in very large societal benefits.
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*Patterns of drinking score ranging from 1-3 with 3 indicating the most harmful drinking pattern, a Based on recorded alcohol consumption and estimations of unrecorded alcohol measured in liters of pure alcohol consumed by the adult population (aged 15 years or more), b Alcohol per capita consumption among drinkers measured as pure alcohol consumed by the drinking population in liters, c Defined as having at least 60 grams or more of pure alcohol on one occasion during the past 7 days, d Lowest minimum purchasing age for any type of alcohol, e Alcohol control policy indexes were taken from Brand et al. (2007), f France was the only country with a score of 2 and was therefore grouped with countries scoring 1, g The UK average was applied to Scotland, England and Wales, since regional data on adult drinking patterns was not available for the time period – no data available.
Table 2: OR (95% CI) for adolescent drunkenness and weekly drinking by adult drinking and alcohol control policies: multilevel logistic regression adjusted for age and gender

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<td>Weak</td>
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<td>Total API</td>
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<td>1.20 (0.74-1.94)</td>
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<td>Advertising restrictions</td>
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<td><strong>Random effects</strong></td>
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<td>Country-level variation</td>
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* Significant interaction on gender (for further information see Results, Discussion and Figure 1)
Table 3: OR (95% CI) for drunkenness among boys and girls by adult drinking pattern and alcohol control policies, multivariately adjusted (only significant associations are showed)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Girls (n=71,319)</th>
<th>Boys (n=68,778)</th>
<th>13-year-olds</th>
<th>15-year-olds</th>
<th>13-year-olds</th>
<th>15-year-olds</th>
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<td>P</td>
<td>OR (CI)</td>
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<td>&lt;0.001</td>
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<td>Adult drinking pattern</td>
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<td>1.00 (ref.)</td>
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<td>1.00 (ref.)</td>
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<td>Per capita</td>
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</tr>
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<td>Low</td>
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<td>1.00 (ref.)</td>
<td>&lt;0.001</td>
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<td>2.04 (1.49-2.80)</td>
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<tr>
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<td>3.50 (3.27-3.74)</td>
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<td>1.00 (ref.)</td>
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<td>1.76 (1.17-2.66)</td>
<td>1.76 (1.03-3.02)</td>
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<tr>
<td>Medium</td>
<td>1.61 (1.18-2.18)</td>
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<td>2.02 (1.33-3.05)</td>
<td>2.82 (1.74-4.54)</td>
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Policies

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<th>Boys (n=51,528)</th>
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<th>15-year-olds</th>
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<tr>
<td></td>
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<td>OR (CI)</td>
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<tr>
<td>15-year-olds</td>
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<tr>
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<td>1.68 (1.32-2.13)</td>
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<tr>
<td>Weak</td>
<td>2.00 (1.15-3.46)</td>
<td>2.82 (1.74-4.54)</td>
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<tr>
<td>Advertising, Strong</td>
<td>1.00 (ref.)</td>
<td>0.022</td>
<td>1.00 (ref.)</td>
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<td>Weak</td>
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<td>1.56 (1.02-2.40)</td>
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Random

<table>
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<th>Variable</th>
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<th>Boys (n=51,528)</th>
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<td>1.37/ 3.2</td>
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</table>

Table 4: OR (95% CI) for weekly drinking among boys and girls by adult drinking pattern and alcohol control policies, multivariately adjusted (only significant associations are showed)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Girls (n=53,148)</th>
<th>Boys (n=51,528)</th>
<th>13-year-olds</th>
<th>15-year-olds</th>
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<td>15-year-olds</td>
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<tr>
<td>Availability, Strong</td>
<td>1.00 (ref.)</td>
<td>0.016</td>
<td>1.00 (ref.)</td>
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<tr>
<td>Medium</td>
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<td>Weak</td>
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<td>2.82 (1.74-4.54)</td>
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<tr>
<td>Advertising, Strong</td>
<td>1.00 (ref.)</td>
<td>0.022</td>
<td>1.00 (ref.)</td>
<td>0.040</td>
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Random

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<td>1.56/ 6.3</td>
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<td>1.56/ 6.3</td>
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</tbody>
</table>

a Assessed as a 10% increase in percent of abstainers, 
b Age adjusted
Figure 1: OR for weekly drinking by the combined variable of gender and availability policy (reference value: girls in countries with strong alcohol control policies)
References


