Beyond the Individual Determinants of Health: The Significance of Social Environment on Alcohol Use

Mohler-Kuo, M
Beyond the Individual Determinants of Health: The Significance of Social Environment on Alcohol Use

Habilitationsschrift zur Venia Legendi an der Medizinischen Fakultät der Universität Zürich im Fachgebiet Sozial- und Präventivmedizin, speziell Sozialepidemiologie

Meichun Mohler-Kuo
1. Introduction

Epidemiology is the study of the frequency, distribution and determinants of disease and states of health in human populations (Susser 1973, MacMathon et al, 1996). One main task of Epidemiology is to identify risk factors of disease. During the last half century, a tremendous body of epidemiologic work has focused upon identifying individual-level risk factors for chronic diseases, such as coronary heart disease. However, despite all of the individual risk factors currently identified, only about 40% of the occurrence of coronary heart disease can be explained (Marmot et al 1975). In the 1990s, some epidemiologists advocated rethinking the epidemiological approach to studying disease (Rose, 1992; Susser 1998; Susser et al 1996a 1996b; Syme 1996). In Mervyn Susser’s series of articles, he urged that Epidemiology must broaden its base and move beyond its focus on individual risk factors towards a ‘multilevel eco-epidemiology’ (Susser et al 1996a 1996b, Susser 1998). This perspective emphasizes the fact that health and disease are influenced by factors not only at the individual level, but also at the group or community level. Focusing on the individual risk factors is insufficient to explain why some societies, communities and groups have high rates of certain diseases or behaviors (such as heavy drinking, hypertension, obesity and diabetes). Moreover, interventions focusing exclusively on changing individual behaviors have proven to be difficult and ineffective (Babor et al 2003; Hansen 1994; Leventhal et al 1980; Syme et al 1982;). New people continue to enter the at-risk population at an unaffected rate, because aspects of the environment in which causes occur have not been targeted. (Syme et al, 2002)

‘Social Epidemiology’ is defined as ‘the branch of epidemiology that studies the social distribution and social determinants of states of health’ (Berkman et al 2000). Social Epidemiology is distinguished by ‘its insistence on explicitly investigating social determinants of population distributions of health, disease, and well-being, rather than treating such determinants as mere background to biomedical phenomena’ (Krieger, 2001a). Since individuals are living in the world simultaneously as social and biological beings, risk factors and risk behaviors observed in individuals are generated and reinforced in multilevel, interactive environments. The crucial insight provided by Rose’s (1992) population perspective is that an individual’s risk of illness cannot be considered independent of the disease risk of
the population to which he or she belongs. Thus, social epidemiology goes beyond the analysis of risk factors at the individual level, to include the social environmental context, within which the state of health and illness occurs. The goal of social epidemiology is to conceptually and operationally test the associations between aspects of social environment (including families, workplaces, residential neighborhoods and political economy) and population health (Kawachi 2002). Michael Marmot has sketched a multi-level approach to understanding the social determinants of Social Epidemiology (Figure 1 Marmot, 2000).

---

**Social epidemiology of alcohol use**

The following five papers selected for habilitation focus upon how social environmental correlates affect risk behavior, specifically the behavior of alcohol consumption. Alcohol has been linked to more than 60 different medical conditions (Rehm et al 2003). According to the recent study of Global Burden of Disease conducted by the World Health Organization (WHO, 2002), alcohol use has been identified as a leading cause of mortality and disability. Alcohol-related death and disability account for about 4 % of the total global burden of disease.

Binge drinking (defined as consumption of $\geq 5$ drinks for men and $\geq 4$ for women, at least once in the past 2 weeks) among U.S college students (Wechsler et al 1995a)
has been recognized as one of the major public health concerns (National Institute on Alcohol Abuse and Alcoholism 1998; U.S. Department of Health and Human Services. Healthy, 2000). It is estimated that 500,000 college students between the ages of 18 and 24 suffer unintentional injuries while under the influence of alcohol, and that 1400 college students die each year from alcohol-related injuries. (Hingson et al, 2002). The consequences of binge drinking include damage to self (academic impairment, personal injuries and death, unintended and unprotected sexual activity, etc), damage to other people (property damage, interpersonal and sexual violence, noise disturbances, etc) and institutional costs (property damage, legal costs, student attrition, etc) (Perkins 2002a; Wechsler et al 1994 1995b).

Individual factors related to the binge drinking have been identified, including age of first drink, genetic predisposition, parental drinking, race/ethnicity, age and sex. (Dowdall et al 2002, Wechsler et al 1995c). However, in spite of enormous intervention efforts, the binge drinking rate among college students has not changed since 1993, having remained at about 44% (Wechsler et al 2002a; Johnston et al 2003). In addition, studies have shown that binge drinking rates among college students are higher than among their counterparts (those who do not attend colleges) and that these differences also have remained steady since 1992 (Bachman 1984; O’Malley et al 2002). These results suggest that the college environment, itself, supports this behavior to a great extend. Drinking behavior among college students is complex and involves a broad range of issues. Therefore, the binge drinking behaviors among college students cannot be explained or dealt with without addressing economic, political and ecological factors.

Compared with most European countries, the binge drinking problem among US college students is unique, largely due to the different education system and culture. For example, that students leave home to live in a dormitory is relatively unique to the U.S. culture, as is the transition from obligatory schooling to higher education, and beginning adulthood in an overall dry culture, in which alcohol consumption only becomes legal at age 21 (Kuntsche et al 2004). However, an increase in binge drinking among adolescents recently has become a major public health concern in Switzerland (Currie et al 2004; Gmel et al 2004; Narring et al 2004) and in several other European countries (Currie et al 2004; Hibell et al 2000). For example, the
weekly alcohol consumption increased from 28 % to 42 % among adolescent girls and from 56% to 67% among boys between 1993 and 2003, according to the Swiss Multicenter adolescent survey on health (SMASH)(Narring et al 2004). Approximately 42% adolescents from 16-20 reported getting drunk at least once over the preceding 30 days in Switzerland (Narring et al 2004). In the European School Survey Project on Alcohol and Drug (ESPAD) study, half of the 18 participating countries reported an increase in binge drinking among 15-year olds from 1995-1999 (Hibell et al, 2000) and many countries have called for increased preventative efforts to curb binge drinking.

The first three papers selected for habilitation report on results from the College Alcohol Study (CAS) in the United States. The first paper focuses upon an international comparison between the U.S. and Canada to look for differences in drinking behaviors among college students. The second paper examines college-level correlates and demonstrates that a college’s demographic composition can serve as a protective factor to prevent binge drinking. The third paper examines the drinking environment surrounding college campuses, addressing such environment-related factors as marketing and price.

The CAS initially was conducted in 1993 at 140 colleges across 40 states. In subsequent surveys in 1997, 1999, and 2001, 120 of these initial 140 colleges participated. For each survey, the administrators at participating colleges were asked to provide a random sample of 215 undergraduates drawn from their total enrollment of full-time students. The attrition of 20 schools primarily was due to the inability of certain colleges to provide an adequate sample of students and mailing addresses to meet the time constraints of the survey. We also excluded one school because of response rate that was substantially lower than those of the other schools, leaving 119 schools in our analytic sample. The analytic sample included all respondents from 119 colleges in the 1993 (n= 15,282), 1997 (n=14,428), 1999 (n=13,954), and 2001 (n=10,904) surveys. Since the demographic characteristics of the student sample for each school may not reflect the true demographic characteristics of that school and could bias results, data were weighted according to sex, age and ethnicity. Details of the sampling methods and inclusion criteria have
been described in previously-published papers (Wechsler et al 1994, Wechsler et al 2002a).

The last two papers selected for habilitation report on the results of a Swiss longitudinal study. The spirits market in Switzerland was reformed based upon the World Trade Organization (WTO) agreement. The change of policy resulted in decreased prices of alcohol and gave us an opportunity to examine its impact on alcohol consumption and related problems in Switzerland.

2. More Canadian students drink but American students drink more: comparing college alcohol use in two countries

Kuo M, Adlaf EM, Lee H, Gliksman L, Demere A, & Wechsler H.
Addiction, 2002;97,1583-1592

2.1. Introduction

Alcohol use among adolescents and college students has been considered a major public health concern in the U.S. and Canada. Demographic risk factors for binge drinking among U.S. college students have been well established. For example, U.S. male and underage college students are more likely to engage in this type of drinking (Wechsler et al. 2000; Wechsler et al. 1995c). However, whether these behaviors differ in the U.S. and Canada remains unknown. Given the lower minimum drinking age of 18 or 19 years in Canada, it is important to examine whether this has an impact upon differences in alcohol use between the two countries.

The present study compares two national surveys and is the first international comparison of alcohol use among college/university students. The purpose of the study is to describe the patterns of alcohol use and heavy alcohol use among college students and to assess the robustness of various risk factors internationally.

2.2. Methods

Study design and Sample. The present study utilized data from two large national surveys: the 1999 College Alcohol Study (CAS), conducted by the Harvard School of Public Health; and the 1998 Canadian Campus Survey (CCS), conducted by the Centre for Addiction and Mental Health, in Canada. Both surveys include large
epidemiological student samples derived from nationally-representative colleges and universities.

To fully evaluate cross-national differences, we pooled the two surveys into a single data file containing 12,344 U.S. students and 6,729 Canadian students from 135 universities. Also, to incorporate the design features of both surveys, we treated each sample as a separate stratum, resulting in a pooled design of six strata, one representing the unstratified CAS sample and the remaining five representing the CCS sample. To enhance cross-national comparisons, students who were 25 years old and over from both CAS and CCS samples were eliminated from analysis; this comprised 12.7% of the CAS and 7.4% of the CCS samples. This was done because older students are more likely to be married, to attend commuter schools, and to drink less than traditional-age college students.

**Data Analysis.** This study compares the prevalence of alcohol use and heavy alcohol use between U.S. and Canadian students. In order to obtain appropriate estimates that adjust for the sampling design and different sampling fractions, weighted percentages were reported. All analyses, including standard errors, 95% confidence intervals and Wald statistics were adjusted for stratification and clustering of data using Taylor series methods (Stata 1999). The analysis is based upon a design with 6 strata and 135 clusters (colleges). Differences with confidence intervals (Fless 1981) were used to compare prevalence rates of alcohol use and heavy alcohol use across the total sample and between various subgroups in the two countries. Multiple logistic regression analysis was performed to provide adjusted odds ratios (OR). These models examined the association of gender, age, legal drinking age, residence and age of first drunkenness with heavy alcohol use. Country effect was represented by a dummy variable (USA=1). In addition, international interaction effects for each correlate also were included in the initial models. These were included in order to assess whether the effects of gender, legal drinking age, residence and age of first drunkenness significantly differed by country within each of the three age groups. International interactions which were not significant at the p< .05 level were dropped from the final model.

2.3. Results
The prevalence of lifetime and past-year alcohol use was significantly higher among Canadian than U.S. students (92% vs. 86% and 87% vs. 81%, respectively). Conversely, the prevalence of heavy alcohol use (typically consuming 5 or more drinks in a row for males/ 4 or more for females) among past-year and past-week drinkers was significantly higher among U.S. students than Canadian students (41% vs. 35% and 54% vs. 42%, respectively).

Table 1. Logistic Regression PredictingHeavy Alcohol Use across the Total Sample (N=18301)

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio &amp; 95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1.00 [0.88-1.13]</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
</tr>
<tr>
<td>Off campus with parent</td>
<td>1.00 -----</td>
</tr>
<tr>
<td>University residence</td>
<td>1.27 [1.05-1.56]</td>
</tr>
<tr>
<td>Off campus without parents</td>
<td>1.36 [1.13-1.65]</td>
</tr>
<tr>
<td>Age</td>
<td>0.87 [0.83-0.90]</td>
</tr>
<tr>
<td>Legal drinking age</td>
<td>0.72 [0.52-1.00]</td>
</tr>
<tr>
<td>Age first got drunk &lt;16</td>
<td>3.12 [2.76-3.52]</td>
</tr>
<tr>
<td>USA</td>
<td>0.79 [0.56-1.12]</td>
</tr>
<tr>
<td>USA * Male</td>
<td>1.21 [1.02-1.44]</td>
</tr>
<tr>
<td>USA * Living with parents</td>
<td>0.53 [0.40-0.69]</td>
</tr>
<tr>
<td>USA * Legal drinking age</td>
<td>1.48 [1.06-2.08]</td>
</tr>
</tbody>
</table>

Table 1 presents the multiple logistic regression analyses examining correlates of heavy alcohol use. The results show that U.S. male students were more likely to engage in heavy alcohol use (OR=1.2[1.02-1.44]) than Canadian male students; however, there was no significant international difference in heavy alcohol use among female students. Older students from both countries were less likely to engage in heavy alcohol use (OR=0.9[0.83-0.90]). The effect of age was more significant than the effect of legal drinking age. However, the international effect of legal drinking age was significant even after adjusting for age. This was most likely due to a higher percentage of underage students drinking in US (43.2%) than in Canada (35.3%), while the drinking among legal age students was the same in both countries (29.7% in US and 29.3% in Canada). Students from both countries who lived in university residences and off-campus without parents were more likely to engage in heavy alcohol use than students who lived off-campus with their parents. The significant country-by-residence interaction indicates that the protective effect of living with parents on heavy alcohol use was greater among U.S. respondents than among Canadian respondents. Finally, students who reported first drunkeness
2.4. Conclusions & Discussion

Programs aimed at reducing heavy alcohol use by students should target freshman at school entry or earlier. Since students living with their parents are less likely to be heavy drinkers, parents may have an important role in prevention efforts. The patterns of drinking in both countries may be influenced by the legal minimum drinking age. However, the relationship is complex and must be viewed in the context of other variables, such as chronological age. Our results provide new insight into potential international differences in important issues, like the gender gap in drinking, and the protective role parents may play. These findings could be used to advance research on heavy drinking in campuses across North America.

3. Watering down the drinks: The Moderating Effect of College Demographics on Alcohol Use of High-Risk Groups
Wechsler H & Kuo M
American Journal of Public Health 2003;93:1929-1933

3.1. Introduction

Heavy episodic or “binge” drinking has been recognized as a major public health problem on many American college campuses. In recent years, much emphasis has been placed on normative influences upon college student drinking behavior (Perkin,2002b) While various interventions have been attempted to lower the level of binge drinking (Perkin 2002b; Larimer et al 2002; Toomy et al 2002), to our knowledge, colleges to date have not examined housing and admissions policies and student demographics to that end. Yet, binge drinking rates vary among student subgroups. For example, African-American, Asian, female and older students all have lower rates of binge drinking than white, male and younger students (O’Malley et al 2002; Wechsler et al 1995; Wechsler et al 2002).

The purpose of the present study was to examine whether an increased presence of students from groups in which alcohol is less heavily consumed will tend to moderate the level of binge drinking in high binge drinking demographic subgroups. Social
learning theories (Aker 1977; Bandura 1986; Hawkin et al 1992) stress the importance that interacting and identifying with others, and imitating their behavior have an impact on individual behaviors. Having more minority students, older students and women will provide more role-models of abstention and responsible drinking, and should lower the overall binge drinking rate.

In the present study, we hypothesized that: (1) binge drinking rates of white, male and underage students would be lower at schools with higher proportions of minority, female and older students; 2) white, male and underage students who did not binge drink in high school would be less likely to take up binge drinking at schools with a larger proportion of minority, female and older students; and 3) white, male and underage students who were binge drinkers in high school would be less likely to continue binge drinking at schools with a higher proportion of minority, female and older students.

3.2. Methods

Subjects & Measures. The study utilized data from the 1993, 1997, 1999 and 2001 College Alcohol Study surveys. Demographic distributions at each school including the percentages of minority, female and older students (ages 22 or older) were obtained from the Integrated Postsecondary Education Data System (IPEDS). School enrollment size was obtained from IPEDS, as well. We further categorized schools into small and medium schools versus large schools. The small/medium schools are those schools whose student population is less than or equal to 10,000. The large schools are those schools whose student population is more than 10,000. We excluded from these analyses two historically black colleges and three religious colleges which prohibit alcohol. Thus, the college-level analyses included 114 colleges at four time points (N=456). The total numbers of students in the 114 colleges were 10,446 in 2001, 13,396 in 1999, 13,846 in 1997 and 14,624 in 1993.

Data analysis Pearson correlation coefficients were used to examine the univariate associations between the proportions of demographic characteristics and college binge drinking rates among total students and high-risk subgroups by each survey year. The correlation coefficients were weighted by school size. We also performed longitudinal multiple regression analyses to simultaneously examine the effects of
the percentages of minority, female, and students age 22 or older, as well as of three dummy variables indicating the 1993, 1997, and 1999 survey years (i.e., 2001 being the comparison year). A General Estimating Equations (GEE) approach (Liang et al 1992; Zeger et al 1988) with a working independence correlation structure was used to fit the longitudinal regression models, so as to appropriately handle the longitudinal repeated measures of the college level outcomes over four survey years. These regression models were stratified by school size (≤10,000 vs >10,000) to demonstrate how the associations vary by school size. All the variables in the model were standardized with the mean=0 and the standard deviation=1, so that the resulting regression coefficients could be on the same scale as the correlation coefficients. Multiple logistic regression analysis was used to examine how these demographic characteristics predict binge drinking in college stratified by drinking status in high school.

3.3. Results

The results showed that binge drinking rates for total students and the high-risk subgroups (white, male and underage) at each school were significantly correlated with the demographic distribution of the school. The higher the percentage of minority, females and students age 22 and older in a school, the lower the binge drinking rates for total students and high-risk subgroups. These correlations did not vary significantly by survey year.

The multiple regression analyses stratified by school size showed that the percentage of minority students was significantly associated with lower binge drinking rates for total students and for high-risk subgroups, after adjusting for other covariates except, for the white binge drinking rates in small/medium schools. The percentage of females was significantly associated with binge drinking rates for total students and high-risk subgroups among small/medium schools. The percentage of female students had no significant effect on binge rates in large schools. This may be because the gender distribution did not vary much among large schools. The percentage of students age 22 and older also was significantly associated with binge drinking rates for total students and high-risk subgroups, regardless of school size.

High school non-binge drinkers attending colleges with higher percentages of minority and older students were significantly less likely to engage in binge drinking
in college, even after adjusting for survey year, sex, underage status and race. Similarly, high school binge drinkers at colleges with higher percentages of minority and underage students were significantly less likely to continue binge drinking in college, after adjusting for survey year, sex, underage and race. The percentage of females at each school was not significantly associated with binge drinking rates for either high school binge or non-binge drinkers.

3.4. Conclusions & Discussion

Being Caucasian, young and male have been identified as the strongest individual risk factors for binge drinking among U.S. college students. The results of the current study points out the importance of the ‘moderating effects’ of social environment on behaviors within these high risk groups: the binge-drinking behaviors of the high risk groups (white, young age and male) can be modified via the social environment, such as the demographic composition of the school. The results may shed light on why fraternities, sororities and freshman dorms have particularly high binge-drinking rates and account for a disproportionate share of alcohol-related problems on campuses. These social and living arrangements tend to group higher-risk drinkers together, with reduced opportunities for intermingling with those who drink less.

Although various interventions have been attempted to lower the level of binge drinking, to our knowledge colleges have not yet examined housing and admissions policies or student demographics to that end. The findings suggest practical solutions for predominantly white colleges, including: creating a campus environment that attracts a diverse student body; increasing the numbers of minorities on campus; encouraging more women and older students to live on campus and in fraternity and sorority houses; and decreasing the heavy campus concentration of high-risk drinkers, who are overwhelmingly young, male and white.

4. The Marketing of Alcohol to College Students: The Role of Low Prices and Special Promotions

Mohler-Kuo M, Wechsler H, Greenberg P & Lee H
American Journal of Preventive Medicine;2003;25:204-211.

4.1. Introduction
Alcohol availability is associated with increased alcohol consumption among the general population, as well as among young adults and older adolescents (Gruenewald et al 1992 1993; Jonnes-Webb et al 1997a; Wagenaar 1993). Heavy alcohol consumption by college students and others is encouraged by a ‘wet’ environment, one in which alcohol is prominent and easily accessible (Babor et al ;2003 Weitzman et al 2003). Previous studies have documented the effect of price on alcohol consumption in the general population and among young adults and adolescents. Young people are more affected by the price of alcohol than those who are older (Chaloupka et al 1996; Kenkel 1993; Sutton et al 1995). Some previous studies of price have used aggregated data of retail price that did not specifically take into account the unique marketing of the sale of alcohol surrounding college campuses (Chaloupka et al 1996; Levy et al 1983). Alcohol outlets near college campuses commonly use various discounts and promotions to attract students, and alcohol promotions and specials may increase consumption. Other studies used ‘perceived alcohol availability’ directly obtained from the respondents, which may be biased by the respondents’ own drinking status (Jones-Webb et al 1997b; Wechsler et al 2002b).

The primary purpose of the present study was to describe the alcohol environment surrounding college campuses and how it may influence drinking behaviors. It examines establishments selling alcohol for on-premise and off-premise consumption, alcohol promotions, price specials and alcohol advertising, and examines the effects of these environmental factors on student drinking.

4.2. Methods

Study design. The study used data from the 2001 Harvard School of Public Health College Alcohol Study, which gathered drinking information on more than 10,000 students nationwide. In addition, alcohol environment assessments of neighborhoods surrounding the college campuses were conducted at each of the 119 participating colleges. Battelle Centers for Public Health Research and Evaluation was contracted to conduct field observations. A marketing systems group was subcontracted to provide a sample of on-premise and off-premise beer venues within a two-mile radius of the participating colleges, using the self-reported Standard Industrial Classification code. The radius was determined using the street
address of the campus. Telephone screening of each establishment in the sample was conducted to make sure that it sold or served alcohol. Off-premise establishments were defined as retail outlets that sell beer (e.g., liquor stores, convenience stores, groceries) for off-premise consumption; and on-premise establishments were defined as drinking establishments that serve beer (e.g., bars, clubs, restaurants) for on-premise consumption. The analytic sample included 10,823 students at 118 colleges. One college for which data about on-premise establishment were not available was not included in analysis. At 118 college sites, 1684 off-premise establishments and 830 on-establishments were observed.

4.3. Results

In examining the marketing of alcohol in the communities surrounding college campuses, we found that alcohol specials, promotions and advertisements were prevalent in the alcohol outlets around college campuses. Approximately three quarters of on-premise establishments offered specials on weekends, and almost half of the on-premise establishments and more than 60% of off-premise establishments offered some type of beer promotion (such as volume discounts, advertised price specials or coupons). The results showed that lower sale prices, more promotions and alcohol advertising at both on- and off-premise establishments, and availability of large volumes of beer (24- or 30-can cases, party balls or kegs) were associated with higher binge drinking rates on the college campuses.

Multiple regression analysis was conducted to examine whether the alcohol environment had any effect on the total number of drinks consumed by students over the preceding 30 days. The results showed that alcohol environment was directly associated with the number of drinks consumed by students in the past 30 days ($\beta=1.6$ (0.62), $p=0.009$). In order to minimize the possibility of selection bias, that more pre-college binge drinkers attending college with higher rates of binge drinking, we repeated the same analysis among high school non-binge drinkers only. The results were very similar ($\beta=1.2$ (0.35), $p=0.0005$), suggesting that it may be the “wet” alcohol environment surrounding colleges, and not self-selection of students who choose to attend these colleges, that is the basis for increased alcohol consumption.

4.4. Conclusions & Discussion
Our finding that lower priced beer in the surrounding community predicted higher binge drinking rates at college is consistent with previous findings that alcohol consumption by young people (in this case, college students) is affected by price. In line with this are the findings that alcohol promotions, price specials and large-volume discounts were associated with higher binge drinking rates. Previous studies on alcohol pricing often have used broad, aggregate data that did not capture specific environmental factors that surround college campuses.

Efforts to reduce problems associated with college binge drinking have focused primarily on education and changes in behavior. However, the results of this study suggest that the regulation of marketing practice (such as sale prices, promotions and advertisement) may be important strategies.

5. 1) Does Price Matter? The Effects of Decreased Price on Spirits Consumption in Switzerland.
   Kuo M, Heeb JL, Gmel G, & Rahm J

2) Decreased Taxation, Spirits Consumption and Alcohol-Related Problems in Switzerland
   Mohler-Kuo M, Rehm J, Heeb JL & Gmel G
   Journal of Studies on Alcohol; 2004;65:266-273

5.1. Introduction

These two papers examined the impact of a policy change on alcohol consumption and related-problems using data from a longitudinal study in Switzerland. The spirits market in Switzerland had been reformed based on the World Trade Organization (WTO) agreement. The regulations eliminated the discrimination of foreign beverages and applied a uniform taxation system starting on the 1\textsuperscript{st} of July, 1999. The tax reform increased competition among importers, and therefore had an indirect effect of reducing the formerly-high profit margins of importers. Together, tax reform and higher competition resulted in a 30-50\% decrease in the retail price of foreign spirits. Foreign spirits accounted for 53\% of total spirits sales in 1998 (SFA, 1999) prior to the reform, and 58\% after the reform in 2000 (SFA, 2001). The tax
reform affected the price of foreign spirits only; the price of domestic spirits, wine and beer did not change.

The impact of prices on alcohol consumption and alcohol-related problems largely has been analyzed by cross-sectional analyses at the individual level or by time-series analyses at the aggregate level. Both methods have shortcomings. Cross-sectional studies cannot establish causal relationships, and aggregate time-series analyses usually correlate per capita consumption data with problem rates, and thus cannot examine differential effects within subgroups (e.g. defined by age, sex or drinking patterns). The scarcity of individual level follow-up studies based on natural experiments has been commented upon extensively in the literature (e.g. Chalupka et al., 1998; Godfrey, 1997).

Changes in price, such as the sudden decrease in the prices of imported spirits in Switzerland, are commonly referred to as “natural experiments”. “Natural experiments” potentially allow control through a quasi-experimental study design, which often is lacking in other designs of social epidemiology (Cook et al, 1979). In the present case, observed changes in consumption are more likely to be related to the price decrease rather than to other confounding predictors, because of the suddenness of the intervention. The purpose of these two papers is to examine: 1) whether decreased prices in Switzerland due to tax reform and the liberated market have had an effect on spirits consumption; 2) whether decreased prices in Switzerland have had an effect on alcohol-related problems; and 3) whether the increase in alcohol-related problems was due to increased consumption of spirits.

5.2. Methods

Participants & measures. The present study used data from a longitudinal study on changes in alcohol consumption in Switzerland’s resident population. The baseline survey was conducted three months before the tax reform, and the follow-up was conducted 28 months after the tax reform. A randomly selected sample of 4007 residents age 15 years or older participated in the baseline survey, and 73% of the same sample participated in the follow-up survey. Alcohol consumption was measured based upon a graduated frequency (Greenfield, 2000; Midanik, 1994), and
alcohol-related problems were measured by items taken from the Alcohol Use Disorder Identification Test (AUDIT) (Babor et al, 1989; Saunders et al 1993.).

**Data Analysis.** Weighted analyses were conducted throughout the study based upon stratification by linguistic regions and the number of persons in the household. We used a Generalized Estimating Equations (GEE) (Liang et al, 1986; Zeger et al 1988) approach to fit regression models, in order to handle correlated outcomes due to repeated measures of the same subject over time. We examined rate of attrition by demographics and other correlates. The results showed that the rate of attrition did not vary by sex, region, working status, education or alcohol consumption (“having 3 or more glasses in a typical drinking day”). However, attrition varied significantly by age (the attrition rate was higher in the group younger than 30 and the group older than 60 years old), and by smoking status (attrition was higher among smokers). Therefore, these correlates were used in the multiple regression model to examine alcohol consumption and alcohol-related problems, thereby adjusting for potential bias due to attrition (Muthén et al 2000).

5.3. **Results**

Consumption of spirits increased after the price of spirits decreased (from 0.71g/d to 0.98g/d, p<0.01). The increase in spirits consumption was consistent across all subgroups, with the exception of the group 60 and older. In addition, the increase in spirits consumption persisted even after adjusting for significant correlates of spirits consumption (sex, age, age*time, smoking, having >=6 drinks, and average number of drinks). The consumption of beer and wine did not increase at follow-up. Alcohol-related problems also increased at follow-up (19%, p=0.04). However, the significance disappeared after controlling for spirits consumption, indicating that the increase of alcohol-related problems at follow-up mainly was mediated via increased consumption of spirits. In addition, spirits consumption had a stronger effect on alcohol-related problems than wine and beer consumption. The effect of spirits consumption on alcohol-related problems was stronger among the age group, 29 and younger. This age group also showed the largest increase in spirits consumption at follow-up.

5.4. **Conclusion & Discussion**
The present study was a longitudinal study that examined whether an increase in spirits consumption at 28-months of follow-up was related to decreased prices of spirits due to Swiss tax reform and market competition. We found the increase in spirits consumption to be consistent across all subgroups, except for those 60 and older. Moreover, the increase in spirits consumption persisted even after we adjusted for significant correlates of spirits consumption. Other than age, we did not find spirits consumption to increase differently within subgroups of each correlate.

The present study demonstrated that self-reported alcohol-related problems increased after the tax reform, and the increase in alcohol-related problems mainly was mediated through increased consumption of spirits. Moreover, our study found that alcohol-related problems increased more at the follow-up period among younger age groups, for whom spirits consumption also increased the most. Other studies have shown that those who drink spirits and beer drink more than other drinkers and also drink at a higher rate (Smart, 1996); these other studies also have demonstrated that young people are especially likely to experience alcohol-related problems (Perkins, 2002a, Wechsler et al, 2000). Since accidents are the leading cause of death in the population that is 15-29 years old in Switzerland, and alcohol consumption is strongly associated with accidents (Schweizerische Todesursachenstatistik, 2000), prevention of alcohol-related consequences should target this younger population.

6. Conclusions

Social environment matters! The findings of the present papers support the existence of a strong link between the social environment and risky behaviors such as heavy alcohol drinking. Studies on binge drinking among U.S college students demonstrate that factors associated with drinking are complex. Our U.S versus Canada comparison showed how these associations differ by culture. The data also showed that binge drinking was moderated by school level factors such as the demographic composition of the school. In addition, the alcohol environment surrounding college campuses (alcohol availability, price, sales, promotions and advertisement) has a great impact on drinking. Similarly, Swiss longitudinal studies have demonstrated how a change in social environment (such as a policy change
resulting in decreased taxation of spirits) affects alcohol consumption. Moreover, the impact was more pronounced in young people.

Taken together, the results of these studies argue that any future interventions to promote alcohol prevention must take social environment into consideration. As Berkman described (Berkman et al 2000) ‘Social environment influences behavior by 1) shaping norms; 2) enforcing patterns of social control (which may be health-promoting or health-damaging; 3) providing or not providing environmental opportunities to engage in certain behaviors; and 4) reducing or producing stress for which certain behaviors may be an effective coping strategy’.

Studying how social determinants affect morbidity and mortality is not new; however, addressing these effects using epidemiological methods is in its early developmental stages. Durkheim’s classic study on suicide is considered by many to provide an important framework by which one can approach Social Epidemiology (Durkheim 1897/1951, Syme 2005). He noted that suicide rates in any group reveal a pattern of regularity over time. Although there may be several different individual factors that determine why individuals commit suicide, there also must be factors linked to the social environment that determine the rate of suicide in whatever group to which that individual belongs. Individuals in a society/group come and go, while the suicide rate in a society or community remains predictable over time. The same can be said of many disease states, such as coronary heart disease, cancer, diabetes and obesity in western countries; and of binge drinking among U.S. college students. Over the past decade, college students have come and gone; and yet, the binge drinking rate among college students in the U.S remains stable, peaked at a prevalence of 44% since 1993, in spite of many interventional efforts that largely have emphasized changing student’s knowledge, attitudes and perceptions. Unfortunately, these types of education programs have demonstrated little evidence of effectiveness in changing behaviors and the rates of various behaviors in the population over time. First, it is very difficult to change individual behavior. In addition, new people (students) continue to enter the at-risk population that is unaffected by any intervention that is only directed towards students already at-risk. Because of this, they enter these new drinking environments naïve to any intervention targeted to
curb their drinking and, until interventions specifically target the environment itself rather than the student, they immediately become at risk themselves.

The term *Social Epidemiology* first was coined in 1950 (Krieger N, 2001a, Yankauer A, 1950). Finally, it has been recognized as a discipline of Epidemiology, and has begun to blossom over the past decade. There now are many voices calling for a new epidemiological approach to replace ‘risk factor epidemiology’ due to the growing strength of molecular epidemiology on the micro level; and some to the transformation to global health patterns resulting from the development of communication systems, information networks and modeling techniques on the macro level. As Susser (1998) pointed out, ‘risk factor epidemiology in its pure form exploits neither the depth and precision of micro-levels, nor the breath and compass of macro-levels.’ One major task of social epidemiology is to conceptualize how to integrate the influences of culture, policy and environment with individual risk factors (Berkman et al, 2000). The assessment of exposures at an environmental or community level may lead to an understanding of social determinants of health that could be more effective than measuring multiple risk factors at the individual level. Even though social epidemiology has developed as a discipline of epidemiology, there is more work to be done. First, we need to sharpen our tools: our theories and analytic techniques.

The need to incorporate social theories into the practice of social epidemiology and public health has been advocated by some researchers in the field (Krieger N 2001b; Frohlich et al, 2004). Applying and incorporating theories can better guide and strengthen research questions and study design. Currently, three main theories that have been applied in Social Epidemiology include: 1) the psychosocial view of health; 2) the social production of disease and / or the political economy of health; and 3) the ecosocial theory and related multi-level frameworks, as described in detail by Nancy Krieger (Krieger 2001b). In addition, complex statistics, such as multi-level analysis, are needed in order to detangle the complex effects and their pathways at different levels. Integrating social determinants and individual level outcomes is complex. Applying multi-level analytical techniques will help us to deeper understand the compositional versus contextual effects, and the pathways that link health outcomes to each different level of exposure. In order to strengthen
and develop the discipline of Social Epidemiology, more research is needed to test and further develop these theories and to refine the statistical analysis process.
Acknowledgement

As I have ventured along this path towards a career in public health, I am indebted to so many for all the support and guidance that I have received over the years.

Most importantly, I thank my late husband, Dr. Beat Mohler, for his endless support and encouragement; and my parents, who give so much, and always hope for the best for me.

My special thanks go to Prof. Dr. Felton Earls, Professor of Social Medicine at Harvard Medical School and the Director of the Project on Human Development in Chicago Neighborhoods (PHDCN), my mentor and thesis adviser while I pursued my doctoral degree at the Harvard School of Public Health. Dr. Earls opened the door to longitudinal and multi-level research for me. I was so grateful to be able to participate in the great study of PHDCN, where I was trained to do longitudinal research taking into account neighborhood and community effects, and also to do multi-level analyses and mapping techniques.

My many thanks go to Dr. Henry Wechsler, the Director and Principal Investigator of the College Alcohol Study (CAS) at the Harvard School of Public Health. I am very grateful to have been able to make the transition from post-doctoral work to working with the CAS study, where I developed the skills to take scientific leadership and responsibility. Dr. Wechsler always has been so supportive, and has allowed me so much room to grow professionally. In particular, his passion for the problem of college binge drinking, his inspiration in targeting the drinking environment and his enthusiasm for publishing have helped to promote my career up to this day. The collaboration with all the CAS team always will remain special for me.

Finally, relocating from Boston to Zurich was not an easy step for me. I am especially grateful for the support and trust I now find in Zurich from Prof. Felix Gutzwiller, Director of the Institute of Social and Preventive Medicine. From the very beginning, his support has made the transition so much easier.
References


Syme SL and Alcalay R (1982). Control of cigarette smoking from a social perspective. *Ann Rev Public Health*


