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Characteristics of Adolescents With Acute Alcohol Intoxication: Role of Population Density

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ABSTRACT

The aim of this study was to investigate the possible differences between adolescents with an acute alcohol intoxication living in high- and low-population-density areas. Data were used from the Dutch Pediatric Surveillance System, which monitors acute alcohol intoxication among treated adolescents. During treatment, questionnaires are completed by the pediatricians involved, covering socio-demographic characteristics and circumstantial and treatment data. Adolescents eligible for inclusion in the current study had to be under the age of 18 years and have a positive blood alcohol concentration, and the living region was known. This resulted in analyzing data from the years 2007 until 2015, with a total of 4,895 questionnaires. This study shows that treated adolescents who are living in a high-population-density area are significantly younger (15.3 versus 15.5 years) and have a lower blood alcohol concentration at admittance (1.86 versus 1.90 g/l). The patients in the high-population-density areas are less from an autochthonous Dutch origin (86.0% versus 90.7%) and are more often enrolled in a higher educational level (45.4% versus 38.1%). Adolescents in urban areas drink more on the streets (27.7% versus 16.3%), in contrast to those living in a lower-population-density area, who drink in a bar or comparable place. Adolescents living in urban areas are overrepresented in the intoxication sample. This article is the first to describe the differences between alcohol-intoxicated adolescents in high- and low-population-density areas in the Netherlands. These findings are important for the awareness of alcohol abusers, and the design of future prevention strategies.

KEYWORDS

alcohol intoxication; blood alcohol content; pediatric hospital treatment; population density

KEY MESSAGES

- Demographic, drinking, and intoxication characteristics during alcohol intoxication treatment differ for youngsters coming from high- and low-population-density areas.
- Youngsters from low-population areas turn out to be older, lower educated, more often Dutch, and drink more in bars, than their counterparts from high-population-density areas.
- Youngsters from lower density areas have higher blood alcohol concentration (BAC) levels, and more often have parental approval to drink. Hospitalization periods are equal for both groups.

Introduction

Adolescent alcohol intoxication has become a widespread problem in the past decade in the Netherlands. Alcohol consumption in general has become very common in this group, with up to 70% of the Dutch underage population consuming alcohol monthly, which can threaten development (Hibell et al., 2009). The characteristics of these Dutch adolescents are well-known nowadays (Van Hoof, Van Zanten, & Van der Lely, 2013), but the possible differences between adolescents living in regions with high and low population densities are not known. This knowledge can be of value for regional, national, and international policy-makers, and help detect differences in policy effectiveness. These data are also of importance in light of future prevention strategies.

Although the awareness of this problem among parents and policymakers is increasing, the total number of hospitalized adolescents nationwide is still not decreasing (Van Hoof, De Klerk, & Van der Lely, 2018). Politicians used these data, amongst others, to increase the legal age to buy alcohol in the Netherlands by January 1, 2014, from the age of 16 to 18 (Eurocare, 2014).

Binge drinking, consuming large amounts of alcohol in a short period of time, is common among adolescents and this is the most important risk factor for having alcohol intoxication (Miller, Naimi, Brewer, & Jones, 2007). Binge drinking is defined as drinking four or more standard glasses of alcohol for girls and five or more standard drinks for boys in a couple of hours or at one occasion (Fillmore & Jude, 2011). Alcohol consumption, and binge drinking in particular, might result in severe health consequences.

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Research shows a negative effect of alcohol on brain function, especially on higher cognitive functions. Heavy drinking accelerated volume decline in frontal and temporal cortical volumes (Squeglia et al., 2015). Neurocognitive performance is poorer among adolescents with alcohol use disorders (Jacobus & Tapert, 2013). Furthermore, alcohol use in early adolescence predicts alcohol use in adulthood and at mature age (Van Zanten, Van der Ploeg, Van Hoof, & Van der Lely, 2013).

The Netherlands, Germany, and Denmark have the highest prevalence of binge-drinking adolescents in Europe (Bouthoorn, Van der Ploeg, Van Erkel, & Van der Lely, 2011). By the age of 18, almost 25% of adolescents report recent heavy episodic drinking, defined as consuming five or more drinks on one occasion during the past two weeks (Squeglia et al., 2015).

In comparison with other drugs, alcohol has the highest negative impact factor on society (Nutt, King, & Phillips, 2010). Alcohol consumption also has negative health-related individual consequences in the short term. Short-term problems such as alcohol intoxication, violence-related injury, and sexual risk behavior are mainly seen together with alcohol-related motor vehicle accidents (Miller et al., 2007).

Studies in the past showed that students living in rural areas are using alcohol more frequently in comparison with urban students (Coomber et al., 2011) as well as adolescents (Hanson et al., 2009). In Europe, binge drinking was less common in the south than in other areas (Kuntsche, Rehm, & Gmel, 2004). Less literature described the differences in characteristics between alcohol-intoxicated adolescents living in different population density levels.

This study aims to investigate the association between characteristics of the adolescents who are hospitalized because of an acute alcohol intoxication and different levels of population density. In this article, we investigate if there are differences between adolescents living in high- and low-population-density areas.

Materials and methods

Data collection

This study analyzed data collected by the Dutch Pediatric Surveillance System (NSCK). The data collection started in 2007 and is ongoing. When an adolescent is admitted to a pediatric department in the Netherlands, the pediatrician reports the admission to the NSCK. During the treatment period (most often the morning after the admittance), a member of the pediatric team interviews the patient. The information that is acquired with this interview is coded onto a questionnaire. The pediatric department staff returns the questionnaire by mail or digitally to the research group. All adolescents (age <18 years) with positive blood alcohol levels (concentration >0.1 g/l) are included. The study has been approved by the medical ethical commission of the Faculty of Behavioral, Management and Social Sciences of the University of Twente and the ethical board of the Reinier de Graaf Gasthuis Hospital Group, with regard to the Helsinki Declaration on human subjects testing.

Questionnaire

The anonymous questionnaire was completed for every admitted and treated adolescent. It consisted of 40 questions (small adjustments were made during the nine years of usage), divided into four categories. These categories contain general and demographic information, information about alcohol use patterns, intoxication and treatment characteristics, and hospital information. Data used in this article include the following:

- date of birth (ddmmyy),
- gender (male/female),
- living region (first two numbers of postal code, name of region),
- reason for hospitalization (reduced consciousness; if yes, duration of unconsciousness in hours), traffic accident, other accident (e.g., fracture), aggression/violence, suicide attempt, educational level),
- family situation (traditional, divorced parents, living alone, foster parents, other),
- cultural background (Dutch, Surinamese, Turkish, Moroccan, Antillean, Asian, other),
- alcohol-consuming location (parents' home, adolescents' own home, on the street, working place, at a school [party], public place [sport/bar/canteen], commercial place [hotel and catering industry/bar/pub/discotheque], on holiday, other])
- origin of alcohol (parents' house, by friends, supermarket, liquor store, commercial place),
- other (illicit) substance use (none, cannabis, cocaine, amphetamines/speed, magic mushrooms, ecstasy, other),
- blood alcohol concentration (grams of alcohol/liter blood), and
- total time of hospitalization (days).

Patients

In the period 2007–2015, 5,005 questionnaires were returned from adolescents who were admitted to a pediatric hospital department due to alcohol intoxication. Patients were included in this study if they were between the ages of 12 and 18 years of age and had a positive blood alcohol concentration (BAC >0.1 g/l). Also, to meet the inclusion criteria, the living area of the adolescents had to be known, which resulted in 4,895 usable questionnaires.

Data analysis

All data were analyzed using SPSS, version 22. Normality was checked with the Kolmogorov-Smirnoff test. Depending on normality and whether the variables were categorical or numerical, a Mann-Whitney U test (performed on mean age, blood alcohol concentration, duration of reduced consciousness, duration of hospitalization), Fisher's exact test (performed on gender), chi-square test (performed on educational level, ethnicity, family structure, reason of admittance, drinking place, origin of alcohol, combined drug use,

permission parents), or one-sample *t*-test (performed on the percentage alcohol intoxications per high/lower population density) were performed. *p*-values < .05 were considered as statistically significant.

Results

The Netherlands are divided into 12 provinces, which have different levels of population density. For the current study, we created two groups with provinces; the three high-population-density areas (the so-called Randstad consisting of three provinces, which is colored gray in Figure 1), compared to the nine low(er)-population-density areas. In the high population area, province population density ranges from 914 to 1,283 persons per square kilometer (= 0.39 mi²). The total number of inhabitants in this area is 7.6 million living on 6,851 square kilometers. In the nine remaining provinces, the population density is 185 to 520 persons per square kilometer (Central Bureau for Statistics, 2016). In this area the remaining 9.3 million inhabitants live on 26,837 square kilometers. In these two regions, the level of education turns out to be equally distributed (Central Bureau for Statistics, 2018a), although more people with an immigrant background live in the high-population-density area (Central Bureau for Statistics, 2018b).

Regarding the admissions for alcohol-intoxicated harm, 54.1% of the treated adolescents live in a high-population density area while 45.9% live in a lower population density ($t(4,894) = 12.55, p < .001$).



Figure 1. The Netherlands, region of high population density colored gray.

Baseline characteristics were analyzed of the alcohol-intoxicated adolescents between the high- and lower-population-density areas. A statistically significant difference ($z = -5.16, p < .001$; Mann-Whitney *U* test) was found for age (analysis outcomes) with adolescents from high-population-density areas having a lower mean age ($M = 15.3$) than adolescents living in lower-population-density areas ($M = 15.5$). No significant differences were found between percentage of boys or girls in the two parts of the country (Table 1).

There was no difference in reason for admittance, $\chi^2(6, N = 4,352) = 3.56, p = .74$. The educational level of the alcohol-intoxicated adolescents was higher, $\chi^2(9, N = 4,062) = 51.95, p < .001$ in the region with high population density and family structures were more often traditional, $\chi^2(6, N = 4,272) = 19.30, p < .01$. A higher amount of adolescents with a Dutch ethnicity were among the group with a lower population density, $\chi^2(5, N = 4,167) = 24.86, p < .001$.

In the areas with high population density, more adolescents are drinking on the streets, whereas in the areas with lower population density adolescents more often visit a commercial place (e.g., a bar), $\chi^2(5, N = 1,972) = 50.96, p < .001$. Comparable to this, in high-density areas, alcohol is more often obtained by friends or bought in a (liquor) store, whereas in the low-density area alcoholic beverages originate from friends or commercial places, $\chi^2(5, N = 1,984) = 64.12, p < .001$. There was no statistical significant difference between combined (illicit) drug use among the two groups, $\chi^2(7, N = 4,308) = 10.73, p = .15$.

In areas with high population density, parents give significantly less permission for consuming alcohol, $\chi^2(4, N = 1,266) = 16.79, p < .01$.

For hospital intoxication characteristics, only the blood alcohol concentration differed significantly between adolescents from high- and low-population-density areas, $z = -2.32, p = .02$ (Mann-Whitney *U* test), although the difference is very small (Table 2).

Discussion

This study shows that adolescents living in a high-population-density area are overrepresented in adolescent alcohol treatment (about 55% of the cases come from a region with 45% of the population). This study also shows that treated adolescents who are living in an area with high population density are slightly younger, although they have a lower blood alcohol concentration at admittance, and are less frequently of autochthonous Dutch origin. Furthermore, treated adolescents from high-density areas are more often enrolled in a higher educational level and more often their family structure is still a "traditional" one. Adolescents in this area tend to drink more on the streets, in comparison to those living in low-density areas, who more often drink at commercial places (such as a bar). In high-density areas alcohol is mostly obtained through friends or bought in the supermarket, in contrast to areas of lower population density, where alcohol is obtained by friends or bought in commercial places (again,

Table 1. Characteristics of study population comparing high versus lower population density.

	High population density (<i>N</i> = 2,650)	Lower population density (<i>N</i> = 2,245)	<i>p</i> -value
Mean age (years)	15.28	15.46	.00*
<i>Gender</i>			.33**
Male (%)	52.8%	54.5%	
Female (%)	47.2%	45.5%	
<i>Educational level</i>			.00**
Low and middle level (%)	54.6%	61.9%	
Higher level (%)	45.4%	38.1%	
<i>Ethnicity</i>			.00**
Dutch (%)	86.0%	90.7%	
Surinamese (%)	3.5%	2.0%	
Turkish (%)	1.7%	0.7%	
Other ^a (%)	8.8%	6.4%	
<i>Family structure</i>			<.01**
Traditionally (%)	68.9%	64.8%	
Divorced parents (%)	7.3%	10.2%	
<i>Reason of admittance</i>			.74**
Reduced consciousness (%)	87.5%	88.7%	
(Traffic/Other) Accident (%)	8.2%	7.7%	
Aggression/violence	2.8%	2.1%	
Other ^b (%)	1.5%	1.5%	
<i>Drinking place</i>			.00**
Parents' house (%)	8.4%	9.9%	
At home by third parties (%)	40.8%	43.8%	
On the streets (%)	27.7%	16.3%	
Commercial place (e.g., bar) (%)	10.9%	18.3%	
<i>Alcohol source</i>			.00**
Parents' house (%)	11.8%	12.0%	
Friends (%)	52.1%	46.2%	
(Liquor) Store (%)	15.5%	8.9%	
Commercial place (e.g., bar) (%)	12.1%	21.5%	
<i>Combined drug use</i>			.15**
No (%)	87.8%	89.2%	
Yes, cannabis (%)	8.4%	6.7%	
Yes, stimulants (%)	3.2%	3.5%	
<i>Permission parents</i>			<.01
No (%)	46.5%	35.3%	
Yes (%)	53.5%	64.7%	

^aIncluding Moroccan, Antillean, Asian, or other ethnicities. ^bIncluding multiple reasons, vomiting, and suicide attempt.
*(*p*-value calculated by Mann-Whitney *U* test). **(*p*-value calculated by Pearson chi-square test).

Table 2. Hospital intoxication characteristics of high versus lower population density.

	High Population Density (<i>N</i> = 2,650)	Lower Population Density (<i>N</i> = 2,245)	<i>p</i> -value
Blood alcohol concentration	1.86	1.90	.02*
Duration of reduced consciousness (hours)	2.88	3.03	.44*
Duration of hospitalization (days)	0.92	0.93	.87*

*(*p*-value calculated by Mann-Whitney *U* test).

a bar). In the areas of lower population density, adolescents reported that their parents were stricter than parents of adolescents in high-population-density areas. This result is surprising since people in rural areas are more conservative in general. It might be that adolescents in high-population-density areas perceive that their parents are stricter. Further research on this matter, also related to foreign cultural values, is needed. The percentage of alcohol-intoxicated adolescents who lived in urban areas was higher compared to the areas of lower population density, although there was no significant difference between reason for admittance, duration of reduced consciousness, hospitalization, or combined drug use.

In literature multiple studies have explained the characteristics of alcohol intoxications among diverse groups in society, including the usage of alcohol and geographical distribution. In a Swiss study, young adults from rural areas

had a higher risk of heavy weekend drinking, compared to those living in a city (Foster, Held, Gmel, & Mohler-Kuo, 2016). A study in England showed that London had the lowest odds of binge drinking, compared to almost all other regions in the country (Shelton & Savell, 2011). A study in Scotland showed that there was no clear urban/rural split between mortality rates comparing men and women (Emslie & Mitchell, 2009). In a Canadian study, there was similarity between urban or rural geographic groups, among the alcohol consumption pattern of adolescents (Jiang, Li, Boyce, & Pickett, 2008). As previously stated, less is described in literature about differences of characteristics among alcohol-intoxicated adolescents living in different population density levels.

Our study concludes that the number of adolescents that experience alcohol intoxication is higher in the area with a

high population density, whereas fewer of the total number of Dutch adolescents are living there.

Family structure was more “traditional” in the areas with high population densities, which could explain why less permission is given by the parents to drink alcohol in this area. A family structure with both parents is a protective factor against the consumption of alcohol during adolescence (Rüütel et al., 2014). The opinion of the parent(s) regarding the alcohol consumption of the adolescent can influence their drinking manners and could lower the consumption (De Looze et al., 2014; Hayes, Smart, Toumbourou, & Sanson, 2004).

In areas with lower population densities, we hypothesized that there is more of a “pub culture” (adolescents tend to go to a commercial place [e.g., pub, bar, discotheque] to drink). When adolescents are living in an area of low population density, where there are not a lot of activities, they seek places to gather around. They probably live somewhat far away from one another, so they meet at a public (or private) place. Whereas the adolescent who is living in a city is surrounded by bars and pubs (they are not allowed to enter), they tend to drink on the streets. It could be hypothesized that bartenders in urban areas are stricter in refusing underage people to enter, whereas bartenders in rural areas are less strict. This could be part of the explanation that treated adolescents from rural areas more often consumed alcohol in commercial places prior to the alcohol intoxication. In future research, drinking location needs further investigation, especially since we know that drinking location has a relationship with alcohol quantity intake (Grüne, Piontek, Slecza, Kraus, & Pogarell, 2017). This could explain the higher mean age among adolescents who live in an area with lower population densities. When an adolescent is drinking on the streets there is no supervision, in contrast to drinking in a pub, where there should be some. Both underage drinking in pubs and drinking on the streets are prohibited in the Netherlands.

There are a few limitations to our study. Only adolescents who are treated in a hospital were included in this study. It is unknown if there is a difference between number of adolescents who were admitted to a hospital between the two areas. The data are—in part—difficult to explain or interpret. In the regions of lower population density, the hospital is in general farther away, so perhaps fewer adolescents end up at the hospital. Finally, due to time constraints in the hospital setting, not all questionnaires were filled in completely.

This article describes differences of characteristics of alcohol-intoxicated adolescents between areas of high and lower population densities in the Netherlands. It is important for policymakers to be aware of these differences in characteristics, so prevention strategies can be adjusted according to this knowledge.

In conclusion, several significant differences in characteristics were detected between adolescents with acute alcohol intoxication who lived in an area of high population densities in comparison to a lower population density.

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Disclosure statement

The authors declare that they have no conflicts of interest.

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