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# Ten Years of Alcohol Intoxication in Adolescents and Treatment in Paediatric Departments in Dutch Hospitals

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## Abstract

***Aim:*** *Alcohol intoxication in children and adolescents is a severe health concern in current paediatrics. In this longitudinal study, we monitored the intake and treatment of 5,323 adolescents in the Departments of Paediatrics in Dutch hospitals from 2007 to 2016.*

***Methods:*** *From 2007 to 2016, we collected data on all adolescents (inclusion criteria: age younger than 18 and a positive BAC) treated by a papediatrician in a hospital. Within the Dutch Pediatric Surveillance System (NSCK), pediatricians report adolescents and complete a questionnaire, making use of a patient interview.*

***Results:*** *In total, 5,323 adolescents were treated, mainly (4,674; 88%) for severe alcohol intoxication; the mean age was 15.4 years, and 52% were boys. The average BAC level increased during the study period (1.82 in 2007 to 2.01 in 2016), and the average reduced consciousness time lasted from 2.24 hours in 2007 to 3.12 hours in 2016. The attitudes of the parents changed over the years: in 2011 (first year of registration for this measure), 24% of the parents did not give permission to their under-aged son or daughter to drink alcohol; however, in 2016, this number had increased to 58%.*

***Conclusion:*** *Alcohol intoxication treatment in adolescents remains an important issue. This dataset enables us to conduct longitudinal analyses on the characteristics of alcohol intoxication in adolescents, the medical treatment, and the events leading up to the intoxication.*

## Introduction

In the first decade of the 21st century, the number of adolescents admitted to Dutch hospitals due to alcohol intoxication has risen dramatically. Alcohol intoxication was added to the Dutch Pediatric Surveillance System (NSCK) to collect more information about this trend. Therefore, every time an adolescent (up to 18 years-old) was treated at a Pediatric Department in a Dutch hospital with acute alcohol intoxication or another problem related to alcohol consumption, the pediatrician reported the admission to the NSCK. Most adolescents were treated for reduced consciousness caused by binge drinking (≥4 or ≥5 alcoholic drinks in a short period of time for girls and boys, respectively [1].

When the NSCK-data of acute alcohol intoxication were published, it became clear that drinking alcohol at a young age had various negative outcomes. Therefore, several interventions for alcohol consumption by adolescents were undertaken. To prevent a repeated hospitalization, in 2006, the first Outpatient Clinics for Adolescents and Alcohol were opened in Delft, the Netherlands. As a result, awareness increased among adolescents, their parents and professionals of the issue of adolescent alcohol intoxication. This was one of the reasons that on January 1st, 2014, the minimum age for buying, possessing and publicly consuming alcoholic beverages that contain up to 15% alcohol was increased from 16 to 18 years. From that moment forward, the same legal minimum age was applied to allowing the consumption of all alcoholic beverages [1].

Adolescent alcohol consumption, especially irresponsible consumption, leads to both long- and short-term damage to health. Alcohol consumption by adolescents between the ages of 10 to 24 years is the most important contributor to disability-adjusted health years (DALY's) [2]. Metabolic acidosis, electrolyte disturbances, hypothermia and reduced consciousness are short-term complications of alcohol intoxication [3]. Other, non-medical complications are risk-taking sexual behavior, accidents, violence and injuries [4]. Long-term complications include a higher risk of malignancies in the gastrointestinal tract and other forms of cancer, as well as a higher risk of alcohol-related problems such as liver cirrhosis and pancreatitis [5, 6]. Adolescents younger than 15 years who consume alcohol have a 4-6 times higher risk of developing alcohol dependence than adolescents who do not drink alcohol [7]. Alcohol consumption during adolescence also has negative effects on brain

development. In puberty, maturation of the brain occurs by forming new and more stable connections [8]. When there is a discrepancy between the developments of the limbic system and the prefrontal cortex, adolescents often show risk-taking behaviors'. This effect is strengthened by puberty, which in recent times is beginning earlier [9]. Drinking alcohol during adolescence leads to a smaller hippocampal volume and lesions in the prefrontal cortex, which may lead to lifelong impairments, including memory dysfunction [8].

The collection of data on adolescent alcohol intoxication over the past ten years has provided an opportune moment to seek answers to the following questions: What has changed in the past 10 years? Has the average age of adolescents admitted to the Pediatric Department with alcohol intoxication become higher? Did the number of admitted adolescents decrease? Did intoxication get worse or better?

## Methods

### Collecting data

Starting in 2007, data regarding Dutch adolescents with alcohol intoxication were collected. Each time an adolescent was admitted to a Pediatric Department in one of the Dutch hospitals, the paediatrician reported the admission and completed a questionnaire that included medical and socio-demographic data. The questionnaires were sent to the NSCK, and data were included in a national database. Thus, all Dutch adolescents admitted to the hospital with alcohol intoxication are in the database, and a large amount of information about the patient, the intoxication and treatment is obtained [10].

A total of 4,674 adolescents were included in the study when they were admitted to the Pediatric Department with alcohol intoxication. In the database, 649 adolescents who were admitted to the hospital for a reason other than alcohol intoxication were included [11]. This included adolescents who had an accident and consumed alcohol before the event (e.g., accident or suicide attempt). Throughout the decade, approximately 88% of adolescents were hospitalized with reduced consciousness due to alcohol intoxication. This percentage was stable over the past decade ($\chi^2$ (9, N = 5325) = 12,263, p = .199). Adolescents with other reasons for admission were excluded from the current analyses, since they were atypical patients [12].

### Statistical Analysis

For statistical analyses, SPSS for Windows, version 21 was used. Categorical data were compared using the Chi-squared test. For continuous data, the one-way ANOVA test was used. Trends were investigated using the polynomial linear ANOVA test. Variance was tested using Levene's test. P-values less than .05 were considered statistically significant when variance was equal. When variance was unequal, p-values less than .01 were considered statistically significant.

## Results

From 2007 to 2015, a significant positive trend in the number of reports of adolescents with alcohol intoxication was observed ($x^2$ (9, N = 4674) = 422,410, p = < .001). The number of admissions declined by 15% between 2015 and 2016 (Table 1).

**Table 1: Number of reports and number of questionnaires**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total | Statistics |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number of reports** | 297 | 337 | 500 | 684 | 762 | 706 | 713 | 783 | 931 | 791 | 6504 | $x^2$ (9, 4674)= 422.410, p < .001 |
| **Increase compared to previous year (%)** | | +13% | +48% | +37% | +11% | -7% | +1% | +10% | +19% | -15% | - | |
| **Number of questionnaires** | 263 | 328 | 449 | 574 | 760 | 676 | 571 | 697 | 874 | 701* | 5893 | |
| **Response (%)** | 89% | 97% | 90% | 84% | 100% | 96% | 80% | 89% | 94% | 89% | - | |
| **Reason for admission** | | | | | | | | | | | | $\chi$2 (9, N = 5325) = 12.263, p = .199 |
| Alcohol intoxication (%) | 226 (91%) | 272 (88%) | 380 (88%) | 464 (86%) | 548 (89%) | 473 (90%) | 455 (87%) | 559 (86%) | 726 (89%) | 574 (86%) | 4678 (88%) | |
| Other reasons (%) | 22 (9%) | 37 (12%) | 50 (12%) | 77 (14%) | 70 (11%) | 53 (10%) | 66 (13%) | 92 (14%) | 90 (11%) | 91 (14%) | 649 (12%) | |
| **Total** | **248** | **309** | **430** | **541** | **618** | **526** | **521** | **651** | **816** | **665** | **5327** | |
| Not registered | 15 | 19 | 19 | 33 | 142 | 150 | 50 | 71 | 58 | 36 | 569 | |

The distribution of the number of boys and girls who were admitted to the Pediatric Department was stable in the last decade ($x$2 (9, N = 4638) = 14,107, p = .119). However, the mean age at admission rose significantly from 14.9 years in 2007 to 15.5 years in 2016 (Table 2). The mean age at admission for boys (M = 15.5) was higher than that for girls (M = 15.1). The number of 10- to 14-year-old adolescents decreased in the past decade.

Most adolescents were in lower education (VMBO or MAVO), and most were Dutch nationals (Table 2). The distribution of school levels ($\chi^2$ = 167,621, p < .001) and cultural background ($\chi^2$ = 203,675, p < .001) did not change significantly.

**Table 2: Demographics of alcohol intoxication**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total | Statistics |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sex** | | | | | | | | | | | | |
| Boys (%) | 116 (52%) | 140 (52%) | 183 (49%) | 264 (57%) | 293 (54%) | 252 (53%) | 229 (51%) | 260 (47%) | 377 (52%) | 286 (50%) | 2400 | $\chi^2$ (9, N = 4638) = 14.107, p = .119 V = .055 |
| Girls (%) | 108 (48%) | 130 (48%) | 189 (51%) | 197 (43%) | 250 (46%) | 220 (47%) | 222 (49%) | 293 (53%) | 343 (48%) | 286 (50%) | 2238 | |
| ***N*** | **224** | **270** | **372** | **461** | **543** | **472** | **451** | **553** | **720** | **572** | **4638** | |
| Not registered | 2 | 2 | 7 | 3 | 5 | 1 | 3 | 5 | 6 | 2 | 36 | |
| **Age (years)** | | | | | | | | | | | | |
| 10 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | $\chi^2$= 155.714 V=0.81 F (1,4635) = 62.268, p < .001* |
| 11 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | |
| 12 | 5 | 5 | 3 | 3 | 4 | 1 | 1 | 6 | 0 | 3 | 31 | |
| 13 | 23 | 25 | 30 | 20 | 32 | 20 | 17 | 26 | 40 | 19 | 252 | |
| 14 | 53 | 66 | 82 | 84 | 100 | 77 | 60 | 102 | 126 | 84 | 834 | |
| 15 | 78 | 80 | 94 | 133 | 129 | 129 | 122 | 155 | 195 | 181 | 1286 | |
| 16 | 67 | 70 | 106 | 150 | 183 | 145 | 164 | 156 | 226 | 168 | 1423 | |
| 17 | 16 | 24 | 58 | 72 | 93 | 101 | 90 | 110 | 137 | 115 | 816 | |
| Mean (SD) | 14.9 (.18) | 14.9 (1.21) | 15.2 (1.24) | 15.4 (1.12) | 15.3 (1.21) | 15.5 (1.13) | 15.5 (1.08) | 15.5 (1.19) | 15.4 (1.14) | 15.5 (1.10) | 15.4 (1.17) | |
| ***N*** | **219** | **271** | **374** | **462** | **543** | **473** | **454** | **555** | **724** | **570** | **4645** | |
| Not registered | 7 | 1 | 5 | 2 | 5 | 0 | 0 | 3 | 2 | 4 | 29 | |
| **Age to sex** | | | | | | | | | | | | |
| **Boys** Mean (SD) | 14.9 (1.22) | 15.2 (1.14) | 15.5 (1.13) | 15.6 (1.02) | 15,4 (1.19) | 15.6 (1.12) | 15.7 (1.03) | 15.6 (1.11) | 15.5 (1.10) | 15.7 (1.04) | 15.5 (1.12) | *F* (1, 2371) = 39.752, p < .001* |
| ***N*** | **113** | **139** | **182** | **262** | **289** | **252** | **229** | **258** | **375** | **282** | **2381** | |
| Not registered | 3 | 1 | 1 | 2 | 4 | 0 | 0 | 2 | 2 | 4 | 19 | |
| **Girls** Mean (SD) | 14.9 (1.15) | 14.7 (1.23) | 14.9 (1.24) | 15.0 (1.16) | 15.3 (1.24) | 15.3 (1.13) | 15.5 (1.12) | 15.2 (1.22) | 15.3 (1.17) | 15.3 (1.13) | 15.2 (1.19) | *F* (1,2222) = 46.009, p < .001* |
| ***N*** | **106** | **130** | **186** | **197** | **250** | **220** | **222** | **292** | **343** | **286** | **2232** | |
| Not registered | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 6 | |
| **School level** | | | | | | | | | | | | |
| Elementary school | 2 | 4 | 4 | 2 | 0 | 2 | 9 | 1 | 2 | 2 | 28 | $\chi^2$(81, N = 4139) = 167.621, p < .001* V = .067 |
| Special education | 5 | 10 | 8 | 8 | 21 | 6 | 9 | 10 | 10 | 6 | 93 | |
| VMBO/MAVO | 87 | 101 | 142 | 165 | 188 | 184 | 160 | 202 | 246 | 205 | 1680 | |
| HAVO | 32 | 42 | 75 | 94 | 100 | 94 | 91 | 138 | 165 | 132 | 963 | |
| VWO | 22 | 36 | 58 | 76 | 75 | 72 | 82 | 93 | 145 | 118 | 777 | |
| MBO | 10 | 13 | 17 | 37 | 35 | 45 | 57 | 62 | 72 | 64 | 412 | |
| HBO | 0 | 1 | 3 | 1 | 3 | 5 | 2 | 7 | 8 | 7 | 37 | |
| University | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | |
| Work | 1 | 0 | 2 | 0 | 2 | 2 | 3 | 3 | 1 | 2 | 16 | |
| Other | 17 | 12 | 15 | 13 | 12 | 11 | 11 | 13 | 20 | 7 | 131 | |
| ***N*** | **176** | **219** | **325** | **396** | **436** | **421** | **424** | **530** | **669** | **543** | **4139** | |
| Not registered | 50 | 53 | 54 | 68 | 112 | 52 | 30 | 28 | 57 | 31 | 535 | |

| **Cultural background** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dutch | 168 | 214 | 306 | 364 | 436 | 379 | 376 | 467 | 572 | 489 | 3771 | $\chi^2$ (63, N = 4392) = 203.675, p < .001* V = .081 |
| Moroccan | 3 | 2 | 2 | 3 | 5 | 7 | 7 | 4 | 6 | 1 | 40 | |
| Surinam | 11 | 10 | 9 | 11 | 14 | 13 | 10 | 13 | 17 | 7 | 115 | |
| Antillean | 4 | 2 | 2 | 7 | 5 | 7 | 4 | 4 | 9 | 5 | 49 | |
| Turkish | 4 | 4 | 9 | 10 | 3 | 3 | 2 | 6 | 7 | 8 | 56 | |
| Other | 16 | 20 | 32 | 36 | 57 | 26 | 37 | 43 | 51 | 43 | 361 | |
| ***N*** | **206** | **252** | **360** | **431** | **520** | **435** | **436** | **537** | **662** | **553** | **4392** | |
| Not registered | 20 | 20 | 19 | 33 | 28 | 38 | 18 | 21 | 64 | 21 | 282 | |

Blood alcohol concentration (BAC) rose significantly from 1.82 g/L in 2007 to 2.01 g/L in 2016 (F (9, 1467) = 6,372, p < .001). The duration of reduced consciousness also increased from 2.24 hours in 2007 to 3.12 hours in 2016 (F (1, 1890) = 3,86, p = .0496). Hospital stay decreased significantly from 1.07 days in 2007 to .79 days in 2016 (F (9, 968) = 42,894, p < .001). The number of parents of the intoxicated adolescents who did not give permission for the alcohol consumption to their child more than doubled from 24% in 2011 to 58% in 2016 (Table 3).

**Table 3: Characteristics of alcohol intoxication**

| | | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **Total** | **Statistics** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BAC** Mean (‰) (SD) | | 1.82 (0.56) | 1.86 (0.61) | 1.85 (0.61) | 1.84 (0.58) | 1.85 (0.56) | 1.94 (0.55) | 1.92 (0.57) | 1.97 (0.51) | 1.98 (0.52) | 2.01 (0.50) | 1.92 (0.55) | $p$ = .03 |
| | ***N*** | **206** | **231** | **335** | **402** | **479** | **451** | **414** | **517** | **662** | **512** | **4209** | $F$ (9,1467) = 6.372, $p$ < .001* |
| | Not registered | 20 | 41 | 44 | 62 | 69 | 21 | 131 | 41 | 64 | 62 | 555 | |
| **Duration of reduced consciousness** Mean (hours) (SD) | | 2.24 (2.23) | 2.89 (3.08) | 3.06 (2.94) | 3.14 (4.40) | 2.94 (3.12) | 2.83 (2.70) | 2.97 (3.02) | 3.14 (3.93) | 3.15 (2.21) | 3.12 (2.43) | 2.99 (3.06) | $p$ = .488 F (1,1890) = 3.86, p = .0496* |
| | ***N*** | **111** | **109** | **142** | **171** | **254** | **215** | **158** | **217** | **288** | **235** | **1900** | |
| | Not registered | 115 | 163 | 237 | 293 | 294 | 258 | 296 | 341 | 438 | 339 | 2774 | |
| **Hospital stay** | Mean (days) (SD) | 1.07 (0.46) | 0.98 (0.45) | 0.95 (0.47) | 0.95 (0.44) | 0.70 (0.54) | 0.98 (0.52) | 1.00 (0.43) | 1.02 (0.16) | 0.78 (0.30) | 0.79 (0.32) | 0.90 (0.41) | $p$ < .001 |
| | ***N*** | **189** | **246** | **341** | **415** | **203** | **153** | **174** | **309** | **575** | **414** | **3019** | F (9, 968) = 42.894, $p$ < .001* |
| | Not registered | 37 | 26 | 38 | 49 | 345 | 320 | 280 | 249 | 151 | 160 | 1655 | |
| **Parental permission** | Yes (%) | | | | | 81 (69%) | 115 (66%) | 125 (62%) | 115 (36%) | 102 (22%) | 80 (19%) | 618 (36%) | |
| | No (%) | | | | | 28 (24%) | 38 (22%) | 67 (33%) | 159 (50%) | 255 (55%) | 242 (58%) | 789 (47%) | $\chi^2$(15, N = 1694) = 293.959, p < .001* V = 0.241 |
| | Sometimes (i.e. New Year's Eve) (%) | | | | | 8 (7%) | 21 (12%) | 11 (5%) | 44 (14%) | 104 (23%) | 99 (24%) | 287 (17%) | |
| | ***N*** | | | | | **117** | **174** | **203** | **318** | **461** | **421** | **1694** | |
| | Not registered | | | | | 431 | 473 | 454 | 240 | 265 | 153 | 2981 | |

At the ages of 13 and 14, significantly more girls than boys were admitted to the Pediatric Department (p < .001 and p < .001, respectively). At the age of 15, the number of boys and girls admitted was comparable (p < .09), and at the ages of 16 and 17, significantly more boys than girls were admitted (p < .001 and p < .001, respectively) (Table 4).

**Table 4: Age to sex**

| Age (years) | Boys | Girls | p-value |
|---|---|---|---|
| 10 (%) | 1 | 0 | 0.32 |
| 11 (%) | 1 | 1 | 1.00 |
| 12 (%) | 16 | 15 | 1.00 |
| 13 (%) | 80 | 171 | <.001* |
| 14 (%) | 344 | 482 | <.001* |
| 15 (%) | 632 | 644 | 0.09 |
| 16 (%) | 828 | 589 | <.001* |
| 17 (%) | 479 | 331 | <.001* |
| ***N*** | **2381** | **2233** | |

*Significant (cut-off-value: 0.003125 (adjusted P))

## Discussion

From 2007 to 2015, the number of adolescents treated for alcohol intoxication increased every year. Between 2015 and 2016, however, there was a visible drop of 15%. This is partly due to a decrease in the number of hospitals that reported adolescent alcohol intoxication: in 2015, the NSCK received reports from 84% of the Dutch hospitals; in 2016, the NSCK received reports from 78%. However, even when correcting for this decrease, the rising trend ceased.

Alcohol consumption by adolescents in the general Dutch population aged 12 to 16 years decreased between 2011 and 2015. During this period of time, the number of binge drinkers also decreased [13]. Thus, there is a discrepancy between the decrease in adolescent alcohol consumption in the general population and the increasing number of reports regarding adolescent alcohol intoxication. This means that excessive alcohol consumption has become more common in adolescents who consume alcohol. In the upcoming years, further research into the characteristics of these adolescents when compared with the general population is needed.

The mean age of adolescents at admission significantly increased, which is partly due to a decrease in the number of 10 to 14 years old who were treated for alcohol intoxication in the Pediatric Department. This effect can be partially explained by the increase in the number of parents who did not give permission for their adolescent to drink alcohol. This is encouraging because alcohol might cause less damage to the more mature brain.

The mean age at admission for girls was significantly lower than that for boys. At the ages of 13 and 14, more girls were admitted to the Pediatric Department with alcohol intoxication. This can be explained by the earlier development of puberty in girls, which leads to experimental behavior, including drinking alcohol [14,15]. By the ages of 16 and 17, boys have reached the age of experimental behaviors', and more boys than girls are admitted [15].

The characteristics of the group of intoxicants did not change in the past decade: the distribution of boys and girls, their school levels and their cultural backgrounds did not change significantly. School level may be a risk factor for alcohol consumption, since adolescents who were treated at the hospital for alcohol intoxication were in lower education more often than those in the general Dutch population [16].

It is known that there is a correlation between blood alcohol concentration and the duration of reduced consciousness, both of which showed a rising trend in the past decade [15]. Thus, alcohol intoxication became more severe. This might result from the effect of changes in drinking patterns: currently, adolescents who have already started consuming alcohol consume more alcohol. Despite the more severe intoxication, hospital stay length significantly decreased in the past decade from 1.07 days in 2007 to 79 days in 2016, perhaps because of the new, structural treatment of adolescent alcohol intoxication.

The number of parents who had not given permission for their child to consume alcohol on the day of intoxication doubled between 2011 and 2016. The higher minimum age to buy, possess and publicly consume alcohol contributed to this increase. Furthermore, more awareness was created, both by informing adolescents and their parents and by publication of the NSCK-data in the Dutch media.

## Conclusion

The total number of adolescents admitted to all Dutch Pediatric Departments showed a rising trend in the past decade until 2015, when this increase stopped, and the number has stabilized. Interestingly, the number of adolescents who have experience with alcohol consumption in the general Dutch population has decreased during the past five years [13]. This suggests that excessive alcohol consumption has become more common in adolescents who already consume alcohol. Alcohol intoxication in this group has also become more severe in the past decade: the duration of reduced consciousness and blood alcohol concentration has increased.

The interventions targeting adolescent alcohol consumption (higher minimum age to buy, possess and publicly consume alcoholic beverages, information for adolescents and their parents and opening of the Outpatient Clinics for Alcohol and Adolescents) did have various positive effects: the mean age at admission has increased, the number of 10 to 14 years old adolescents has decreased, and parents have become stricter.

The characteristics of the group of adolescents who were admitted to the hospital with alcohol intoxication did not change in the past decade: the distribution of boys and girls, their cultural backgrounds and their school levels remained stable. In the upcoming years, we should focus on decreasing the number of 15 to 17 years old adolescents and consolidating the positive trends. Prevention of adolescent alcohol consumption will be of the highest importance.

## Future

After collecting data for the past 10 years, reports of adolescent alcohol intoxication in Pediatric wards will stop. Therefore, it is extremely important not to lose sight of these adolescents, because adolescent alcohol intoxication has various negative effects, both in the short- and long-term. Other ways of collecting data about these adolescents should be employed, for example, collecting data about adolescents and students who are admitted to all Dutch Intensive Care Units, obtaining reports from general practitioners or obtaining reports from First aid departments by a system called the "Injury Information System". In this system, in several Dutch hospitals, all patients admitted to the first aid unit with injuries due to an accident or violence is registered [17].

After increasing the legal age to buy, possess and publicly consume

alcohol, other interventions should be taken, for example, increasing of the price of alcoholic beverages, prohibiting alcohol commercials and limiting the availability of alcohol [18]. Furthermore, in our opinion, the general population, and especially adolescents, should be protected from "blurring", "happy hours" and drinking alcohol in most gatherings.


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