Alcohol use and abuse in adolescence: proposal of an alternative analysis

C. Simões,* J. M. Batista-Foguet,† M. G. Matos* and L. Calmeiro‡§

*Technical University of Lisbon, Faculty of Human Kinetics, Lisbon, Portugal
†ESADE BS. University Ramon Lull, Barcelona, Spain
‡Florida State University, Tallahassee, FL, USA
§Present address: University of Abertay Dundee, Scotland

Accepted for publication 10 September 2007

Abstract

Background A national, representative, school-based sample of Portuguese youths was used to examine the prevalence of alcohol use in this population and to analyse differences between demographic variables such as gender and age, as well as to propose a statistical procedure that optimally quantifies categorical variables.

Methods Data on 6109 state school students from Portugal, in the 6th, 8th and 10th grades, aged 11–18, who participated in the 2002 (Health Behaviour in School-aged Children/WHO) survey of adolescent health, were analysed. Adolescents aged between 11 and 14 were placed in the younger group, and those 15–18 years old were placed in the older group. Optimal scaling was used to optimize the computation of factor scores, which were subsequently submitted to multiple regression analysis in order to analyse the impact of gender and age on alcohol use.

Results The results of this study show that the majority of Portuguese school-aged adolescents attending regular school at 6th, 8th and 10th grades do not drink alcoholic beverages (beer, wine or spirits) on a regular basis (at least once a month). However, about 8% of these adolescents do drink beer, 3% do drink wine and 12% do drink spirits on a regular basis. With regard to age and gender, about a quarter of the older boys stated that they drink beer or spirits regularly. The multiple regression analysis showed that age and gender had a significant impact on alcohol use.

Conclusion Alcohol – in particular spirits – is a substance used by some Portuguese adolescents. Alcohol use and abuse is more frequent in boys and increases with age. The importance of these findings for health promotion strategies is discussed.

Introduction

Adolescence is generally considered a period in which an individual is healthy, given that young people are less vulnerable to illness. However, adolescence is also a critical period in health chronology. Many of the lasting choices that have an impact on a person’s future health are made at this time. These choices include certain types of behaviour, generally called risk behaviour, which are frequently associated with symptoms of maladjustment in the present and the future (DiClemente et al. 1996; United States Department of Health and Human Services 2000).

One of the most problematic types of risk behaviour in adolescence is substance use and abuse, such as alcohol consumption. The negative effects of alcohol abuse are currently well known. Heavy alcohol consumption leads to personal, social and economic problems, and is associated with mortality.
Individuals who abuse alcohol are at greater risk of suffering the following conditions: cancer, cardiovascular diseases, cirrhosis (Kaplan et al. 1993), accidents, violence and crime (Gorman & Speer 1996; Kodjo et al. 2002; Miczek et al. 2004; Blitstein et al. 2005) and work-related problems (Romelsjo et al. 2004), namely absenteeism and dysfunctional performance (Cunradi et al. 2005). Consequently, it can be seen that alcohol has a significant impact on life expectancy, especially in males (Makela 1998; Corrao et al. 2002; Hemstrom 2002; Martelin et al. 2004). In adolescents, heavy alcohol consumption is associated with premature and violent deaths, which generally result in the three most common forms of mortality in this life stage: accidents, homicides and suicides (Pechansky et al. 2004; Pentland et al. 2005; Tardiff et al. 2005). Alcohol use is also associated with the increased probability of having risky sexual intercourse, and consequently to the increased probability of contracting HIV and other sexually transmissible diseases, as well as unplanned pregnancy in adolescence.

Moreover, alcohol use is associated with mental disorders, namely anxiety (Degenhardt et al. 2001) and depression (Windle & Davies 1999; Haarasila et al. 2004). According to DSM-IV (American Psychiatric Association 1996), alcohol is a substance that can lead to mental disorders. In addition to intoxication and abstinence syndrome, alcohol abuse can lead to other possible disorders: dementia, amnesia, psychotic disorders, mood disorders, anxiety disorders, sexual disorders and sleep disorders. Heavy alcohol consumption is also related to poor attachment to family and school (Matos et al. 2001a; Hoel et al. 2004), poor academic performance, learning difficulties, school dropout, low self-esteem (Scheier et al. 2000), and damage to the development and structuring of cognitive–behavioural and emotional abilities (Windle et al. 1996; Pechansky et al. 2004). Alcohol-related risks to cognitive functions (e.g. memory, learning) seem to be higher in adolescents than in adults (Pechansky et al. 2004; Andreason & Allebeck 2005; White & Swartzwelder 2005).

In addition to all these negative consequences, there is evidence to suggest that alcohol consumption during adolescence is a precursor to the progression to other drugs (Allen et al. 1994; Kandel 1998; Weinberg et al. 1998; Simões 2005a). Adolescents generally start with legal drugs for adults, such as tobacco and alcohol, and follow on with cannabis and other illicit drugs. These data are rather problematic when combined with the fact that alcohol is the drug most commonly used and abused by adolescents (Sells & Blum 1996; Weinberg et al. 1998). Over 10 years ago, the World Health Organization (WHO 1993) stated that over the last 40 years alcohol consumption in adolescence had increased in quantity and frequency, and that the age of its onset had decreased. More recently, data from the Health Behaviour in School-aged Children study (HBSC) showed that this tendency is still valid (Currie et al. 2000; Schmid & Gabhainn 2004). According to data from the National Institute on Drug Abuse (Sells & Blum 1996), the vast majority of young people in secondary schools have already tried alcohol. Approximately one-third reported that they had been drunk in the 30 days preceding the study. In Portugal, two studies with representative samples, European School Survey Project on Alcohol and other Drugs (ESPAD) and HBSC, provide information on alcohol use among Portuguese adolescents. The data from the 2003 ESPAD Portuguese study (Hibell et al. 2004) show that 78% of Portuguese adolescents said they had consumed alcohol during the last 12 months, and 32% reported that they had been drunk in this same period. Comparing the ESPAD Portuguese data with the ESPAD countries average, it can be seen that the level of alcohol consumption by Portuguese adolescents is lower, especially with regards to abusive consumption. The Portuguese HBSC 1998 study (Matos et al. 2000a) shows that 71% of the participants had already tried an alcoholic beverage. About 10% consumed beer or spirits regularly (weekly or monthly). Beer is the most commonly consumed alcoholic beverage (12.2%), and wine the one least frequently consumed (3.2%). Approximately a quarter of the participants reported that they had already been drunk at least once in their life. International HBSC 1998 and 2002 data (Gabhainn & François 2000; Schmid & Gabhainn 2004) show that the results from the study of Portuguese adolescents are generally lower than the participating countries’ average with regard to alcohol use and abuse. Nevertheless, for spirits in 2002, it can be seen that the results from the Portuguese adolescents (boys and girls) in the three age groups analysed in this study (11, 13 and 15-year-olds) are higher than the overall HBSC countries’ average for each age/gender group (only 15-year-old boys are 0.2% below the average).

Several factors are associated with alcohol use. Gender and age are two of these factors. Higher levels of alcohol use and abuse are found in boys (Gabhainn & François 2000; Matos et al. 2000a; Adalbjarnardottir 2002; Schmid & Gabhainn 2004). Some authors (Windle & Davies 1999) report that the consumption ratio in boys and girls is 2:1. In the Portuguese 1998 HBSC study, this proportion can be found in the use of beer and spirits. Regular use of beer was reported in 16.1% of the boys and in only 7.5% of the girls. Regular use of spirits was found in 13.3% of the boys compared with 7.2% of the girls. Pleck, Sonenstein and Ku (Pleck et al. 1994) state that problem behaviour such as alcohol use and abuse in
adolescent males is related to the masculinity ideology. These authors point out that boys who have more traditional beliefs and conceptions of masculinity are more prone to getting involved in problem behaviour. Moreover, parental monitoring is referred to as a factor that contributes to gender differences in alcohol use. More girls than boys report perceived parental monitoring, which is considered a protective factor for substance use (Li et al. 2000; Webb et al. 2002; Simões 2005a). The literature converges to show that alcohol use increases with age (Gabhainn & François 2000; Sells & Blum 1996; O’Malley et al. 1998; Matos et al. 2000a,b), especially during middle adolescence. Despite alcohol use being confirmed, consumption frequency remains very low until the children are 15 years old (Dishion et al. 1995). In the Portuguese 1998 HBSC study, it can be seen that regular consumption is around 2% and 3% for younger adolescents (for beer and spirits respectively) but increases substantially in the older adolescents group (around 23% for beer and 17% for spirits).

The increase in alcohol use at this stage is associated with the fact that adolescents spend more time without supervision and are given more freedom to attend events, such as parties (Dishion et al. 1995). Parties constitute one of the contexts in which extreme alcohol consumption, frequently called binge drinking, commonly occurs. Binge drinking is defined as the consumption of five or more consecutive drinks on a single occasion (Windle et al. 1996). This type of consumption is frequent in mid-teenage consumers and in both genders. Binge drinking is associated with serious problems at home, school and with the authorities, and sets the scene for the development of serious problems with alcohol (Hoel et al. 2004). Recent data show that binge drinking is increasing at weekends. It is also important to note that binge drinking in adolescence is related with binge drinking in adulthood (Bonomo et al. 2004; Jefferis et al. 2005) in both genders, but especially in males (McCarty et al. 2004).

The purpose of this paper is to (1) examine the prevalence of alcohol use in a large population-based sample of Portuguese adolescents; (2) propose a statistical procedure that optimally quantifies the arbitrary categorical original values often used; (3) analyse the impact of demographic variables such as gender and age on alcohol use; and (4) consider the implications for both prevention and intervention.

### Methods

The data used in this study are from the Portuguese HBSC 2002 study (Matos & Equipa do Projecto Aventura Social 2003), a collaborative WHO study (Currie et al. 2001). To obtain a representative sample of Portuguese students 11, 13 and 15 years old (according to the international HBSC protocol), 135 schools were randomly selected from the 1535 Portuguese state schools (Madeira and the Azores not included). This study used a cluster sample drawn from grades 6, 8 and 10. The basic sampling unit was the class. Therefore, 374 classes were selected from the 6th (127 classes), 8th (122 classes) and 10th grades (125 classes), with a total of 7331 students (corresponding to 2.4% of all Portuguese students in the 2001/2002 school year in the selected grades). Data were collected through anonymous self-completion questionnaires administered in the classroom by teachers (detailed information about the survey procedures can be found in Roberts et al. 2004). The school response rate was 93% (87% for classes and students). Of the 6371 questionnaires received, 262 (4.1%) were excluded owing to missing data on variables such as gender or age. The final sample included 6109 subjects. Subjects were 11–18 years old (M = 14 years, SD = 1.82 years). Of these, 49% were boys and 51% girls. In terms of grade levels, 38.7% attended the 6th grade, 35.7% were in the 8th grade and 25.6% were in the 10th grade. Age equivalents for the school grades are given in Table 1.

The main HBSC survey included questions on demographics (age, gender, socio-demographics), school-related variables, tobacco and alcohol use, physical activity and leisure, nutrition, safety, psychosocial health aspects, general health symptoms, social relations and social support. For the purposes of the present study, alcohol-related variables were used: ‘drink beer’, ‘drink wine’ and ‘drink spirits’ (1 = never; 2 = rarely; 3 = every month; 4 = every week; 5 = every day), and the ‘been drunk’ variable (1 = never; 2 = once; 3 = 2–3 times; 4 = 4–10 times; 5 = more than 10 times).

### Table 1. Age equivalents for school grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Age (years)</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th</td>
<td>49.1%</td>
<td>32.6%</td>
<td>11.8%</td>
<td>4.5%</td>
<td>1.7%</td>
<td>0.3%</td>
<td>0.0%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>8th</td>
<td>0.0%</td>
<td>0.6%</td>
<td>46.8%</td>
<td>32.0%</td>
<td>12.0%</td>
<td>6.8%</td>
<td>1.7%</td>
<td>0.1%</td>
<td></td>
</tr>
<tr>
<td>10th</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.2%</td>
<td>46.0%</td>
<td>36.4%</td>
<td>12.6%</td>
<td>4.9%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.0%</td>
<td>12.8%</td>
<td>21.2%</td>
<td>13.2%</td>
<td>16.7%</td>
<td>11.9%</td>
<td>3.9%</td>
<td>1.3%</td>
<td></td>
</tr>
</tbody>
</table>

© 2008 The Authors
Journal compilation © 2008 Blackwell Publishing Ltd, Child: care, health and development, 34, 3, 291–301
Table 2. Observed percentages of ‘drink beer’, ‘drink wine’ and ‘drink spirits’ variables by groups and for the total sample

<table>
<thead>
<tr>
<th></th>
<th>Younger boys</th>
<th>Younger girls</th>
<th>Older boys</th>
<th>Older girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beer</td>
<td>Wine</td>
<td>Spirits</td>
<td>Beer</td>
<td>Wine</td>
</tr>
<tr>
<td>Never</td>
<td>73.8%</td>
<td>85.4%</td>
<td>72.5%</td>
<td>86.7%</td>
<td>93.1%</td>
</tr>
<tr>
<td>Rarely</td>
<td>19.9%</td>
<td>11.1%</td>
<td>19.7%</td>
<td>11.2%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Every month</td>
<td>2.8%</td>
<td>1.1%</td>
<td>3.5%</td>
<td>1.4%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Every week</td>
<td>2.3%</td>
<td>1.0%</td>
<td>2.5%</td>
<td>0.6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Every day</td>
<td>1.2%</td>
<td>1.4%</td>
<td>1.8%</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

Analysis

One of the aims of this paper is to propose a statistical procedure that optimally quantifies the arbitrary categorical original values often used. A vital question for social science researchers concerns how observable indicators should be combined and aggregated to obtain global indexes or factor scores, in order to be related with other constructs or compared among different groups. The use of multiple indicators combined to define a composite measure is a usual strategy. This strategy aims to increase measurement reliability, improve accuracy and power of discrimination, because a composite construct range is larger and more parsimonious for comparisons between different groups than those between the individual items (Batista-Foguet et al. 2004). When group comparisons are sought, it is important to be aware that weighting in the composite depends on the relationships among the construct’s indicators, which in turn depend on the group. This is why it is crucial to use the appropriate weighting procedures for the different groups before computing the composite measure. Categorical Principal Components Analysis (CATPCA, from the Optimal Scaling module in the SPSS package version 14.0) is a procedure that attaches optimal quantifications to the arbitrary original ordinal values, while it analyses the relationships among the observable variables to produce the factor scores (see Appendix explaining CATPCA). As the indicators in our study are ordinal, it is appropriate to submit them to optimal scaling before using linear relationship analysis techniques such as multiple regression, in order to account for the variation in alcohol use in adolescence.

Results

Descriptive data

The sample was divided into four groups: younger boys and younger girls (aged 11–14) and older boys and older girls (aged 15–18). The cut-off point used to create the two age groups was not the median criterion (which would quantitatively give a uniform subject distribution), but a theoretical criterion. Some authors (Felner & Adan 1988; Bronfenbrenner 1997) point to the importance of transitional ages, such as, the age of school transition, as a factor that could be responsible for some of changes in an adolescent lifestyle. In Portugal, transition from basic level to secondary occurs when adolescents are 15 years of age or older. Therefore, the decision was made to create one younger group, for children under 15 years of age, and another, older group, for children aged 15 and older. The mean age for each group was: 12.93 years old for younger boys (SD = 1.08; n = 1949); 12.88 years old for younger girls (SD = 1.08; n = 2102); 16.18 years old for older boys (SD = 0.80; n = 1043); and 16.08 years old for older girls (SD = 0.76; n = 1015).

The frequency of alcohol use (beer, wine and spirits) in Portuguese adolescents is shown in Table 2. The majority of the subjects said they had never drunk beer, wine or spirits. Nevertheless, about 8% of the adolescents stated that they had drunk beer and 12% reported that they drank spirits regularly (at least once a month). Considering the consumption by groups, it can be seen that this percentage is much higher in the older groups, especially for spirits (26.8% of the older boys and 21.1% of the older girls use this kind of beverage on a regular basis). It is also true for beer, but in this case the difference between the older boys (24.3%) and the older girls (9.0%) is greater. Consumption among the younger groups is smaller, but boys still drink more often (7.8% and 6.3% of the younger boys reported a regular consumption of spirits and beer respectively vs. 4.9% and 2.1% of the younger girls). Wine is the beverage that is least frequently consumed. However, once again boys consume more, especially the older ones (3.5% for the younger boys and 7.6% for the older boys) than girls (2.1% for the younger girls and 2.7% for the older girls). Around 3% of the whole sample reported drinking wine on a regular basis.

About three quarters of the adolescents said that they had never been drunk (see Table 3), which also means that a quarter of the adolescents in the survey reported having been drunk at least once. Again older groups stated a greater involvement in this kind of behaviour (14.6% of the older boys and 6.5% of older girls reported having been drunk 4–10 times or more, compared with 4.4% of the younger boys and 0.9% of the younger girls).
Variable transformation

One of the objectives of this article is to show a statistical procedure, optimal scaling, which attributes optimal quantifications to categorical variables that lead to the improvement of the indicators’ reliability, and, as a consequence, increase the power of any statistical test (Batista-Foguet et al. 2004). The transformations were made for the whole sample and also for each group in order to see differences between them.

As the original arbitrary values for drinking indicators were: 1 = Never; 2 = Rarely; 3 = Every month; 4 = Every week; 5 = Every day, the range of the original scale was four points. Comparing the new range (obtained after optimization) and old ranges (original scale), it can be seen that the biggest differences are in the younger girls group, which shows a wider range in scale values for all the four variables (see Tables 4 and 5). Moreover, in the ‘drink beer’, ‘drink wine’ and ‘drink spirits’ variables, the older girls group shows a wider range in scale values. We can see that the older boys group shows a small decrease in scale values for two variables (‘drink beer’ and ‘been drunk’). Looking at the sample overall, we can see several differences. These amount to a slightly extended range in the four variables studied. It is also possible to see that the first two categories (‘never’ and ‘rarely’) are now closer (the difference between the scale values is generally lower than 1) and that the last two (‘every week’ and ‘every day’) are further apart (the difference between scale values is generally higher than 2, except in the older boys group).

Non-linear factor analysis

As mentioned earlier, the optimal scaling procedure quantifies categorical variables and simultaneously reduces the dimensionality of the data. The factor loadings of the optimal score indicators varies between 0.64 and 0.87. The results of the non-linear factor analysis show that ‘drink beer’ and ‘drink spirits’ are

Table 3. Observed percentages of the ‘been drunk’ variable by groups and for the total sample

<table>
<thead>
<tr>
<th>Categories</th>
<th>Younger boys</th>
<th>Younger girls</th>
<th>Older boys</th>
<th>Older girls</th>
<th>Total sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80.1%</td>
</tr>
<tr>
<td>Once</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.7%</td>
</tr>
<tr>
<td>2–3 times</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.9%</td>
</tr>
<tr>
<td>4–10 times</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.9%</td>
</tr>
<tr>
<td>+10 times</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Table 4. Optimal scale values obtained using Principal Components Analysis for Categorical Data (PRINCALS)* and the new range W (old range in brackets) for the ‘drink beer’, ‘drink wine’ and ‘drink spirits’ variables by group and for the total sample

<table>
<thead>
<tr>
<th>Categories</th>
<th>Beer</th>
<th>Wine</th>
<th>Spirits</th>
<th>Beer</th>
<th>Wine</th>
<th>Spirits</th>
<th>Beer</th>
<th>Wine</th>
<th>Spirits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>-0.38</td>
<td>-0.29</td>
<td>-0.38</td>
<td>-0.24</td>
<td>-0.19</td>
<td>-0.30</td>
<td>-0.88</td>
<td>-0.57</td>
<td>-0.97</td>
</tr>
<tr>
<td>Once</td>
<td>0.42</td>
<td>0.81</td>
<td>-0.31</td>
<td>1.10</td>
<td>2.29</td>
<td>0.58</td>
<td>-0.04</td>
<td>0.92</td>
<td>0.06</td>
</tr>
<tr>
<td>2–3 times</td>
<td>2.10</td>
<td>3.36</td>
<td>1.76</td>
<td>3.03</td>
<td>2.29</td>
<td>2.02</td>
<td>1.07</td>
<td>2.49</td>
<td>1.04</td>
</tr>
<tr>
<td>4–10 times</td>
<td>2.91</td>
<td>4.15</td>
<td>2.85</td>
<td>4.45</td>
<td>2.29</td>
<td>3.26</td>
<td>1.81</td>
<td>2.55</td>
<td>1.71</td>
</tr>
<tr>
<td>+10 times</td>
<td>6.83</td>
<td>6.63</td>
<td>6.15</td>
<td>24.34</td>
<td>25.03</td>
<td>16.90</td>
<td>3.08</td>
<td>4.17</td>
<td>3.13</td>
</tr>
<tr>
<td>W (4)</td>
<td>7.21</td>
<td>6.92</td>
<td>6.53</td>
<td>24.58</td>
<td>25.22</td>
<td>17.20</td>
<td>3.96</td>
<td>4.74</td>
<td>4.10</td>
</tr>
</tbody>
</table>

*In the latest version of SPPS. 14.0 & 15.0 they have changed the name from PRINCALS to CATPCA.

Table 5. Optimal scale values obtained using Principal Components Analysis for Categorical Data (PRINCALS)* and the new range W (old range in brackets) for the ‘been drunk’ variable by group and for the total sample

<table>
<thead>
<tr>
<th>Categories</th>
<th>Beer</th>
<th>Wine</th>
<th>Spirits</th>
<th>Beer</th>
<th>Wine</th>
<th>Spirits</th>
<th>Beer</th>
<th>Wine</th>
<th>Spirits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>-0.36</td>
<td>-0.27</td>
<td>-0.34</td>
<td>-0.41</td>
<td>-0.22</td>
<td>-0.52</td>
<td>-0.48</td>
<td>-0.34</td>
<td>-0.54</td>
</tr>
<tr>
<td>Once</td>
<td>0.42</td>
<td>1.05</td>
<td>0.04</td>
<td>0.12</td>
<td>0.65</td>
<td>-0.14</td>
<td>0.52</td>
<td>1.38</td>
<td>0.34</td>
</tr>
<tr>
<td>2–3 times</td>
<td>1.47</td>
<td>2.82</td>
<td>0.82</td>
<td>1.40</td>
<td>2.44</td>
<td>0.87</td>
<td>2.06</td>
<td>3.79</td>
<td>1.66</td>
</tr>
<tr>
<td>4–10 times</td>
<td>2.72</td>
<td>7.04</td>
<td>1.54</td>
<td>2.34</td>
<td>3.00</td>
<td>1.49</td>
<td>2.99</td>
<td>4.19</td>
<td>2.56</td>
</tr>
<tr>
<td>+10 times</td>
<td>5.08</td>
<td>11.11</td>
<td>5.60</td>
<td>11.94</td>
<td>15.46</td>
<td>14.06</td>
<td>6.16</td>
<td>7.07</td>
<td>5.94</td>
</tr>
<tr>
<td>W (4)</td>
<td>5.44</td>
<td>11.38</td>
<td>5.94</td>
<td>12.35</td>
<td>15.68</td>
<td>15.58</td>
<td>6.64</td>
<td>7.41</td>
<td>6.48</td>
</tr>
</tbody>
</table>

*In the latest version of SPPS. 14.0 & 15.0 they have changed the name from PRINCALS to CATPCA.
better indicators of alcohol use than ‘drink wine’ and ‘been drunk’. These indicators explain 65% of the variance in alcohol use for the whole sample. It is also interesting to see that while ‘drink spirits’ is the best indicator for the younger groups (boys and girls, 0.86 and 0.87 respectively), ‘drink beer’ is the best indicator of alcohol use for the older groups (boys and girls, 0.87 and 0.86 respectively).

After the optimal scaling procedure, both the exploratory factor analysis and reliability analysis show clear improvements. Before, with the original values, our one-dimensional factors, Cronbach’s alpha varied between 0.73 and 0.81, and after transformation the values ranged from 0.77 to 0.83. It should be noted that the levels of explained variance before transformation ranged between 56.23% and 64.76%, while after transformation these values varied between 58.78% and 66.09%.

Moreover, in the correlation analysis, before and after transformation, it can be seen that the correlation values generally increase after transformation. For example, before optimization, for the older girls group the correlation value between ‘drink spirits’ and ‘drink wine’ was 0.31, and after optimization it was 0.55. In general, correlations after transformations varied from 0.24 to 0.64. It is also interesting to note that for the younger groups the variable that shows the greatest correlation with ‘been drunk’ is ‘drink spirits’, while for older groups it is ‘drink beer’.

**Multiple regression**

After variable optimization, we performed multiple regression using the factor scores of the alcohol factor obtained in the optimization as dependent variables and gender and age group as independent variables. As residuals do not show clear violations of the underlying assumptions and the appropriate indices do not reveal multicolinearity as an issue, we can trust the estimates and the statistical tests. This analysis showed that age and gender had a significant impact on alcohol use. Age had a positive impact ($\beta = 0.36$, $F_{1,379} = 868.60$, $P < 0.001$), which means that older adolescents are more involved in this kind of behaviour than younger adolescents. Gender had a negative impact ($\beta = -0.15$, $F_{1,379} = 446.72$, $P < 0.001$), which according to our gender code means that girls are less involved than boys in alcohol use. Both variables account for 15% of the alcohol use variance. Age had the greatest bearing on alcohol use, about 13% of the variance, while gender explained 2% of the alcohol use variance.

**Discussion**

The results of this study show that the majority of Portuguese school-aged adolescents attending regular school at 6th, 8th and 10th grades do not drink alcoholic beverages (beer, wine or spirits) on a regular basis (at least once a month). However, about 8% of these adolescents do drink beer, 3% do drink wine and 12% do drink spirits on a regular basis. Comparing these values with the 2002 HBSC overall means for each drink, it can be seen that Portuguese adolescents drink less than their European and North American counterparts. Of the drinks studied, only spirits are slightly above the overall mean. Although statistics on alcohol consumption (OECD 2005) show that Portugal is one of the 10 countries with the highest alcohol consumption per capita (out of 30 countries in Europe and North America, also including Japan, Australia and New Zealand), it seems that this does not apply to Portuguese adolescents. The data in our study do not permit us to explain the causes of this lower consumption. Nevertheless, several hypotheses can be put forward linked to aspects concerning family, peers and school. It is likely that a more protective parenting style (higher parental supervision and restrictions on going out at night, especially for girls), more characteristic of Southern European countries, has some bearing on this behaviour. Portuguese adolescents are also among those who report spending less time in the evenings with their friends (Setterbulte & Matos 2004), which is a particular risk factor for alcohol use. Moreover, a higher level of connection to school, which is found to be a protective factor for alcohol consumption (Simões 2005a), may lie behind this fact. Portuguese adolescents are those who say they like school most and find their classmates kind and helpful (Samdal et al. 2004).

With regard to gender and age groups, these values are considerably different. These results support other studies, which show that boys and older groups consume more alcohol than girls and younger groups (Windle & Davies 1999; Gabhainn & François 2000; Matos et al. 2000b). Overall, boys’ consumptions are twice the girls’ consumptions. The level of consumption in older groups is four times greater than the level recorded in younger groups. However, it is important to stress that these differences are greater for beer than for spirits. This general tendency is also valid for abusive consumption (McCarty et al. 2004). Again boys and older groups report having been drunk more frequently than girls and the younger groups. More specifically, the difference between boys and girls is four times greater in the younger groups and twice as great in the older groups. As for differences between age groups within gender, the difference between younger boys and older boys is three times greater, and six times greater between younger girls and older girls. These results were supported by the multiple regression results where it was possible to find a significant age and gender impact on alcohol use.
The optimization of alcohol indicators improved reliability and precision. The optimal scaling procedure leads to considerable changes to the original ordinal quantifications (which were quite arbitrary leading to categories only describing relative levels, with the distances between them not necessarily being equal), especially considering the different groups. For all the groups in the study, there were differences in the range variability, which shows that arbitrary numerical quantifications do not lead to scales with metric properties and, as such, indicators could not be evaluated and weighted appropriately (Batista-Foguet et al. 2004).

Results show that gender (male status) and age (being older) are risk factors for alcohol use. And it seems that this risk is increasing with time. Comparing the 2002 HBSC data with the 1998 HBSC data, it can be seen that there has been an increase in alcohol use (Matos et al. 2001b; Simões 2005a), more specifically in the consumption of spirits (every week or every day). The values of spirits use are in 2002 the double of the 1998 values for girls and young boys, which reflect the WHO standpoint that alcohol consumption is increasing. Moreover, abusive drinking increased by 2.5% in the period from 1998 to 2002. Another important difference between the data from 1998 and 2002 is the shift from beer to spirits as the most commonly consumed alcoholic beverage, which means that adolescents probably consume a greater amount of alcohol.

What should be done to prevent this situation? As mentioned in the Introduction, alcohol use presents several important utilitarian functions for adolescents, and this aspect constitutes an important factor that leads them to adhere to this behaviour. Alcohol use has serious long- and short-term consequences in several important life contexts, and that is why its prevention is so important. We would like to highlight several issues regarding prevention, specifically the need for early intervention and the promotion of protective factors. The need for early intervention is referred to in several studies, which show that the involvement in problematic behaviour increases with age. Furthermore, it is known that previous behaviour constitutes one of the main determinants of future behaviour, and that alcohol consumption constitutes an important risk factor for the consumption of other kinds of substances and for involvement in violent behaviour. Therefore, it is important to intervene in the early developmental stages, when experimentation has not yet occurred. Although not all adolescents who try substances go on to consume them regularly, it is known that experimentation constitutes a basic stage in substance use development, namely for attitude development, and attitudes are important behaviour determinants (Ajzen 1988; Eagly & Chaiken 1993). The promotion of protective factors should constitute the essence of the intervention. Today it is well known that protection, like risk, occurs in diverse contexts (Harris 1998; Lerner & Galambos 1998; Gilvarry 2000; Werner & Smith 2001). It seems therefore that any preventive work on an individual level must approach life contexts in order to achieve an effective reduction of risk, an activation of resources and the promotion of personal and social abilities. Individuals with these kinds of abilities present a greater capacity for adapting to different situations and dealing with adversity (Matos et al. 2004; Simões 2005b).

One of this study’s limitations is the fact that the findings are based entirely on adolescents’ self-reports and biases in perception and reporting cannot be ruled out. Notwithstanding this limitation, this study used a large sample of adolescents and the sampling procedures helped to ensure a nationally representative sample.

Acknowledgements

The authors would like to thank the Portuguese HBSC team – ‘Aventura Social’, for their work on collection and data management. The Portuguese HBSC study was funded in 2002 by Fundação para a Ciência e Tecnologia/Ministério da Ciência e do Ensino Superior/Projecto POCTI–37486/PSI/2001-January 2002–2004), e Comissão Nacional de Luta Contra a SIDA (specific study) and PSIDA/PSI/49649/2003. We would like to thank the anonymous reviewers for comments and suggestions which improved the quality of this paper.

References


Andreasson, S. & Allebeck, P. (2005) [Alcohol as medication is no good. More risks than benefits according to a survey of current knowledge]. Lakartidningen, 102, 632–637.


Appendix explaining CATPCA

The simplest and most simplistic way to build a composite is known as the Summated Rating Scale (SRS), which consists of adding up the values for each individual on each variable. Obviously, metric properties of ordinal variables cannot be summed up.

Let us suppose that ordinal values are actually arbitrary quantifications for the original (0) categories of the p items, $Y_1^{(0)} = (1, 2, 3, \ldots, k_1); Y_2^{(0)} = (1, 2, \ldots, k_2)$, etc., which in our case could be for example: 1 for Never; 2 for Rarely; 3 for Every month; 4 for Every week; 5 for Every day. Then we could consider these original values as a first step in an iterative process for obtaining factor scores for the global index, $F$, which will lead to a non-linear approach to index construction.

The natural way to obtain factor scores, $F$, from an arbitrary $Y_j^{(0)}$ quantification is by computing the sum (SRS) or the average of the arbitrarily quantified p category values for each individual:

$$F = G_i Y_i^{(0)}$$  \hspace{1cm} (1)

$G_i$ being the indicator matrix from equation (1).

Note that this strategy would actually lead to a global index built on the assumptions that each indicator, $Y_i$, has at least interval properties, though they were expressed in ordinal scales, and that the three indicators are equally reliable in every group, so they are simply added. Had we used factor analysis, interval properties would be assumed.

Our aim in constructing a single index from the p indicators involves condensing the information from these variables to one factor that must capture as much of their information as possible. In order to do this, it seems more sensible to find scale values for the categories of the items which could be determined by the data themselves, optimizing a certain criterion (loss function below) rather than using the original arbitrary category quantification $Y_j^{(0)}$ as has been done so far.

The natural way to improve the original arbitrary category quantification, $Y_j^{(0)}$, from the arbitrary factor scores, $F$, obtained in (1), is to replace those category values with the mean of the $F$-values for the individuals that have chosen a specific original category, $1, \ldots, k_j$ from each item, $Y_j$. This ‘reciprocal averaging’ leads to a new set of category quantification $Y_j^{(1)}$ computed as:

$$Y_1^{(1)} = D_1^{(1)} G_1 F;$$
$$Y_2^{(1)} = D_2^{(1)} G_2 F; \text{ being } D_j^{(1)} = (G_j G_j^{-1})^{-1};$$
$$Y_3^{(1)} = D_3^{(1)} G_3 F;$$

......

These expressions are reminiscent of Least Squares, and the procedure is therefore known as Alternating Least Squares. Note that the matrix, $D$, has the same structure as the diagonal matrices in a Burt table in Correspondence Analysis. This means that it contains the marginals of each category. Pre-multiplying by the inverse of $D$ involves dividing each $G$ column by the marginal, so we are actually computing the means of the $F$-values.

Now the obvious comment is that the resulting quantifications are, to say the least, as arbitrary as the original ones. This is indeed true, but it turns out that the iterations -varying from quantification $Y^{(k)}$ to a new vector of factor scores $F^{(k)}$, and vice-versa- converge to a stable pair $(F, Y)$.

This iterative process is known as reciprocal averaging and its solution is known as HOMALS (for Homogeneity Analysis). By imposing additional order constraints on the category values that are appropriate for data of an ordinal nature, as in our case, the solution we get is known as Categorical Principal Components Analysis or CATPCA (in SPSS). Note that final scores obtained through this iterative process:

1. Are intrinsic and objective. That is, they are independent of the starting point, $Y_j^{(0)}$, and depend only on the data – let the data speak for themselves!
2. Optimise a loss function (criterion) that can be described in different ways:
   - Maximum correlation of the categorical variables (with the quantification of the final solution) with the factor scores $F^{(k)}$. This is what is known as optimal scaling.

The final scores obtained when there are no additional order constraints on the category values, i.e. the HOMALS solution, coincide with those of the maximum inertia dimension obtained with Multiple Correspondence Analysis.

---