



# Educational and sport factors as predictors of harmful alcohol drinking in adolescence: a prospective study in Bosnia and Herzegovina

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## Abstract

**Objectives** The cause–effect relationship between educational and sport factors, and alcohol drinking in adolescents is rarely prospectively investigated. This study aimed to establish the possible influence of sport, scholastic and socio-demographic factors on harmful alcohol drinking (HD) and the initiation of HD in adolescents from Bosnia–Herzegovina.

**Methods** Study included 881 adolescents (49% females) and consisted of (1) baseline tests (16 years of age) and (2) follow-up testing (18 years of age). The independent variables were scholastic and sport-related factors. Alcohol Use Disorders Identification Test was used, with the following dependent variables: (1) HD at baseline, (2) HD at follow-up, and (3) HD initiation. Logistic regressions were applied to define the relationships.

**Results** Higher likelihood of HD was evidenced in children who performed poorly in school. Sport factors were positively correlated with HD at study baseline. Higher odds for HD initiation were found for adolescents who reported a lower GPA, a lower behavioral grade, more frequent school absences, and more unexcused school absences.

**Conclusions** The results showed scholastic failure as the predictor of HD initiation. The potential influence of sport factors on HD initiation should be studied at an earlier age.

**Keywords** Substances · Predictors · Puberty · Transition

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## Introduction

Drinking alcohol is directly and indirectly related to the occurrence of more than 200 diseases (Clemens et al. 2009; Rehm et al. 2010; Seigers and Carey 2010). In addition to being a health hazard, increased consumption of alcohol is associated with other serious problems, such as family violence, physical abuse, sexual risk behaviors, and traffic accidents (Hurley et al. 2017; Johnson et al. 2014; O'Meara et al. 2012; Sanchez et al. 2016; Swahn et al. 2017). Therefore, the prevention of excessive alcohol consumption is a highly prioritized issue in the public health sector around the world, and special attention is paid on adolescence (Diep et al. 2016; Ferreira-Borges et al. 2017). Specifically, in most countries, 18 years is the age limit for legal alcohol purchase. Consequently, adolescents are then able to legally consume alcohol in different “non-controlled” situations, which increases the risk of intoxication and harmful alcohol consumption. Therefore, this transition period (i.e., late adolescence) is particularly important

in the development of targeted preventive programs against harmful alcohol consumption.

Studies performed around the world systematically investigate factors related to alcohol consumption in adolescents (Cerkez et al. 2015; Sumskas and Zaborskis 2017; Tomcikova et al. 2009). Generally, the idea is to identify factors that may contribute to alcohol consumption in this age group in order to identify adolescents that are at specific risk of alcohol consumption and/or to identify factors that may serve as a certain protective barrier against drinking alcohol. Among the most studied factors potentially related to alcohol consumption are (1) educational factors (i.e., scholastic and academic factors), (2) socioeconomic factors, and (3) sport factors (Doku et al. 2012; Sekulic et al. 2017; Torikka et al. 2017; Webb et al. 2007). In a good practice example, Icelandic research has been used to develop an effective approach to prevention with a broad-scale and a systematic assessment of the risk and protective factors that predict adolescent substance use. A key component for this prevention approach is encouraging youth to participate in organized recreational and extracurricular activities and sports (Sigfusdottir et al. 2008).

The alcohol consumption can alter cognitive capacities and consequently result in deterioration of learning capacities, and studies frequently examined the associations between consumption of alcohol and academic achievement (Magrys and Olmstead 2014; Silva et al. 2017). Indeed, studies frequently reported alcohol consumption as being related to poor scholastic achievement demonstrated through lower grade point averages, more frequent absences from school, and lower behavioral grades in adolescents (Balsa et al. 2011; Mazur et al. 2016a, b; Sekulic et al. 2012). Additionally, poor familial (parental) control, low self-reported parental interest in the adolescents' problems, and higher rates of conflict with parents and family are regularly reported to be correlated with higher consumption of alcohol and more frequent binge drinking (Smorti and Guarnieri 2015; Yu et al. 2016). Meanwhile, socioeconomic status (SES) is variably related to alcohol consumption (Doku et al. 2012; Humensky 2010; Liu et al. 2013). The influence of participation in sports on drinking alcohol is also unclear (Cerkez et al. 2015; Sekulic et al. 2012; Vest and Simpkins 2013). In brief, since some investigators reported sports as being protective against drinking alcohol (Sigfusdottir et al. 2008), others highlighted sports participation as a factor contributing to increased risk of alcohol consumption and binge drinking (Bedendo et al. 2013; Bjelica et al. 2016).

Considering that approximately 30% of adolescents self-reported harmful alcohol consumption based on the Alcohol Use Disorders Identification Test (AUDIT), a scale proposed by the World Health Organization (Reinert and

Allen 2002), Bosnia and Herzegovina has one of the highest prevalences of alcohol misuse in this age group in Europe (Cerkez et al. 2015; ESPAD; Sekulic et al. 2012), and this is similar to reports from other countries in the southeastern Europe (Modric et al. 2011; Tahiraj et al. 2016). This high prevalence is explained by several important factors, including relatively low alcohol beverage prices, availability of alcohol in regular markets, and social acceptance of alcohol consumption (i.e., Mediterranean style of drinking is accepted in the entire territory of western Balkans, mostly because of the former Yugoslav tradition) (Cerkez et al. 2015; Sekulic et al. 2012). Because of such high alcohol consumption statistics, several cross-sectional studies from the region have investigated the associations between drinking alcohol and sport participation in older adolescents. In Croatian adolescents, sport participation factors were weakly negatively related to drinking alcohol in males, but sport participation was evidently higher in girls who were more prone to harmful alcohol drinking (Modric et al. 2011); similar results were reported in a recent study on adolescents from Bosnia and Herzegovina, with a higher occurrence of harmful drinking in girls who achieved better success in sports (Zenic et al. 2015a). Former sport participation was identified as a risk factor for the higher occurrence of harmful alcohol consumption in Kosovar adolescents, but there was no difference in the prevalence of harmful drinking behaviors between adolescents who were currently involved in sports and those that were never involved in sports (Tahiraj et al. 2016).

The associations established in the previously reviewed cross-sectional investigations lack important information regarding the causality between the precipitating factors and drinking alcohol (Modric et al. 2011; Tahiraj et al. 2016; Zenic et al. 2015a, b). First, it is possible that alcohol misuse is a cause of low scholastic achievement (i.e., because of the negative influence of heavy drinking on attentional focus and/or learning capabilities in adolescents) (Magrys and Olmstead 2014; Silva et al. 2017). However, it is also possible that adolescents first failed at school and consequently skipped classes, which put them in out-of-school social circumstances where they were more likely to start drinking because of negative social influences (Abar and Maggs 2010; Cheadle et al. 2015; Epstein et al. 2008). Similar problems of uncertain causality can be anticipated for associations between sport participation and drinking alcohol in adolescence (Sekulic et al. 2012; Vest and Simpkins 2013).

This prospective study aimed to establish the possible influence of the sport, scholastic and certain socio-demographic factors on the initiation of harmful alcohol drinking in older adolescents from Bosnia and Herzegovina. In this study, we used the AUDIT scale and their proposed level of

“harmful drinking” as criteria for problematic alcohol consumption.

## Methods

### Participants and procedures

In this prospective study, participants were observed on two occasions: at the study baseline (when they were in their 3rd year of high schools and were 16 years old on average; September 2014) and after follow-up (18 months later, at the end of their high school education; May–June 2016). Of the 1197 eligible students, 1003 (84%) had complete data in both the baseline and follow-up testing. The ethnicity was previously identified as possible covariate of substance use and misuse among adolescents (Bjelica et al. 2016). Therefore, 881 adolescents who identified as ethnic Bosniaks were included in this study (74% of the eligible students). The sampling was based on a multistage cluster sampling method including (1) random selection of one-third of high schools in two Cantons and (2) random selection of half of the 3rd year classes in the selected schools. Schools were not stratified by size because their sizes varied by 10–15%. We aimed to investigate the typical regions of Bosnia and Herzegovina (i.e., regions characterized by traditional Bosnian and Herzegovinian heritage); therefore, the study was performed in the territories of Tuzla Canton and Zenica-Doboj Canton. The sampling, the theoretical cohort, the retention, and dropout rates are presented in Fig. 1. Approval from the ethical board of the School of Medicine, University of Mostar, Bosnia and Herzegovina, was obtained prior to study. Additionally, the investigation was authorized by the Cantonal Ministries of Education.

Potential participants were informed about the study 1 week prior to baseline testing. Additionally, 1 week prior to the study, investigators explained the study background, idea, and protocol to the children’s parents at regular school meetings and obtained parental written consent for study participation. Prior to baseline testing, the participants were informed that they could leave any of the questions and/or the entire questionnaire blank. No personal information was asked, and the participants remained anonymous. However, they were asked to choose confidential codes for identification purposes in the repeated test (i.e., last three digits of their e-mail password). After completing the questionnaire, each participant placed the questionnaire in an envelope and then placed the envelope in a closed box.

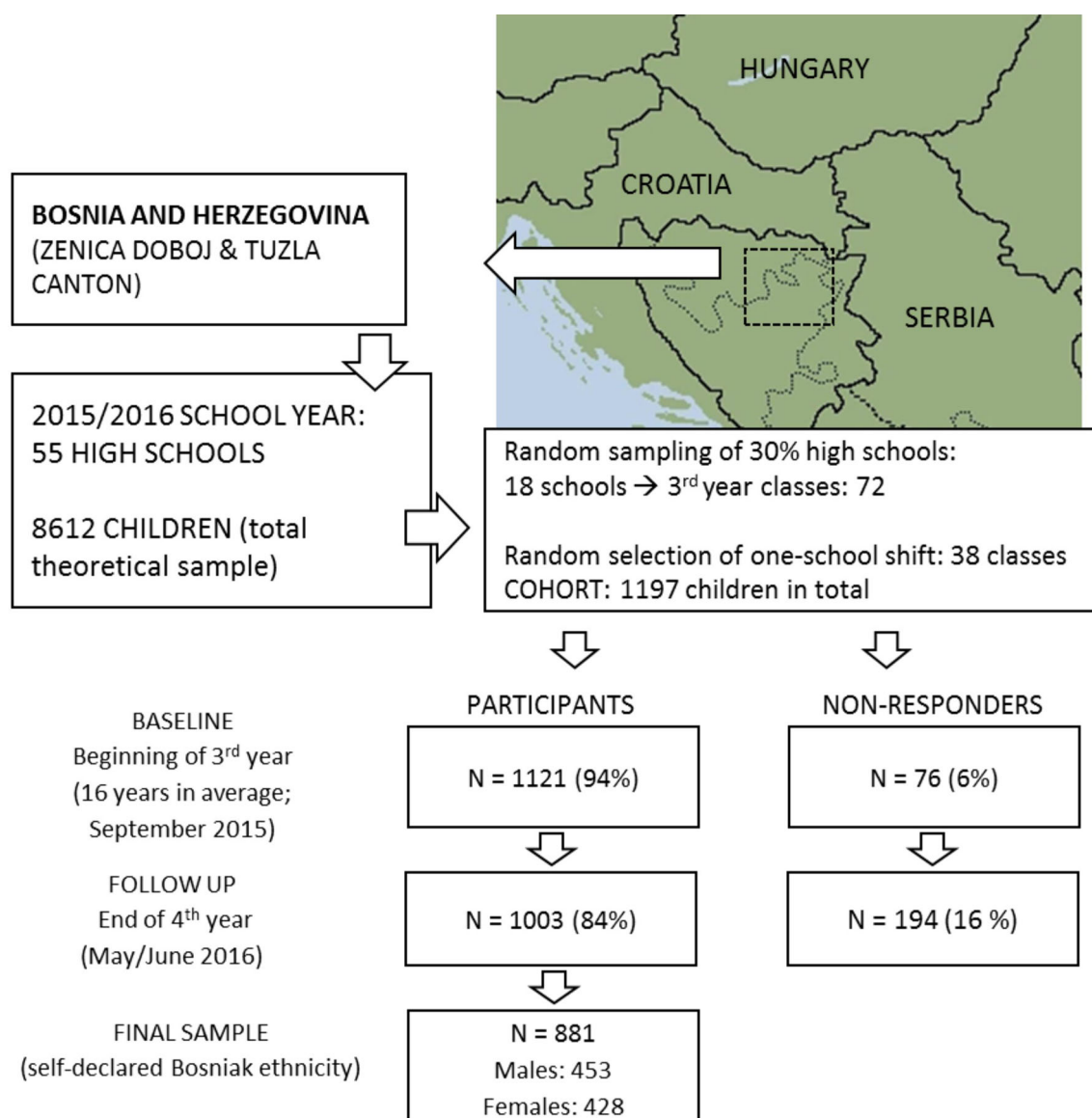
The analysis of attrition bias showed no significant differences in the initial harmful drinking status between the participants who dropped out and those who remained

in the study (Chi-square: 0.99,  $p > 0.05$ ), but there were significantly more males than females who dropped out (Chi-square: 7.01,  $p < 0.01$ ), which is explainable knowing that males are more frequently absent from school than females (Sekulic et al. 2012). The intracluster correlation coefficient calculated for baseline harmful drinking prevalence with schools observed as clusters was 0.07, indicating appropriate within-cluster (i.e., within-school) variance (Killip et al. 2004).

### Variables

All subjects filled out two questionnaires: the Questionnaire of Substance Use—QSU—and the AUDIT (Modric et al. 2011; Reinert and Allen 2002; Sekulic et al. 2012). The QSU is a questionnaire repeatedly found to be a reliable and valid measuring tool in the former Yugoslavia territory, including Croatia, Kosovo, and Bosnia and Herzegovina (Idrizovic et al. 2015; Sekulic et al. 2012; Zenic et al. 2015a). Among other questions, this questionnaire evaluates (a) socio-demographic factors, (b) scholastic factors, and (c) sport factors. The socio-demographic factors included questions on the subjects’ gender, age (in years), ethnicity (Bosnia, Serbian, Croatian, Other [please specify]), and self-determined socioeconomic status (below average–average–above average). The scholastic factors were evaluated by the participants on their academic achievement over the previous semester by three variables: (1) grade point average (GPA); (2) behavioral grade (both on a five-point scale ranging from excellent to poor/failed); and (3) absences from school/classes (almost never–rarely–from time to time–often). The sport factors included questions on (1) involvement in team sports; (2) involvement in individual sports (never been involved, quit, currently involved); (3) highest competitive achievement in sports (never competed/did not participate in sports, local competitions, national-/international-level competitions); (4) time of involvement in sports (never involved, < 1 year, 2–5 years, > 5 years); and (5) training frequency per week (1 session or less, 2–3 sessions, 4–5 sessions, more than 5 sessions per week).

The AUDIT questionnaire measured the consumption of alcohol (Saunders et al. 1993). This questionnaire contains 10 items with scores ranging from 0 to 4 for a hypothetical minimum (0) to maximum (40) range. The overall results of the AUDIT were divided into “harmful drinking” (HD) and “non-harmful drinking” (NHD), and this classification was used for the logistic regression calculation (see later for details). For a meaningful comparison with the results from previous studies on similar subject samples, we used a total score of 11 as a cutoff score for HD, although two types of HD and NHD dividing scores are suggested in the literature (i.e., using the scores of 8 and 11 as “cutoff



**Fig. 1** Sampling procedure, participants, and non-responders (i.e., absent from school on testing day, inconsistency in identification codes); Bosnia and Herzegovina 2015–2017

points”) (Cerkez et al. 2015; Sekulic et al. 2012; Zenic et al. 2015b).

## Statistics

The prevalence of HD, as well as HD initiation, is presented in percentages, while raw AUDIT scores are calculated as means  $\pm$  standard deviations. Gender differences between raw AUDIT scores were established by *t* test for independent samples. Binary logistic regression was used to estimate the odds ratio (OR) and the corresponding 95% confidence interval (95% CI) of the following: (1) HD at the baseline, (2) HD at the end of the study, and (3) HD initiation occurring during the course of

the study by the studied covariates. The logistic analyses were additionally adjusted for gender, age, and socioeconomic status. For all significant regression models, the distributions of residuals were expected (Stoltzfus 2011). Specifically, in most cases residuals were positioned within  $\pm 3SD$ , and only few outliers were evidenced for prediction of HD at baseline by individual sport participation, and prediction of HD at follow-up by team sport participation (i.e., 2 and 3 outliers, respectively), which did not strongly influence the model.

## Results

Males had significantly higher overall AUDIT scores than females at baseline ( $5.59 \pm 3.53$  and  $3.45 \pm 2.77$ ;  $t$  test: 6.59,  $p < 0.01$ ) and follow-up ( $6.67 \pm 4.12$  and  $3.78 \pm 3.01$ ,  $t$  test: 6.76,  $p < 0.01$ ).

Descriptive results for all covariates and predictors are presented in Supplementary Tables 1 and 2. In total, 11% of males and 4% of females were identified as being harmful drinkers at study baseline, while 22% males and 7% females were identified as harmful drinkers at follow-up. Males were more likely to be harmful drinkers than females at study baseline (OR 2.9; 95% CI 1.6–5.1) and follow-up (OR 3.3; 95% CI 2.1–5.2).

Scholastic variables were systematically related to HD prevalence at study baseline with higher odds for HD in children who reported lower GPA (OR 1.4, 95% CI 1.1–1.8), those who were more absent from school (OR 1.9, 95% CI 1.4–2.5), who had more unexcused school absences (OR 1.5, 95% CI 1.2–2.7), and who reported lower behavioral grade (OR 1.6, 95% CI 1.1–2.1). Sport factors were positively correlated with HD at study baseline. Namely, those children who were currently involved in team sports (OR 2.3, 95% CI 1.2–4.7), who reported longer experience in sports (OR 1.4, 95% CI 1.4–1.8), and who had participated in more training sessions weekly (OR 1.6, 95% CI 1.2–2.1) were more likely to be engaged in HD (Table 1).

Scholastic achievement was associated with HD at follow-up (ORs: 1.3, 2.4, 1.5, 1.7; 95% CIs: 1.1–1.6; 1.9–3.0, 1.2–1.7, and 1.3–2.2, for GPA, school absences, unexcused school absences, and behavioral grade, respectively) with higher odds for HD among those who performed poorly in school. There was no significant association between the sport factors at baseline and HD at follow-up (Table 2).

Higher odds for HD initiation during the course of the study were found for adolescents who reported lower GPAs (OR 1.3, 95% CI 1.0–1.6), lower behavioral grades (OR 2.0, 95% CI 1.6–2.6), more frequent school absences (OR 1.4, 95% CI 1.2–1.7), and more unexcused school absences (OR 1.5, 95% CI 1.1–2.0) at study baseline. Sport factors observed at the baseline were not related to HD initiation during the course of the study (Table 3).

## Discussion

Although the majority of studied adolescents started to drink alcohol at the HD level before the study baseline, the prevalence of HD increased between testing periods. It is important to note that the results showed evident decreases in the prevalence of HD in comparison with reports from several years ago. Namely, 8% of adolescents reported HD at baseline, and 15% reported HD at follow-up, which is evidently lower than those from 2012 to 2013 when studies reported HD in more than 25% of 17- to 18-year-old

**Table 1** Results of the logistic regression for the criterion—harmful drinking at study baseline; Bosnia and Herzegovina 2015–2016

|                                          | Crude model <sup>a</sup> |                  |         | Model 1 <sup>b</sup> |                  |         |
|------------------------------------------|--------------------------|------------------|---------|----------------------|------------------|---------|
|                                          | $\chi^2$ ( $p$ )         | OR               | 95% CI  | $\chi^2$ ( $p$ )     | OR               | 95% CI  |
| Grade point average <sup>d</sup>         | 7.7 (0.01)               | 1.4              | 1.1–1.8 | 20.6 (0.01)          | 1.4              | 1.1–1.8 |
| School absences <sup>d</sup>             | 23.1 (0.01)              | 2.0              | 1.5–2.6 | 37.0 (0.01)          | 1.9              | 1.4–2.5 |
| Unexcused school absences <sup>d</sup>   | 16.4 (0.01)              | 1.5              | 1.3–1.8 | 27.8 (0.01)          | 1.5              | 1.2–1.7 |
| Behavioral grade <sup>d</sup>            | 11.1 (0.01)              | 1.8              | 1.3–2.3 | 23.2 (0.01)          | 1.6              | 1.1–2.1 |
| Participation in individual sports       | 5.3 (0.07)               |                  |         | 18.8 (0.01)          |                  |         |
| Never                                    |                          | REF <sup>c</sup> |         |                      | REF <sup>c</sup> |         |
| Quit                                     |                          | 1.8              | 0.9–3.6 |                      | 1.3              | 0.7–2.7 |
| Yes, currently                           |                          | 1.8              | 0.9–3.2 |                      | 1.6              | 0.9–2.9 |
| Participation in team sports             | 12.2 (0.04)              |                  |         | 22.9 (0.01)          |                  |         |
| Never                                    |                          | REF <sup>c</sup> |         |                      | REF <sup>c</sup> |         |
| Quit                                     |                          | 2.5              | 1.2–5.4 |                      | 1.8              | 0.8–3.9 |
| Yes, currently                           |                          | 3.1              | 1.5–5.8 |                      | 2.3              | 1.2–4.7 |
| Experience in sports <sup>d</sup>        | 14.1 (0.01)              | 1.5              | 1.2–1.9 | 22.8 (0.01)          | 1.4              | 1.1–1.8 |
| Results achieved in sports <sup>d</sup>  | 5.6 (0.01)               | 1.5              | 1.1–2.2 | 19.3 (0.01)          | 1.4              | 0.9–1.9 |
| Number of training sessions <sup>d</sup> | 17.7 (0.01)              | 1.7              | 1.4–2.6 | 25.2 (0.01)          | 1.6              | 1.2–2.1 |

$\chi^2$ —Chi-square numerical value,  $p$ —level of significance, OR odds ratio, CI confidence interval

<sup>a</sup>Non-adjusted logistic regression, <sup>b</sup>logistic regression model adjusted for gender, age, and socioeconomic status, <sup>c</sup>reference value, <sup>d</sup>presents variables observed as continuous for the purpose of the logistic regression calculation



**Table 2** Results of the logistic regression for the criterion—harmful drinking at study follow-up; Bosnia and Herzegovina 2015–2016

|                                          | Crude model <sup>a</sup> |                  |         | Model 1 <sup>b</sup>  |                  |         |
|------------------------------------------|--------------------------|------------------|---------|-----------------------|------------------|---------|
|                                          | $\chi^2$ ( <i>p</i> )    | OR               | 95% CI  | $\chi^2$ ( <i>p</i> ) | OR               | 95% CI  |
| Grade point average <sup>d</sup>         | 7.0 (0.01)               | 1.4              | 1.2–1.7 | 30.3 (0.01)           | 1.3              | 1.1–1.6 |
| School absences <sup>d</sup>             | 41.0 (0.01)              | 2.5              | 2.0–3.1 | 59.4 (0.01)           | 2.4              | 1.9–3.0 |
| Unexcused school absences <sup>d</sup>   | 18.3 (0.01)              | 1.6              | 1.4–1.9 | 36.69 (0.01)          | 1.5              | 1.2–1.7 |
| Behavioral grade <sup>d</sup>            |                          | 2.1              | 1.5–2.5 |                       | 1.7              | 1.3–2.2 |
| Participation in individual sports       | 0.7 (0.81)               |                  |         | 29.9 (0.01)           |                  |         |
| Never                                    |                          | REF <sup>c</sup> |         |                       | REF <sup>c</sup> |         |
| Quit                                     |                          | 1.1              | 0.6–1.7 |                       | 1.3              | 0.8–2.2 |
| Yes, currently                           |                          | 0.8              | 0.5–1.3 |                       | 1.4              | 0.8–2.3 |
| Participation in team sports             | 3.1 (0.11)               |                  |         | 26.2 (0.01)           |                  |         |
| Never                                    |                          | REF <sup>c</sup> |         |                       | REF <sup>c</sup> |         |
| Quit                                     |                          | 1.2              | 0.7–1.9 |                       | 1.5              | 0.9–2.4 |
| Yes, currently                           |                          | 1.5              | 0.6–2.1 |                       | 1.6              | 0.6–2.2 |
| Experience in sports <sup>d</sup>        | 0.2 (0.81)               | 1.2              | 1.0–1.4 | 28.2 (0.01)           | 0.9              | 0.8–1.2 |
| Results achieved in sports <sup>d</sup>  | 10.6 (0.01)              | 1.6              | 1.3–2.1 | 31.7 (0.01)           | 1.3              | 0.9–1.8 |
| Number of training sessions <sup>d</sup> | 1.2 (0.66)               | 1.3              | 1.1–1.6 | 26.1 (0.01)           | 1                | 0.8–1.3 |

$\chi^2$ —Chi-square numerical value, *p*—level of significance, *OR* odds ratio, *CI* confidence interval

<sup>a</sup>Non-adjusted logistic regression, <sup>b</sup>logistic regression model adjusted for gender, age, and socioeconomic status, <sup>c</sup>reference value, <sup>d</sup>presents variables observed as continuous for the purpose of the logistic regression calculation

**Table 3** Results of the logistic regression for the criterion—initiation of harmful alcohol drinking during the course of the study; Bosnia and Herzegovina 2015–2016

|                                          | Crude model           |                  |         | Model 1               |                  |         |
|------------------------------------------|-----------------------|------------------|---------|-----------------------|------------------|---------|
|                                          | $\chi^2$ ( <i>p</i> ) | OR               | 95% CI  | $\chi^2$ ( <i>p</i> ) | OR               | 95% CI  |
| Grade point average <sup>d</sup>         | 7.1 (0.01)            | 1.3              | 1.1–1.6 | 30.2 (0.01)           | 1.3              | 1.0–1.6 |
| School absences <sup>d</sup>             | 41.0 (0.01)           | 2.2              | 1.7–2.8 | 59.4 (0.01)           | 2.0              | 1.6–2.6 |
| Unexcused school absences <sup>d</sup>   | 18.2 (0.01)           | 1.5              | 1.3–1.8 | 36.6 (0.01)           | 1.4              | 1.2–1.7 |
| Behavioral grade <sup>d</sup>            | 12.1 (0.01)           | 1.7              | 1.3–2.2 | 33.0 (0.01)           | 1.5              | 1.1–2.0 |
| Participation in individual sports       | 0.1 (0.84)            |                  |         | 29.4 (0.01)           |                  |         |
| Never                                    |                       | REF <sup>c</sup> |         |                       | REF <sup>c</sup> |         |
| Quit                                     |                       | 1.5              | 0.7–1.9 |                       | 1.4              | 0.5–2.0 |
| Yes, currently                           |                       | 1.5              | 0.4–2.2 |                       | 1.5              | 0.4–2.4 |
| Participation in team sports             | 1.8 (0.17)            |                  |         | 25.6 (0.01)           |                  |         |
| Never                                    |                       | REF <sup>c</sup> |         |                       | REF <sup>c</sup> |         |
| Quit                                     |                       | 1.0              | 0.7–1.4 |                       | 1.1              | 0.6–1.5 |
| Yes, currently                           |                       | 1.1              | 0.7–1.6 |                       | 1.1              | 0.6–1.7 |
| Experience in sports <sup>d</sup>        | 0.2 (0.66)            | 1.0              | 0.8–1.3 | 28.2 (0.01)           | 0.8              | 0.7–1.1 |
| Results achieved in sports <sup>d</sup>  | 0.3 (0.51)            | 0.8              | 0.6–1.1 | 22.1 (0.01)           | 0.8              | 0.5–1.2 |
| Number of training sessions <sup>d</sup> | 1.3 (0.26)            | 1.1              | 0.9–1.4 | 26.1 (0.01)           | 0.9              | 0.7–1.1 |

$\chi^2$ —Chi-square numerical value, *p*—level of significance, *OR* odds ratio, *CI* confidence interval

<sup>a</sup>Non-adjusted logistic regression, <sup>b</sup>logistic regression model adjusted for gender, age, and socioeconomic status, <sup>c</sup>reference value, <sup>d</sup>presents variables observed as continuous for the purpose of the logistic regression calculation

adolescents (Sekulic et al. 2012; Zenic et al. 2015a). Therefore, although this study involved adolescents from only two Cantons in the country, it seems that recent public health efforts aimed at reducing alcohol drinking in the

country were effective. This reduction is almost certainly connected to strict controls in selling alcoholic beverages to minors (e.g., younger than 18 years).

We can underline strong associations between scholastic (educational) variables and alcohol drinking habits in adolescents. In brief, all scholastic variables were negatively correlated with HD at the study baseline and at follow-up, with poorer academic achievement in children who reported HD. Therefore, our findings are actually in agreement with most of the previous investigations that examined this problem where authors depicted negative associations between drinking alcohol and educational achievement (Balsa et al. 2011; Mazur et al. 2016b; Sekulic et al. 2012). However, the causality between drinking alcohol and educational variables are rarely investigated, mostly because identification of the cause–effect relationship calls for a prospective study design. Therefore, the true “mechanism” of the influence is understudied and still relatively unknown. In short, alcohol consumption may cause different types of physiological losses and consequently result in alterations in cognitive functions (Magrys and Olmstead 2014; Silva et al. 2017). The physiological background of such influence is still not sufficiently explored, and potential explanations include the depressive influence of alcohol on the central nervous system, reticular formation, spinal cord, cerebellum, and cerebral cortex, as well as the negative influence of alcohol on the neuro-transmitting capacity in humans (Most et al. 2014; Silva et al. 2017). Consequently, if such physiological explanations are accepted, poor educational achievement in adolescents should be considered “an effect” of alcohol consumption.

It is also possible that educational achievement could be observed as “a cause” of increased alcohol consumption in adolescents due to sociocultural origins (i.e., sociocultural influence). In short, the strong relationship between educational failure observed by low grade point averages (GPAs) and absences from school is well known (Steward et al. 2008). Additionally, children with lots of school absences are more likely to be exposed to negative social influences, including an increased possibility to consume alcohol or other drugs (Kerfoot and Butler 1988). Indeed, in adolescence, individuals identify with particular groups of peers, and being a member of a social network directly and indirectly affects a person’s values, as well as their attitudes and the norms to which they are exposed (Moore and Werch 2005). Therefore, it is not hard to observe that those adolescents who are out of school (probably even because of their poor GPA) have a higher risk of drinking alcohol at a harmful level. This is even more possible in communities where school (i.e., teaching) is organized in two shifts and considering that skipping school likely occurs in the late afternoon and early night, such as in Bosnia and Herzegovina.

As they are actively involved in the educational system in Bosnia and Herzegovina, the authors of this research are

convinced as to why “nonstandard” variables of educational achievement (i.e., behavioral grade, school absence), and not GPA, are the strongest predictors of HD and HD initiation. Although GPA is supposed to be a general measure, in the studied country, it is not an objective tool to measure academic achievement. The fact that almost 40% of the studied students reported the highest GPAs (i.e., excellent; grade A on a five-point scale) at the study baseline, with an additional 40% who reported “grade B,” speaks for itself. Compared with the results from studies of the other parts of former Yugoslavia, where an equal system of academic evaluation is used, it seems that this is a general problem in this type of analysis (Bjelica et al. 2016; Tahiraj et al. 2016). In brief, practically in all studies done in the region where authors reported GPAs, the tendency toward better grades is evident (Bjelica et al. 2016; Idrizovic et al. 2015; Modric et al. 2011; Tahiraj et al. 2016; Zenic et al. 2015a).

Our results showed positive correlation between sport participation and alcohol drinking at study baseline, and this is not surprising. Indeed, the investigations already pointed to higher levels of alcohol consumption in adolescents who were engaged in some form of sport compared to those who were not involved in sport activities (Lisha and Sussman 2010; Modric et al. 2011). However, not all studies confirmed a higher risk of alcohol consumption in adolescents engaged in sports, while in some studies, sports participation was found to be protective against alcohol use (Donato et al. 1994). Among others, our results showed relationships between sport participation factors and HD at study baseline (i.e., when participants were 16 years old), with a higher occurrence of HD in adolescents who had a higher number of training sessions per week. This finding is in accordance with previous reports where authors reported a correlation between drunkenness and the frequency of participation in sports among French adolescents (Peretti-Watel et al. 2002). Additionally, our results point to another important relationship. Briefly, a higher risk of HD is demonstrated in adolescents who were more experienced in sports. Therefore, long and intensive sport participation is a risk factor for HD at the study baseline.

However, the relationships between sport factors and HD were not present at follow-up. Additionally, there was no significant association between sport factors and initiation of HD over the course of the study. Together, these results suggest specific associations between sports participation and HD. Athletic adolescents evidently started to consume alcohol at the level of HD at an earlier age compared to their non-athletic peers (i.e., before 16 years of age), which is evident on a basis of significant cross-sectional analyses at the study baseline. However, alcohol consumption in non-athletic adolescents increased in the

forthcoming period of life (from 16 to 18 years of age), resulting in a nonsignificant relationship between sport factors and HD at follow-up. This probably even explains some contradictory findings of previously cited investigations where authors reported opposite associations between sports participation and drinking alcohol (Donato et al. 1994; Modric et al. 2011; Peretti-Watel et al. 2002). Namely, it seems that associations between sports factors and drinking alcohol vary not only as a function of gender (Modric et al. 2011) and/or sport type (Cerkez et al. 2015) but also as a function of age. Even in our study where adolescents were tested on two occasions separated by less than 2 years, the associations between sport factors and HD prevalence changed considerably over the two testing waves.

The main explanation for the earlier initiation of HD among athletic adolescents should be found in the social context of sport participation. In brief, adolescents involved in sports are more frequently in out-of-home situations (because of training or competition) but are also frequently in social situations when alcohol consumption is common (after competition or training sessions (O'Brien 1993; Sekulic et al. 2014). In the entire former Yugoslavia territory, including Bosnia and Herzegovina, beer consumption is frequently considered a regular behavioral norm in social gatherings and celebrations after sporting events. While it is not uncommon that beer manufacturers and suppliers are significant financial sponsors of sport teams, the association between alcohol and sports is a problem that is recognized around the world (Overman and Terry 1991). Indeed, alcohol became an undividable part of the sports culture (Jones 2010). It is well known that peer pressure is a predictor of the misuse of substances (including alcohol) (Dumas et al. 2012). Naturally, it is logical that once the consumption of alcohol is a part of the sports culture, adolescents involved in sports would behave similarly to their peer mainly because they naturally tend to promote social bonds and connections (Bedendo et al. 2013). In youth sports and at the age observed in this study (16 to 18 years), it is even more apparent because of age-related bonding in sports competition (i.e., sport competitions and training are organized for certain ages). Accordingly, athletes between the ages of 15 and 16 years compete (and practice) together with their somewhat older peers (18 years of age), allowing the younger athletes to have easier access to alcoholic drinks, which is further aggravated by the legal drinking age in the country (i.e., 18 years). Such contact with older peers and the consequent peer pressure is even more common in younger athletes who are more successful (in a term of competitive achievement). In short, younger athletes who excel at sports are involved in training and competition with their

older peers, which increases the chances for earlier contact with alcohol.

The main limitations of this study come from the fact that the data were self-reported. Therefore, participants may not tell the truth if they felt uncomfortable. However, as the study was strictly anonymous and conducted in a country where drinking alcohol is a socially accepted behavior, the possibility that participants did not respond honestly is lower. Studied sport factors included only questions on formal sport participation, while some other important factors related to sport involvement (exercising in gyms and fitness centers, self-exercising, etc.) were possibly not evaluated. This study observed adolescents from 16 to 18 years of age, while the majority of participants initiated alcohol drinking at an earlier age. Therefore, the generalizability of the results is limited to this age group. Finally, this study was primarily designed as descriptive investigation and therefore was unable to capture the hierarchical and clustered nature of the specific relationship between predictors and criterion, which should be more specifically evidenced in future investigations.

This is one of the first studies to prospectively investigate the predictors of alcohol drinking behavior in southeastern Europe and the first study to investigate it in the former Yugoslavia territory, where the prevalence of drinking alcohol in adolescents is alarmingly high. Additionally, the important strengths of the study are its high retention rate (85% of the adolescents were studied at baseline and follow-up) and its low rate of missing data.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** The study has been approved by the Ethics Board of the University of Mostar, School of Medicine Mostar, Bosnia and Herzegovina. All data are anonymized to prevent any potential identification of individual respondents.

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