The Role of Physical Activity in the Relation between Compensatory Health Beliefs and Alcohol Consumption among Young Adults

BACHELORTHESIS

Jannik Scheffels

s1454285

Enschede, June 2016

Health Psychology

Behavioral Sciences

Department of Psychology

Supervisors:

Dr. M. E. Pieterse

Dr. P. M. ten Klooster

UNIVERSITY OF TWENTE.

Abstract

Heavy alcohol drinking among young adults is a prevalent public health problem in most Western countries such as the Netherlands. Compensatory health beliefs (CHBs) may play an important role in the consumption of alcohol. CHBs are beliefs that negative effects of volitional unhealthy behaviours can be compensated for by engaging in another, volitional healthy behaviour. This may cause health problems in the long run, especially when continuously carrying out unhealthy behaviour and not engaging in the planned healthy behaviour.

This study examined the relationship between PA-CHBs (compensation of alcohol consumption by performing physical activity) as well as other CHBs and alcohol consumption among young adults. It specifically focused on the role of physical activity and gender in this relationship. Past research indicated that CHBs are positively related to the consumption of alcohol, that physical activity may play a role in this relationship, and that there are gender differences in both physical activity and the consumption of alcohol.

An online survey study was conducted during April and May 2016 (n = 209). It was found that PA-CHBs as well as total CHBs were significantly positively related to alcohol consumption (r = .34; r = .21), whereas other CHBs were only marginally significantly positively related (r = .13). There was a significant moderation effect of physical activity on the relationship between total CHBs and alcohol consumption. Thus, the effect of CHBs on alcohol consumption was stronger for people with high physical activity than for those with lower physical activity. This moderation effect was also found for PA-CHBs, but inversely for males and females. Whereas PA-CHBs predicted alcohol consumption when males were engaged in low and moderate physical activity, they were predictive when females were moderately and highly physically active. Thus, both physical activity and gender had an influence here.

The current study revealed interesting insights with regard to the association between CHBs and the consumption of alcohol among young adults. It was the first to investigate the role of physical activity in this relationship. It also demonstrates the importance of using more specific CHB scales, tailored to the context that is examined, which might result in stronger relations. In order to reduce the consumption of alcohol among young adults, informing them about especially incorrect CHBs could serve as a starting point. Additionally, engagement in physical activity and related gender differences should be taken into account when dealing with this issue.

Keywords: compensatory health beliefs, alcohol consumption, physical activity, young adults, health behaviours**,** gender.

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1. Introduction

Health behaviours and their consequences for health outcomes are gaining ever more attention in our life (Knäuper, Rabiau, Cohen, & Patriciu, 2004). Research by McGinnis and Foege (1993) showed that major contributors to morbidity and mortality are life-style factors such as smoking, dieting and activity patterns, alcohol consumption, and illicit use of drugs. However, in an increasingly sedentary nature of our life and a decrease in physical activity throughout life due to changing modes of transportation and many forms of work (Berli, Loretini, Radtke, Hornung, & Scholz, 2014), executing healthy behaviours in daily life becomes more and more challenging. According to Knäuper and colleagues (2004), people are well aware of which behaviours have positive or negative effects on their health but they often fail to execute healthy or inhibit unhealthy behaviours. For example, despite the fact that drinking alcohol has negative health effects, it is consumed for reasons such as relaxation, enjoyment and sociability (Davoren, Cronin, Perry, Demant, Shiely, & O'Connor, 2015).

This study aims at explaining this discrepancy by especially focussing on the consumption of alcohol, which has been consistently regarded as an important risk factor for chronic diseases such as hypertension and diabetes (Zhang, Shu, Si, Yu, Liao, Gao, Zhang & Zheng, 2015). In 2006, the Dutch Health Council ("Gezondheidsraad") advised males to not drink more than 14 units and females to not drink more than seven units of alcohol per week (Gezondheidsraad, 2006), with one unit representing ten grams of pure alcohol. However, around 14 percent of Dutch men and 10.5 percent of Dutch women failed to adhere with this recommendation in 2007 (Schulz, Kremers, & de Vries, 2012). In 2015, the guideline was even sharpened. Since then, it is advised to not drink alcohol at all or at least no more than one unit per day, which is a maximum of seven units per week for both men and women (Gezondheidsraad, 2015). When someone drinks more than six units of alcohol on one occasion, the Dutch Health Councils is speaking of binge drinking.

Non-adherence to alcohol consumption guidelines can lead to several health problems, especially during adolescence, since this represents a period of significant neurodevelopment and increased vulnerability to alcohol's neurotoxic effects. Therefore, even seemingly modest doses of alcohol may have great impact on developing adolescents' brains (Jones, Cservenka, & Nagel, 2016). Besides neurophysiological consequences for adolescents, extreme forms of alcohol consumption ("binge drinking") increase the risk of dying from alcohol poisoning or fatal traffic accidents (Veliz, McCabe, & Boyd, 2016), thereby also affecting young adults. According to Turrisi, Mallett, Mastroleo and Larimer (2006), heavy drinking among college

students is a major social problem in the United States. As they put it: “twenty years of research has revealed that the highest proportion of heavy drinkers and individuals with diagnosable alcohol-use disorders and multiple substance dependencies are in the age range encompassing over 90% of all enrolled college students, the majority of these individuals being between the ages of 18 and 21” (p. 401). However, alcohol use among young adults is not only a prevalent public health problem in the United States but also in most Western countries such as the Netherlands (Voogt, Poelen, Kleinjan, Lemmers, & Engels, 2013).

1.1 Compensatory Health Beliefs (CHBs)

Individuals have to make many decisions regarding their own health, throughout daily life. For instance, people must consider whether to eat the delicious-looking cookies right on the table, despite the fact that they are unhealthy. Especially when holding specific goals concerning their own health, individuals are torn between their long-term dieting goals and giving in to the immediate temptation. This pattern can not only be observed in eating behaviour but also in other behaviours such as smoking cigarettes, having a drink or taking the car instead of the bicycle for short distances.

One reason for such “self-defeating” or “maladaptive” behaviours (as they seem to the outside observer) is that they depend on the time that goes by until a certain positive or negative consequence occurs. As Hall and Fong (2007) put it “the rationality of human [health] behaviour largely depends on the temporal frame adopted” (p. 6). According to them, “maladaptive” behaviours are mostly driven by a favourable balance of immediate costs and benefits. For instance, drinking alcohol might be associated with few costs (e.g. headaches the next day) and many benefits (e.g. relaxation and sociability) for the individual at the time of action but substantial long-term costs (such as coronary heart disease) and few (if any) benefits in the future. In contrast, many “adaptive” behaviours such as being physically active are associated with substantial costs (e.g. having less time for other things or having to take the long way to the gym) and few benefits (e.g. feeling good after exercising) at the time of activation, which can result in knowing “what is good for me” but not doing it.

Such behaviour patterns might not only be explained by their requirement of active self-regulation (Hall & Fong, 2007), but also by the fact that people act following the so-called hedonic principle, which means that “individuals strive to achieve an ideal balance between fulfilling their desires and pursuing their goals” (Radtke & Rackow, 2014, p. 12413). Thus, they seek to maximize pleasure and minimize harm. For instance, a person could choose to drink alcohol on a party because he or she is offered a drink. Simultaneously, the same person

could strive to live a healthier life. Because he or she is aware that consuming alcohol is counterproductive for reaching this goal, the person might be motivated to seek and implement a strategy to mitigate this inner conflict. According to Rabiau, Knäuper and Miquelon (2006), activating compensatory health beliefs (CHBs) is an effective strategy for realizing this. For instance, in the previous example of being torn between the cognition that the consumption of alcohol would be pleasurable and the conflicting cognition that alcohol will be a hindrance of reaching the goal of being healthier, the person might tend to think that having a drink would be fine as long as he or she will go to gym the next day. This might protect the body from negative effects of alcohol. In other words, the person tends to think that "the [harmful] effects of a volitional unhealthy behaviour can be compensated for, or 'neutralized', by engaging in another, volitional healthy behaviour" (Rabiau, Knäuper, & Miquelon, 2006, p. 140).

CHBs can be activated both before (in anticipation of) and after (as the consequence of) engaging in the unhealthy behaviour, creating the cognitive dissonance. This cognitive state can be perceived due to a variety of reasons. For instance, the unhealthy behaviour can violate a valued self-perception (e.g. being somebody who wants to stay healthy), differ with self-expectations (e.g. trying to be healthier) or might be feared to cause illness (Knäuper et al., 2004). According to Knäuper and colleagues (2004), using CHBs "is thus an automatic motivated regulatory process that functions to reduce cognitive dissonance by justifying unhealthy behaviour choices with the plan to engage in healthy behaviours" (p. 608). Another important aspect regarding CHBs is that they can be clearly distinguished from irrational health beliefs, which can also weaken the effect of health behaviours (e.g. believing that smoking cigarettes is safe because of the own family history). Knäuper and colleagues (2004) mentioned two reason why these beliefs are different from CHBs. First, CHBs are not always irrational or wrong, but may (partly) be accurate. For instance, the belief that perfect hygiene behaviour might prevent infections, which makes vaccination unnecessary, is an accurate compensatory health belief (Ernsting, Schwarzer, Lippke, & Schneider, 2012). Secondly, they differ in the type of cognition. Whereas irrational health beliefs are outcome expectancies, CHBs function as justifications of unhealthy behaviours or they are used to annihilate such outcome expectancies.

As a consequence, CHBs do not always result in negative effects on health. For instance, they might be accurate and therefore effectively neutralize the effects of the unhealthy behaviour. In addition, the person holding the CHBs might indeed follow through with the healthy (compensatory) behaviour. However, those two conditions often do not apply. In these cases, continuously carrying out the unhealthy behaviour and not engaging in the planned

healthy behaviour usually results in negative health effects in the long run (Knäuper et al., 2004).

1.2 CHBs and health-related behaviours

Past research has especially focussed on the impact of CHBs on both unhealthy behaviours such as smoking or eating high caloric food, and healthy behaviours such as fruit and vegetable consumption or physical activity. For instance, research has shown that holding more CHBs is associated with lower readiness and lower intentions to quit smoking, and that they are positively related to the intake of high caloric food and to poor diabetes self-management (Radtke & Rackow, 2014). Supporting these results, Kronick, Auerbach, Stich and Knäuper (2011) found that CHBs were predictive of caloric intake in dieters. Furthermore, CHBs have been found to be associated with lower adherence to self-set dieting rules and lower adherence of adolescents with type 1 diabetes to treatment (Berli et al., 2014). Another study of Storm, Reinwand, Wienert, Kuhlmann, de Vries and Lippke (2016) revealed that CHBs are negatively correlated with intentions to eat fruit and vegetables when levels of self-efficacy were particularly low. In addition, Kaklamanou and Armitage (2012) showed that if exercise is believed to compensate for unhealthy behaviours, people consumed fewer fruits and were less engaged in moderate physical activity. Furthermore, according to Berli and colleagues (2014), "holding CHBs is rather counterproductive as higher CHBs go along with lower intentions and a reduction in intentions to be physically active" (p. 469). However, in their research, physical activity was not significantly predicted by CHBs. Regarding the relationship between alcohol consumption and CHBs among people between 18 and 74 years of age, a study by Kaklamanou and Armitage (2012) indicated a positive association between CHBs and alcohol consumption. In addition, they found that more alcohol was consumed especially when sleep was believed as an effective compensatory strategy. A study by Knäuper and colleagues (2004) indicated that substance use related CHBs were highly positively correlated with risk behaviour such as the consumption of alcohol. In addition, they found that participants with strong CHBs showed lower self-efficacy toward alcohol resistance.

1.3 Alcohol consumption and physical activity

It is unclear why especially young people engage in drinking large amounts of alcohol. One reason might be that they are under greater influence of peers and that their risk taking behaviour increases during adolescence, including experimentation with alcohol (Bedendo & Noto, 2016; Jones et al., 2016). This period is also important because it sets the stage for future

alcohol-related behaviour. According to Turrisi and colleagues (2006), excessive alcohol drinking in college represents a continuation or even an escalation of drinking patterns for many students.

To investigate possible factors influencing alcohol consumption among young people, Bedendo and Noto (2015) focussed on alcohol consumption and its relationship with different sorts of sports, assuming that drinking alcohol can be used to encourage or strengthen group bonds among sport players. They found that more frequent sports practice was indeed positively associated with the consumption of alcohol, including heavy episodic drinking. However, professional participation in sport was less related to alcohol consumption. Regarding the type of sport, Zhou, Heim and O'Brien (2015) found that team sports players showed greater rates of alcohol consumption and were more likely to be categorized as heavy drinkers than individual sports players. In contrast to these findings, a study by Nelson and Gordon-Larsen (2006) indicated that participation in a range of physical-activity-related behaviours such as skating and sport participation was associated with higher grades, self-esteem and a favourable adolescent risk profile, including decreased use of substances. In another study concentrating on physical activity and food intake, Werle, Wansink and Payne (2010) found that people do not only increase energy intake after exercising, by serving themselves more snacks, but also after simply reading about physical activity. This means that even thinking about exercising might lead to a higher caloric intake among people who are unable to estimate the caloric content of food. Since energy intake in general increases after (reading about) exercising, this result might also apply to a higher caloric intake by means of the consumption of alcoholic drinks. Especially people who do not know much about the caloric density of foods and beverages might underestimate the caloric content that alcohol entails and therefore increase their energy intake with it after being physically active.

1.4 Aim of the study

Because little is known about the association of CHBs with alcohol consumption, and which role physical activity really plays in this relationship, the current study focused on this issue. Here, physical activity refered to each behaviour resulting in all kinds of movements that contribute to the total energy consumption. It covers all large muscle movements carried out throughout the day, for each purpose (Bauman, Schoeppe, & Owen, 2006), which also includes goal-directed and repetitive body movements in order to improve one's cardiorespiratory fitness (also known as exercise). This study distinguished between "physical activity as compensation for alcohol use" CHBs (PA-CHBs) and other CHBs. In other words, PA-CHBs are defined here

as beliefs that the consumption of alcohol can be compensated by being physically active. This is, however, at least partly inaccurate. Without a doubt, being physically active is an effective behaviour in maintaining or improving general health. In addition, it might prevent overweight by burning calories, which are taken in due to the consumption of alcohol. Nevertheless, it does not protect the individual from possible other health risks or harms such as coronary heart disease or alcoholic cirrhosis, which the consumption of alcohol brings along (Grönbaek, 2009). In this study, the term "other CHBs" means all other compensatory beliefs, as defined above. When the terms "total CHBs" or just "CHBs" are used, all CHBs in general (thus PA-CHBs as well as other CHBs) are meant.

The main purpose of this study was to investigate the association of CHBs with the consumption of alcohol among young adults (between 18 and 25 years of age). It was chosen for this target group because, as previously noted, alcohol consumption in this age group is a great problem. The research question therefore was: do CHBs predict alcohol consumption among young adults? This study also aims to investigate possible factors (here: physical activity) that reinforce or attenuate the relationship between CHBs and unhealthy behaviours, especially alcohol consumption.

1.5 Hypotheses

Based on the findings previously described, it is expected in this study that holding CHBs is positively associated with the consumption of alcohol. In other words, the more an individual thinks that engaging in a healthy behaviour can compensate or neutralize the negative effects of drinking alcohol, the more of this substance and the more often it is consumed.

Hypothesis 1: CHBs are positively associated with alcohol consumption.

Furthermore, this research focussed on physical activity as the compensatory healthy behaviour, indirectly influencing the consumption of alcohol among young adults. This is because people who actually carry out compensatory behaviour (high physical activity) tend to legitimate their consumption of large amounts of alcohol with this behaviour more easily. This means that the more someone engages in physical activity, the more alcohol consumption is justified by holding CHBs. Thus, it is assumed that physical activity serves as a moderator for the relationship between CHBs and drinking alcohol.

Hypothesis 2: The effect of CHBs on alcohol consumption is stronger for people with high physical activity than for those with lower physical activity.

Based on the previously noted study by Berli and colleagues (2014), in which CHBs did not contribute to the prediction of physical activity significantly, it is assumed that CHBs do not predict physical activity directly.

Hypothesis 3: CHBs do not predict physical activity directly.

Furthermore, it is assumed that the moderation effect of physical activity on the relationship between CHBs and alcohol consumption is different for the type of CHBs that is measured. More specifically, the assumed relationship is expected to be stronger for the CHB items stating that alcohol consumption can be compensated by engaging in physical activity (PA-CHBs) rather than for other CHBs. The four hypotheses are illustrated in *Figure 1*.

Hypothesis 4: The moderation effect of physical activity on the relationship between CHBs and alcohol consumption is stronger for the physical-activity-specific CHB-subscale.

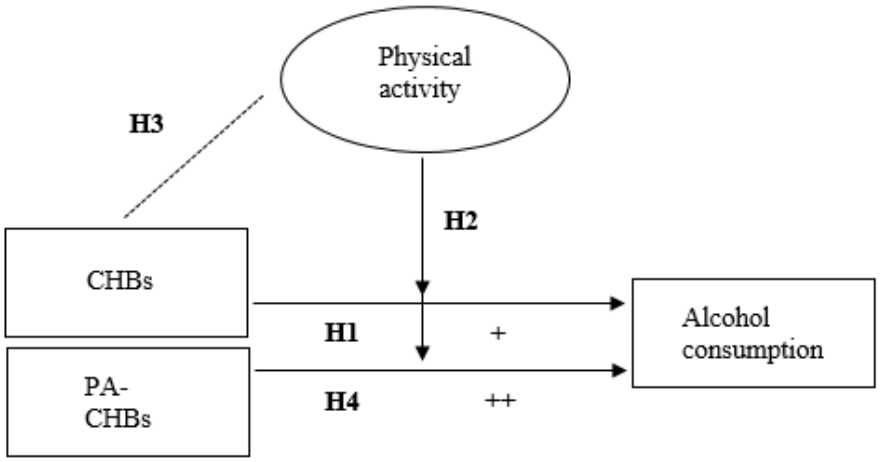

Figure 1. Hypothesis 1 to 4. This figure illustrates the assumed positive relationship of two different types of CHBs (PA-CHBs and other CHBs) with alcohol consumption among young adults, moderated by physical activity.

The assumed relationship between PA-CHBs and alcohol consumption, moderated by physical activity, could be influenced by demographical factors such as gender. Firstly, this might be the

case due to gender differences in holding CHBs. For instance, Knäuper and colleagues (2004) showed that males reported more or stronger CHBs than females. Secondly, this might be the case due to sex differences in engaging in health-related behaviours such as physical activity and alcohol consumption. For instance, a study by Poortinga (2007) revealed that high levels of physical activity were more prevalent among men. In concordance with this result, another study by Buscemi and colleagues (2011) has shown that males engaged in higher levels of both physical activity and alcohol consumption. Supporting these findings, research by Riedel (2016) indicated that explicit CHBs related to substance use contributed to the prediction of alcohol consumption, but only among male participants. Thirdly, there might be a sex difference in the purpose and handling of their compensatory strategies used to legitimate the consumption of alcohol. Bryant, Darkes and Rahal (2012) showed for example that women were more likely than men to make up for alcohol calories by eating low-calorie or low-fat food while drinking. Thus, females might rather compensate their alcohol consumption by regulating their eating behaviour while males might participate rather in sports. Based on these gender differences, it is expected that being male or female influences the moderation effect of physical activity on the relationship between PA-CHBs and the consumption of alcohol. The last hypothesis can be seen in *Figure 2*.

Hypothesis 5: The moderation effect of physical activity on the relationship between PA-CHBs and alcohol consumption is different for males and females.

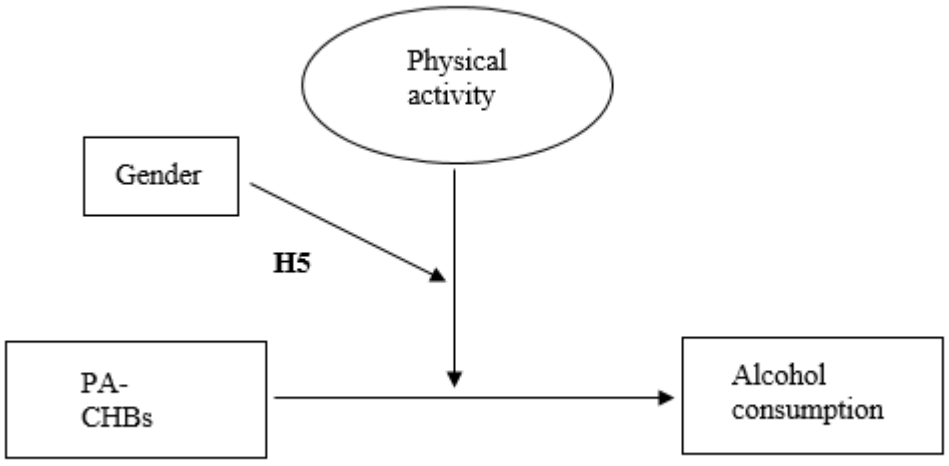

Figure 2. Three-way interaction. This figure illustrates the influence of gender on the moderation effect of physical activity in the assumed positive relationship between PA-CHBs and alcohol consumption among young adults (hypothesis 5).

2. Method

2.1 Participants and procedure

An online survey was set up with Qualtrics (https://www.qualtrics.com/) in order to collect data. The respondents were recruited online as well as face-to-face. Firstly, behavioural sciences students of the University of Twente, the Netherlands, were approached via the University's online participant pool SONA systems, which is a cloud-based participant management platform (https://www.sona-systems.com/). Secondly, people were approached via the social media platform Facebook by sending and sharing posts, which described the aim of the study and invited to voluntary participation. Besides contacting people online, some participants of the researchers' private network were invited face-to-face to join the study. The procedure was equal to all participants.

The cross-sectional study was conducted in April and May 2016. Participation took 15 minutes on average and was possible from the 1st of April to the 14th of May. As compensation, the behavioural sciences students of the University of Twente gained 0.25 credits, which have to be collected during the first two years in order to successfully graduate. People from other faculties and non-students did not receive any compensation for they participation.

The current study followed the standards for ethical conduct of scientific research and was approved by the Ethics Commission of the Faculty of Behavioural Sciences of the University of Twente on the 23rd of March, 2016. Participation in the study was voluntary and involved providing confidential responses to the questionnaire. In addition, all individuals were provided informed consent for the study and were treated in accordance with the ethical guidelines for the ethical conduct of scientific research.

After deciding to join the study and clicking on the link to the questionnaire, participants had to read the informed consent. When they agreed to take part in the study, the respondents were transferred to the actual questionnaire. Firstly, the participants had to answer questions about general demographical details, such as sex, age, nationality, education and current living situation (7 items). Then, questions about physical activity (7 items), CHBs (21 items) and alcohol consumption (6 items) followed. After filling in the questionnaire, the respondents were informed about the accomplishment of the survey and the opportunity to leave their email address for further interest in the study results. In addition, the email address of the researcher was reported to offer the opportunity of asking study-related questions or of requesting to delete their data.

2.2 Measures

The 41-item online questionnaire consisted of one general part concerning demographical details and another part consisting of items regarding physical activity, CHBs and alcohol consumption. The whole questionnaire was conducted in English language and can be seen in the Appendix.

2.2.1 Physical activity

In order to measure physical activity the short-form of the International Physical Activity Questionnaire (IPAQ) was used. The questionnaire consisted of seven items, divided into vigorous physical activity (e.g. heavy lifting), moderate physical activity (e.g. bicycling) and mild physical activity (walking). Subsequently, the respondents were asked about their sitting behaviour. For answering the questions, they had to indicate on how many days in the past week and how much time (in minutes per day) they usually spend with those activities per day. They also could answer that they are not sure. An example of a typical question is: "During the last 7 days, on how many days did you walk for at least 10 minutes at a time?" and "How much time did you usually spend walking on one of those days?" Questions of the latter sort were followed by a short example response in order to prevent mistakes in reporting time spend in physical activity.

Preliminary to computing a total physical activity score, the values were adjusted according to the IPAQ Scoring Protocol (IPAQ Research Committee, 2005). Based on this protocol a categorical score was calculated for low, moderate and high physical activity. In addition, a continuous total physical activity score (in minutes per week) was computed based on continuous scores for walking, moderate and vigorous activity. Research by Craig et al. (2003) has shown that the short version of the International Physical Activity Questionnaire has acceptable psychometric properties and that it is applicable to measure physical activity among people from 18 to 65 years of age in different contexts.

2.2.2 Compensatory health beliefs

CHBs were measured using the 17-item Compensatory Health Belief Scale as developed by Knäuper, Rabiau, Cohen and Patriciu (2004). A typical questions was "Relaxing in front of the TV can compensate for a stressful day." In order to create a physical-activity- and alcohol-specific CHB scale, the following four items were added: "If I am physically active during the week, I can drink more alcohol during the weekend", "Drinking alcohol in the evening can be compensated by bicycling or walking home afterwards", "Being physically active can

compensate for the effects of regularly drinking alcohol" and "Drinking alcohol on one day can be compensated by being physically active the next day". The final scale thus comprised 21 items in total, assessing various CHBs concerning compensatory behaviours such as sleeping, exercising, eating healthy, weight regulation and physical activity in general. Items about behaviours that had to be compensated concerned for instance smoking or alcohol and coffee consumption. Response options ranged from 1 (totally disagree) to 5 (totally agree). The scale did not distinguish between accurate and inaccurate health beliefs. The items were introduced by the original instructions of Knäuper and colleagues (2004). Research has shown that the Compensatory Health Beliefs Scale being used is a valid and reliable instrument for the measurement of explicit CHBs (Knäuper et al., 2004). In order to attain a total score on the original 17-item Compensatory Health Beliefs Scale, the individual scores were added and an average total score was computed for each respondent. Based on the four additional items, another physical-activity- and alcohol-specific CHBs score (compensating alcohol consumption with physical activity) was calculated in a similar procedure. A high score on each of the two scales represented many CHBs, whereas a low score represented a few CHBs. In the current study, Cronbach´s alpha for the internal consistency of the whole CHB scale was $\alpha = .79$. Cronbach's alpha for both the PA-CHBs subscale and the original scale by Knäuper and colleagues (2004) was $\alpha = .73$.

2.2.3 Alcohol consumption

In order to assess the alcohol consumption of the respondents, six items were selected from a Dutch Quantity-Frequency (QF) questionnaire developed to measure alcohol drinking patterns among adolescents (Korte, Pieterse, Postel, & van Hoof, 2012). The items were introduced by a short illustration of units of alcohol. Three pictures (of a full pint of beer, a glass of wine and a shot filled with spirituous liquor) were shown, explaining the number of units per kind of drink. Additionally, a short table with some examples (kinds of drinks and the units they entail, such as a bottle of wine, a mix-drink or a bottle of liquor) were shown in order to improve the validity of responses. The first item was about the lifetime prevalence of alcohol use and asked "Have you ever had an alcoholic drink (yes/no)?" People reporting "no" (code 0) were transferred to the next part of the questionnaire. All other respondents had to answer the next questions regarding alcohol consumption. The average weekly alcohol consumption frequency was assessed with four items. Two items asked about the number of weekdays (Monday through Thursday) on which the respondents usually drink alcohol (response options ranged from "4 days" to "I never drink on a weekday") and how many units of alcohol they usually drink on

such a weekday ("11 units or more per day" to "0 units per day"). The other two items asked about the number of weekend days on which they usually drink (Friday through Sunday) and the corresponding units of alcohol they drink. Regarding the frequency of drinking alcohol in the weekend, response options ranged from "3 days" (code 3) to "I never drink alcohol on weekend days" (code 0). Concerning the number of alcohol units, they ranged from "20 units or more per day" (code 20) to "0 units per day" (code 0). If the questions for instance were answered with "7-10 units per day", the mean was used as a code (code 8.5). Average weekday alcohol consumption was calculated by multiplying the number of weekdays the respondents had drunk alcohol and the number of units they had drunk. A similar procedure was used to estimate the weekend consumption. By adding the consumption on weekdays to that of the weekend, an average total weekly consumption of alcohol was calculated. The results ranged from 0 to 61.5 units of alcohol per week, with one unit representing 10g or 12cl of pure alcohol (van Laar et al., 2015), which is half a pint of beer (about 250ml). Respondents were divided into three categories, according to the UK government's guideline, which says that both men and women should not drink more than six pints of beer per week ("Alcohol unit guidelines", n.d.). Thus, they could fall in one of three categories: none (0 pint glasses, which is 0 units), moderate (1 – 6 pint glasses, which is 0.5 – 12 units) or high (more than 6 pint glasses, which is more than 12 units) alcohol consumption.

Finally, the respondents' monthly frequency of heavy drinking was assessed with the following question "In the last 4 weeks, how often did you drink six or more units of alcohol on one occasion (for example on a party or on an evening)?" Answers ranged from "1 time in the last 4 weeks" (code 1) to "9 or more times in the last 4 weeks" (code 9).

QF measures of alcohol consumption are most useful when a quick assessment of unpatterned drinking behaviour is needed (Sobell & Sobell, 1995), which applies to the current study. They also provide reliable information about the quantity and frequency of drinking days. In addition, the used alcohol consumption measure met many of the recommendations for measuring drinking patterns in adult general population surveys, provided after a thematic conference in Stockholm by the Centre for Social Research on Alcohol and Drugs (Dawson & Room, 2000). Therefore, the used alcohol consumption measure is suitable for the current study.

2.3 Analysis

The data analysis was conducted with the Statistical Package for the Social Science (SPSS 23). First of all, respondents who did not meet the inclusion criteria (such as being older or younger

than 18 to 25 years) were removed from the dataset. Then, demographic variables were analysed by means of descriptive statistics. The constructs measured by the questionnaire were tested for internal consistency reliability in terms of Cronbach's alpha (α). By using Pearson correlation coefficients, a correlational analysis was performed in order to assess the relationship between the constructs. To determine the significance of the results, the standard level of statistical significance was set at $p < .05$ (Cohen, Cohen, West, & Aiken, 2013). As recommended by Ellis (2010), the strength of the relationships between the constructs were descripted by effect sizes such as $r = .10$ (small effect size), $r = .30$ (medium effect size) and $r = .50$ (large effect size).

The next step was to conduct the appropriate analyses in order to test the five hypotheses. To explore the relationship between CHBs and alcohol consumption (hypothesis 1), a Pearson's correlation analysis was performed. In addition, the same analysis was done stratified by gender. In order to test if the relationship between CHBs and alcohol consumption is stronger for people with high physical activity than for those with lower physical activity (hypothesis 2), a moderation analysis was conducted using multiple regression analyses (Baron & Kenny, 1986). This was done by firstly transforming the scores on the CHB scale (independent variable; IV) and the physical activity scale (moderator variable; MV) into centred variables. Then, their interaction term was computed by creating a new predictor based on those two variables (centred IV multiplied by centred MV). Lastly, the IV, the predictor variables, and their interaction term were entered into a simultaneous regression model (Cohen et al., 2013), with alcohol consumption as the dependent variable (DV). This moderation analysis was done for the whole sample as well as for males and females separately. The next assumption, that CHBs do not predict physical activity directly (hypothesis 3), was tested with a Pearson's correlation analysis, both for the whole sample and stratified by gender. The assumption that the moderation effect of physical activity on the relationship between CHBs and alcohol consumption is stronger for the physical-activity-specific CHB-subscale (hypothesis 4) was tested with a similar procedure as used for the second hypothesis, but with the PA-CHBs as the IV. Again, this was done for the whole sample as well as for males and females separately. In addition, moderation analyses were conducted with binge drinking (instead of alcohol consumption) as the DV and respectively PA-CHBs as well as total CHBs as the IV. Both of these moderation analyses were then also stratified by gender. To test if the moderation effect of physical activity on the relationship between PA-CHBs and alcohol consumption is significantly different for males and females (hypothesis 5), a moderated moderation analysis (three-way interactions) was conducted with the PROCESS plug-in for SPSS, as developed by

Hayes (2013). Alcohol consumption was used as the IV, PA-CHBs as the DV and physical activity as well as gender as the MV.

3. Results

3.1 Descriptive statistics

A total of 258 respondents filled in the online questionnaire. Of them, a total of 49 respondents were excluded because they did not fill in the questionnaire completely (n = 39), did not meet the inclusion criterion of being above 18 years and under 25 years old (n = 8) or, as estimated based on the IPAQ Scoring Protocol (IPAQ Research Committee, 2005), reported unreasonably high physical activity (n = 9). As a result, a total of 209 respondents were included in the conducted analyses, with ages ranging between 18 and 25 years of age (M = 21.2, SD = 1.6). The majority of respondents (63%) were women (n = 132), 77 respondents were male (37%). The majority of respondents were students (n = 185, 88.5%). Of all people, 142 had a German (67.9%), 66 a Dutch (31.6%), and one an Italian (0.5%) nationality. Table 1 shows the means and standard deviations of the all measured constructs: CHBs, physical activity and alcohol consumption.

Table 1.

Descriptive statistics of CHBs, physical activity and alcohol consumption.

	Scale	Min	Max	Mean	SD
Total CHBs	1-5	1.00	4.00	2.55	0.47
PA-CHBs	1-5	1.00	4.25	2.19	0.78
Other CHBs	1-5	1.47	4.29	2.64	0.47
Physical activity[a]	1-3	1.00	3.00	2.34	0.59
Alcohol consumption[b]	1-3	1.00	3.00	2.18	0.54
Binge drinking[c]	1-9	1.00	9.00	2.41	1.98

Note. [a]3 categories of physical activity according to the IPAQ Scoring Protocol: low, moderate and high; [b]3 categories of alcohol consumption: none, moderate and high; [c]binge drinking frequency in the last 4 weeks.

3.2 Physical activity and alcohol consumption

The frequencies of physical activity, weekly alcohol consumption and binge drinking in the last four weeks, stratified by gender, are shown in Table 2. There was no significant difference for gender in physical activity ($\chi^2 = 3.47$, df = 2, p = .18). Among both males and females, most people fell in the moderate physical activity category (more than 50%) and the least in the

category of low physical activity (below 10%). Regarding the weekly frequency of alcohol consumption, there was a significant difference for gender (χ^2 = 19.91, df = 2, p < .001). As expected, male respondents consumed more alcohol and fell more often in the high alcohol consumption category (43%) than female respondents (15%). Man also engaged more often in binge drinking behaviour (M = 3.05, SD = 2.41) than females (M = 2.04, SD = 1.58). Concerning the consumption of alcohol, it is notable that men were almost equally present in both the moderate and high consumption category (51% and 43% respectively), whereas most women fell in the moderate category (77%) and only a few in the high category of alcohol consumption (15%). In addition, both males (39%) and females (55%) were mostly prevalent in the first category of binge drinking (0 to 1 time in the last 4 weeks).

Table 2.

Physical activity and alcohol consumption stratified by gender.

Physical activity[a] (%)			Alcohol consumption[b] (%)			Binge drinking[c] (%)		
Codes	Men	Women	Codes	Men	Women	Codes	Men	Women
Low	2 (2.6)	11 (8.3)	None	5 (6.5)	10 (7.6)	1	30 (39)	72 (54.5)
Moderate	40 (51.9)	72 (54.5)	Moderate	39 (50.6)	102 (77.3)	2	9 (11.7)	26 (19.7)
High	35 (45.5)	49 (37.5)	High	33 (42.9)	20 (15.2)	3	12 (15.6)	15 (11.4)
						4	12 (15.6)	7 (5.3)
						5	3 (3.9)	6 (4.5)
						6	2 (2.6)	3 (2.3)
						7	1 (1.3)	1 (0.8)
						8	3 (3.9)	1 (0.8)
						9	5 (6.5)	1 (0.8)
	χ^2 (df)	p		χ^2 (df)	p		t (df)	p
	3.47 (2)	.18		16.19***	< .001		3.67 (209) ***	< .001

Note. *p < .05, **p < .01, ***p <.001,

[a]Codes for physical activity according to the IPAQ Scoring Protocol; [b]Codes for alcohol consumption: none = 0 pint glasses per week, moderate = 1 – 6 pint glasses per week, high = more than six pint glasses per week; [c]Codes for binge drinking frequency: 1 = 1 time during the last four weeks, … - 9 = 9 times during the last four weeks.

3.3 Correlation analyses

A Pearson's correlation analysis was done between the different constructs. The results can be seen in Table 3. By means of this analysis, the hypothesis that CHBs are positively associated with alcohol consumption (hypothesis 1) was tested. Supporting this hypothesis, PA-CHBs

were indeed moderately positively correlated with alcohol consumption (r = .34, p < .001), whereas for other CHBs and alcohol consumption only a marginally significant positive correlation was found (r = .13, p = .06). Total CHBs had a significant weak positive correlation with alcohol consumption (r = .21, p = .002). Similarly, for binge drinking significant positive correlations were found for PA-CHBs (r = .32, p < .001) and total CHBs (r = .15, p = .03), but not for other CHBs (r = .07, p = .33). Thus, respondents holding more CHBs also had a higher binge drinking frequency as well as alcohol consumption in general.

Regarding the relationship between CHBs and physical activity (hypothesis 3), no significant correlation was found for PA-CHBs (p = .62), other CHBs (p = .96) as well as total CHBs (p = .84), and physical activity. This supports the third hypothesis. The results of the correlation analyses for the whole sample can be seen in Table 3.

Table 3.

Bivariate correlations of CHBs, physical activity and alcohol consumption in the total sample (n = 209).

		1	2	3	4	5
1	Total CHBs					
2	PA-CHBs	**.73*** **				
3	Other CHBs	**.96*** **	**.52*** **			
4	Physical activity[a]	-.01	-.04	-.004		
5	Alcohol consumption[b]	**.21** **	**.34*** **	.13	.05	
6	Binge drinking[c]	**.15** *	**.32*** **	.07	.05	**.58*** **

Note. *p < .05, **p < .01, ***p < .001,
[a]3 categories of physical activity according to the IPAQ Scoring Protocol: low, moderate and high; [b]3 categories of alcohol consumption: none, moderate and high; [c]binge drinking frequency in the last 4 weeks.

3.4 Correlation analyses stratified by gender

Table 4 and Table 5 show the descriptive statistics of CHBs, physical activity and alcohol consumption as well as the correlations between these constructs, stratified by gender. Whereas total CHBs and binge drinking correlated weakly but significantly in the whole sample and female subpopulation, no significant correlation was found between these two constructs in the male subpopulation (r = .08, p = .51). Furthermore, total CHBs and alcohol consumption were found to weakly and positively correlate in the whole sample (r = .21, p = .002) and the male subpopulation (r = .27, p = .02) but not among females (r = .15, p = .09). In addition, other CHBs and alcohol consumption marginally positively correlated with each other (p = .06), whereas no correlation is found for males (p = .18) and females (p = .27) separately. Finally,

correlations for both binge drinking and especially alcohol consumption with PA-CHBs were higher among males (r = .34; r = .44) than for females (r = .27; r = .24).

Table 4.

Descriptive statistics and bivariate correlations of CHBs, physical activity and alcohol consumption in the male subpopulation (n = 77).

		Scale	Min	Max	Mean	SD	1	2	3	4	5
1	Total CHBs	1-5	2.00	4.00	2.61	.46					
2	PA-CHBs	1-5	1.00	4.00	2.34	.77	**.68*** **				
3	Other CHBs	1-5	1.88	4.29	2.67	.47	**.96*** **	**.44*** **			
4	Physical activity [a]	1-3	1.00	3.00	2.43	.55	-.10	-.08	-.09		
5	Alcohol consumption[b]	1-3	1.00	3.00	2.36	.61	**.27***	**.44*** **	.16	.04	
6	Binge drinking[c]	1-9	1.00	9.00	3.05	2.41	.08	**.34****	-.04	-.04	**.61*** **

Note. *p < .05, **p < .01, ***p < .001,
[a]3 categories of physical activity according to the IPAQ Scoring Protocol: low, moderate and high; [b]3 categories of alcohol consumption: none, moderate and high; [c]binge drinking frequency in the last 4 weeks.

Table 5.

Descriptive statistics and bivariate correlations of CHBs, physical activity and alcohol consumption in the female subpopulation (n = 132).

		Scale	Min	Max	Mean	SD	1	2	3	4	5
1	Total CHBs	1-5	1.00	4.00	2.52	0.47					
2	PA-CHBs	1-5	1.00	4.25	2.10	.77	**.76*** **				
3	Other CHBs	1-5	1.47	3.59	2.62	.46	**.97*** **	**.57*** **			
4	Physical activity[a]	1-3	1.00	3.00	2.29	.61	.01	-.04	.03		
5	Alcohol consumption[b]	1-3	1.00	3.00	2.08	.47	.15	**.24*** **	.10	.01	
6	Binge drinking[c]	1-9	1.00	9.00	2.04	1.58	**.20***	**.27****	.14	.07	**.48*** **

Note. *p < .05, **p < .01, ***p < .001,
[a]3 categories of physical activity according to the IPAQ Scoring Protocol: low, moderate and high; [b]3 categories of alcohol consumption: none, moderate and high; [c]binge drinking frequency in the last 4 weeks.

3.5 Moderation analyses

The Pearson's correlation analyses revealed that CHBs correlated positively with the consumption of alcohol (hypothesis 1) but that they did not significantly correlate with physical activity (hypothesis 3). In addition, physical activity did not correlate with alcohol consumption. Although engagement in physical activity does not have a direct effect on the consumption of alcohol, it might have an indirect effect on the relationship between CHBs and

the consumption of alcohol among young adults. It is therefore considered as a possible moderator. This assumption was tested by means of multiple regression analysis, with firstly alcohol consumption as the dependent variable. Both alcohol consumption and physical activity were expressed in categorical scores (low, moderate and high) because their continuous scores were not normally distributed. As expected, the effect of the interaction between total CHBs and physical activity on alcohol consumption was significant (B = .33, SE = .14, β = .16, t = 2.35, p = .02). This means that the effect of CHBs on alcohol consumption is stronger for people with high physical activity than for those with lower physical activity, which supports the second hypothesis. The model explained a low proportion of variance in alcohol consumption (R^2 = .07). Table 6 shows the results of this analysis.

Table 6.

Multiple regression analysis with alcohol consumption (low, moderate, high) as the dependent variable and total CHBs as the independent variable.

	B	SE(B)	β	t	p
Total CHBs[a]	**.29*** **	.08	.24	3.55	< .001
Physical activity[a]	.07	.06	.08	1.10	.27
Interaction term	**.33***	.14	.16	2.35	.02

Note. *p < .05, **p < .01, ***p < .001, [a]centred, R^2 = .07, F(3,205) = 5.35, p = .001.

Another multiple regression analysis was conducted in order to test the hypothesis that the moderation effect of physical activity on the relationship between CHBs and alcohol consumption is stronger for the PA-CHB subscale (hypothesis 4). No interaction effect was found (B = .11, SE = .09, β = .09, t = 1.32, p = .19), which does not support the fourth hypothesis. There was no moderating effect of physical activity on the relationship between PA-CHBs and the consumption of alcohol in the whole sample (Table 7).

Table 7.

Multiple regression analysis with alcohol consumption (low, moderate, high) as the dependent variable and PA-CHBs as the independent variable.

	B	SE(B)	β	t	p
PA-CHBs[a]	**.24*** **	.05	.35	5.31	< .001
Physical activity[a]	.06	.06	.07	.99	.32
Interaction term	.11	.09	.09	1.32	.19

Note. *p < .05, **p < .01, ***p < .001, [a]centred, R^2 = .13, F(3,205) = 10.09, p < .001.

Because significant differences in the consumption of alcohol between males and females were found, the moderation analyses with alcohol consumption as the dependent variable were also conducted separately for men and women. A significant moderation effect of physical activity on the relationship between total CHBs and alcohol consumption was found among women (B = .50, SE = .15, β = .30, t = 3.35, p = .001), but not among men (B = -.09, SE = .28, β = -.04, t = -.32, p = .75). Both models explained a low proportion of variance in alcohol consumption (men: R^2 = .08; women: R^2 = .10). The results can be seen in Table 8.

Table 8.

Multiple regression analysis stratified by gender with alcohol consumption (low, moderate, high) as the dependent variable and total CHBs as the independent variable.

	Men, R^2 = .08					Women, R^2 = .10				
	B	SE(B)	β	t	p	B	SE(B)	β	t	p
CHBs[a]	**.36***	.15	.28	2.45	.02	**.25****	.09	.25	2.77	.006
Physical activity[a]	.07	.13	.06	.57	.57	.04	.07	.06	.64	.52
Interaction term	-.09	.28	-.04	-.32	.75	**.50*****	.15	.30	3.35	.001

Note. *p < .05, **p < .01, ***p < .001, [a]centred, men: F(3,74) = 2.04, p = .12, women: F(3,128) = 4.80, p = .003.

Whereas in the whole sample no significant interaction effect was found for PA-CHBs, the multiple regression analyses stratified by gender revealed that in both the male and female subpopulation separately there is a significant moderating effect of physical activity on the relationship between PA-CHBs and alcohol consumption (Table 9). This effect is inversed for the male subpopulation (β = -.22) and the female subpopulation (β = .26). Among males, the effect of CHBs on alcohol consumption is stronger when they were engaged in low physical activity rather than high physical activity. Among females, this effect is stronger when they were engaged in high physical activity rather than low physical activity. Additionally, the model for men explained a bigger proportion of variance in alcohol consumption (R^2 = .24) than that for women (R^2 = .12).

Table 9.

Multiple regression analysis stratified by gender with alcohol consumption (low, moderate, high) as the dependent variable and PA-CHBs as the independent variable.

	Men, R^2 = .24					Women, R^2 = .12				
	B	SE(B)	β	t	p	B	SE(B)	β	t	p
PA-CHBs[a]	**.40*** **	.08	.51	4.75	< .001	**.17*** **	.05	.28	3.32	.001
Physical activity[a]	.13	.12	.12	.1.15	.25	.06	.07	.07	.86	.39
Interaction term	**-.30***	.15	-.22	-1.99	.051	**.30****	.10	.26	2.99	.003

Note. *p < .05, **p < .01, ***p < .001, [a]centred, men: F(3,74) = 7.75, p < .001, women: F(3,128) = 5.63, p = .001.

In order to test if the moderation effect of physical activity on the relationship between PA-CHBs and alcohol consumption is indeed significantly different for males and females (hypothesis 5), a moderated moderation analysis (three-way interactions) was conducted with the PROCESS plug-in for SPSS, as developed by Hayes (2013). As expected, a significant interaction effect was found between physical activity and gender on the relationship between PA-CHBs and alcohol consumption [R^2 = .23, F(7,201) = 8.83, p < .001]. PA-CHBs and gender were significant predictors of alcohol consumption [b = .26, t(201) = 5.26, p < .001; b = -.19, t(201) = -2.47, p = .01]. However, physical activity was not found to significantly predict the consumption of alcohol [b = .09, t(201) = 1.46, p = .15]. In the male subpopulation, PA-CHBs significantly predicted alcohol consumption when men were engaged in low and moderate physical activity, but only marginally when they were engaged in high physical activity. Among female respondents, PA-CHBs significantly predicted alcohol consumption when they were moderately and highly physically active but not when they were engaged in low physical activity. Thus, this three-way interaction effect was inversely for men and women. The results of the moderated moderation analysis (three-way interactions) can be seen in Table 10.

Table 10.

Three-way interactions of gender, physical activity and PA-CHBs with alcohol consumption (low, moderate, high) as the independent variable.

Gender	Physical activity	B	SE(B)	t	p
Male	Low	**.57*** **	.12	4.73	< .001
	Average	**.40*** **	.08	5.07	< .001
	High	.22	.11	1.90	.06
Female	Low	-.00	.09	-.03	.98
	Average	**.17****	.06	2.79	.006
	High	**.35*** **	.10	3.54	<.001

Note. *p < .05, **p < .01, ***p < .001, R^2 = .23, F(7,201) = 8.83, p < .001.

In order to be able to interpret these results per physical activity level, *Figure 2* illustrates the results of the moderated moderation analysis by means of a multiple line graph, stratified by gender. For males, a positive relationship can be seen between PA-CHBs and alcohol consumption, moderated by low, average and high physical activity. The more a male respondent participated in physical activity, the less predictive PA-CHBs were for the consumption of alcohol. Among females, the opposite pattern can be observed: the more they were engaged in physical activity the more predictive were PA-CHBs for alcohol consumption. Concerning the engagement of women in low physical activity, the coefficient between PA-CHBs and consumption of alcohol approaches zero.

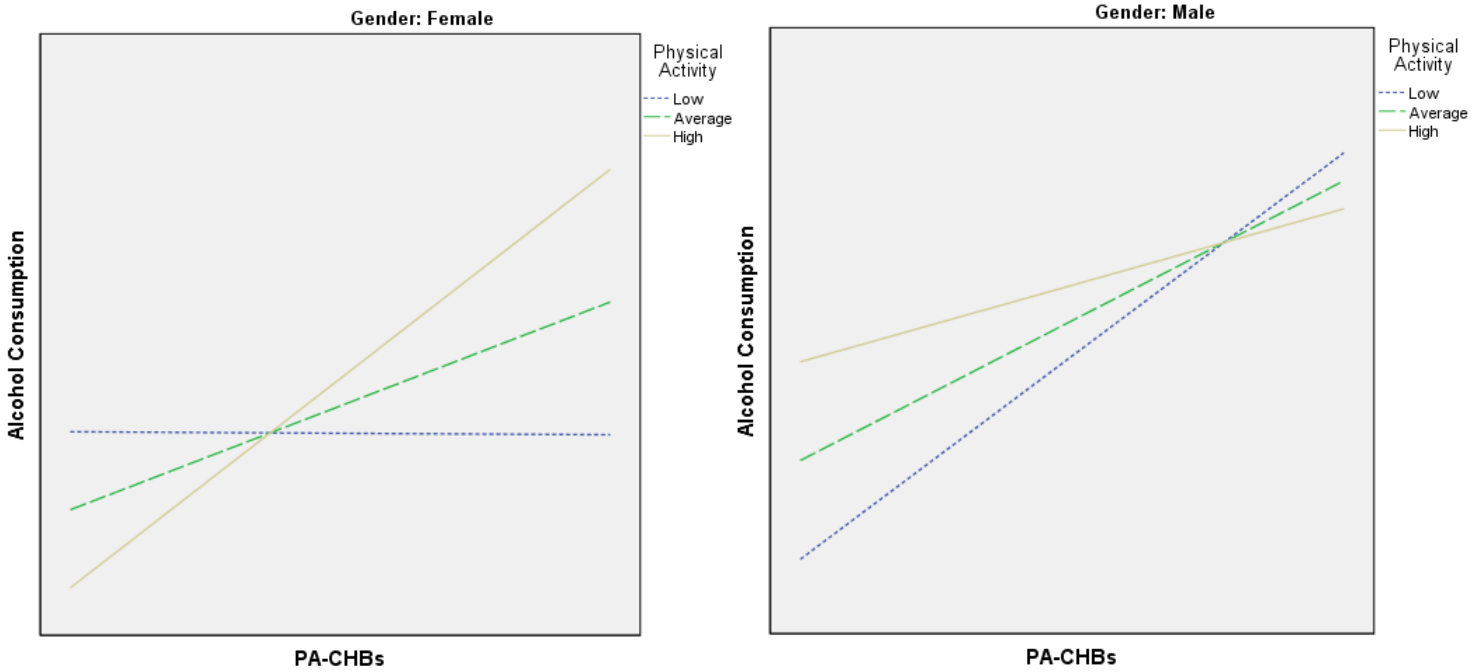

Figure 2. Multiple line graphs of the effect of gender, physical activity and PA-CHBs on alcohol consumption, separately for the male (n = 77) and female (n = 132) subpopulation. This figure illustrates the influence of gender separately for high, average and low physical activity on the positive relationship between PA-CHBs and alcohol consumption among young adults.

Additionally, similar moderation analyses as for alcohol consumption were conducted with binge drinking as the dependent variable, for both the whole sample and for gender separately. No significant moderating effect of physical activity in the relationship binge drinking and total CHBs (B = .19, SE = .51, β = .03, t = .37, p = .71) as well as PA-CHBs (B = -.06, SE = .31, β = -.01, t = -.19, p = .85) was found. When stratified by gender, there was again no significant

moderating effect of physical activity in this relationship. Further results of these analysis were therefore not reported here.

4. Discussion

This study investigated the relationship between CHBs and alcohol consumption among young adults. It specifically focused on the role of physical activity in that relationship in order to further refine the concept of CHBs by taking the specific context, target group and its behaviour into account. Thereby it did not only examine the effects across the whole population, but also looked specifically at the effects among males and females separately. Additionally, this study distinguished between two different types of CHBs, namely "physical activity as compensation for alcohol use" (PA-)CHBs and other CHBs. PA-CHBs are beliefs that negative effects of alcohol consumption can be compensated by being physically active. Other CHBs refer to the definition of CHBs by Rabiau, Knäuper and Miquelon (2006): they are all other beliefs that negative effects of any volitional unhealthy behaviour in general (such as smoking; not only the consumption of alcohol), can be compensated for by engaging in another, volitional healthy behaviour (such as eating healthy; not only physical activity). The current study used three CHB scales: a specific PA-CHBs scale, the original CHB scale by Knäuper and colleagues (2004) and a total scale consisting of these two.

The conducted research revealed several interesting findings. Firstly, it was found that PA-CHBs were moderately positively related to alcohol consumption. Furthermore, there was a significant moderating effect of physical activity on the relationship between total CHBs and alcohol consumption. This means that the effect of CHBs on alcohol consumption was stronger for people with high physical activity than for those with lower physical activity. In addition, there was no moderation effect of physical activity on the relationship between PA-CHBs and alcohol consumption among the whole sample. However, stratified by gender, significant and inversed (males: negative interaction term; females: positive interaction term) moderation effects were found. This three-way interaction effect between physical activity and gender on the relationship between PA-CHBs and alcohol consumption was confirmed by means of a moderated moderation analysis.

In order to test the assumption that CHBs and alcohol consumption are positively correlated, a Pearson's correlation analysis was conducted. Indeed, a significant positive relationship between total CHBs as well as PA-CHBs and the consumption of alcohol was found in the whole population. Thus, the more CHBs were hold the more alcohol was

consumed. This is in line with past research which has shown that there is a positive association between CHBs and alcohol consumption (Kaklamanou & Armitage, 2012; Knäuper et al., 2004). However, when stratified by gender, total CHBs and alcohol consumption were found to significantly positively correlate in the male subpopulation but not among females. This indicates that females relative to males might use less CHBs in order to legitimate their unhealthy behaviour (here alcohol consumption), which is in line with past research by Knäuper and colleagues (2004), who showed that women had significantly lower CHB scores than men. Another possible explanation is that this result is due to gender differences in the consumption of alcohol. In the current study, males reported a significant higher consumption of alcohol than female respondents, which supports past research claiming that men engaged in higher levels of alcohol consumption than women (Buscemi et al., 2011), and that explicit CHBs related to substance use contributed to the prediction of alcohol consumption, but only among male participants (Riedel, 2016). This indicates that especially among males, risk behaviour (such as a high consumption of alcohol) evokes the need for CHBs, which in turn elicit risk behaviour.

Based on the above finding as well as the fact that physical activity was found not to correlate with alcohol consumption, it was assumed that physical activity may have an indirect rather than direct effect on alcohol consumption by serving as a moderator in the positive relationship between CHBs and drinking alcohol. Indeed, the assumed moderation effect of physical activity was found. Thus, the effect of CHBs on alcohol consumption was stronger for people with high physical activity than for those with lower physical activity. This is an important finding since it demonstrates the importance of physical activity in the relationship between CHBs and alcohol consumption. It is concluded that people who actually carry out compensatory behaviour (high physical activity) tend to legitimate their consumption of large amounts of alcohol with it more easily. This means that the more someone engages in physical activity, the more alcohol consumption is justified by holding CHBs. Thus, physical activity might serve as an important target in reducing the consumption of alcohol, especially among young adults. Surprisingly, regarding PA-CHBs, no moderation effect of physical activity was found in their relationship with alcohol consumption among the whole sample. However, this appeared to be confounded by gender because inversed significant moderation effects separately for males and females were found. Among males, the relationship between PA-CHBs and alcohol consumption was stronger the less they were engaged in physical activity. For females, the opposite pattern could be observed: the more they were physically active, the stronger the relationship between PA-CHBs and alcohol consumption was. Interestingly, stratified by the different categories of physical activity, the moderation effect of physical

activity in the male subpopulation was significant for low and average, but only marginally significant for high physical activity. Among females, it was significant in high and average, but not in low physical activity. This gender difference indicates that the extent to which one legitimates the consumption of alcohol by holding physical activity and alcohol related CHBs depends on gender and on the behaviour in which someone engages. For instance, males and females might have different motives for the use of alcohol and may value physical activity differently. In order to address this idea, Kilpatrick, Hebert and Bartholomew (2005) conducted a study and showed that men reported significantly higher levels of physical activity motivation for challenge, competition, social recognition as well as strength and endurance, whereas for women weight management was more important. Thus, while females might use physical activity as a means to avoid too high caloric intake for instance due to alcohol consumption, males might view it as a type of competition in which they want to be better than their "rivals". Therefore, they might tend to see the consumption of alcohol in this competition as a threat to their performance, which could be an explanation why the relationship between PA-CHBs and alcohol consumption is weaker for males and stronger for females engaging in high physical activity. Besides different motivations for engagement in physical activity, past research also indicated gender based differences in the motives for drinking alcohol. Cooper (1994) distinguishes between four categories of motives: enhancement (drinking to have fun), coping (drinking to forget problems), social (drinking to be sociable), and conformity (drinking to fit in with a group). Research by Kuntsche and Labhart (2013) has shown that enhancement motives predicted alcohol consumption among men, whereas coping motives were predictive for alcohol use among women. According to them, males might drink primarily for the feeling of being drunk and having fun, whereas females tend to use alcohol as a means to become more self-confident and to cope with social anxiety and stress. It could therefore be the case that females might use both weight regulation by means of physical activity (as mentioned above) and alcohol consumption in combination as a strategy to become more self-confident, which could possibly explain a strong relationship between PA-CHBs and alcohol consumption when engaging in high physical activity. Males, on the other hand, might see alcohol as a threat to their sport performance as well as a means to have fun. As a result, it is possible that men who are highly physically active are more orientated towards competition and "getting better" (with less space for having fun), whereas men already engaging in low physical activity are more orientated towards having fun and therefore also drink more alcohol. This might explain the found inversed moderation effect among males and females but, since this explanations are not based on empirical evidence, future research should especially focus on differences in

motivations of engaging in physical activity and alcohol consumption among males and females when examining CHBs in this context. Consequently, the effects here should always be tested separately for men and women.

An important aspect is that this study did not differentiate between different types of physical activity such as different sport practices. Physical activity was broadly defined as any bodily movements, including those to improve one's fitness. Consequently, factors such as sport-related achievement motivation could not be taken into account in the current study. However, research by Weaver, Martens, Cadigan, Takamatsu, Treloar and Pedersen (2013) has shown that such motivations could be important when dealing with physical activity. For instance, they found that motivations such as competitiveness or orientation toward winning result in different drinking patterns. Therefore, future research should focus on different sorts of sports and their influence on the relationship between CHBs and alcohol consumption in order to get a better grip on how physical activity does have an influence here. This could be of special importance when examining this relationship among males, since they, as described above, might see physical activity as a type of competition.

Despite the significant results of the moderation analyses mentioned above, it should be noted that no significant moderating effect of physical activity in the relationship of binge drinking and PA-CHBs as well as total CHBs was found. Additionally, binge drinking correlated only moderately with alcohol consumption ($r = .58$). This could be the case due to the fact, that binge drinking and alcohol consumption are not necessarily related to each other. For instance, past research has shown that weekly alcohol consumption did not correlate with binge drinking (Townshed & Duka, 2005). This might be an explanation for the results of the current study regarding binge drinking behaviour. However, since binge drinking is a major social problem (Turrisi et al., 2006) and increases the risk of dying from alcohol poisoning or fatal traffic accidents (Veliz et al., 2016), future research should focus on the relationship between CHBs and specifically binge drinking behaviour instead of alcohol consumption in general only.

In the current study, the R squares and standardized coefficients in the multiple regression analyses were notably low. For instance, when the relationship between alcohol consumption and total CHBs was tested for being moderated by physical activity, a significant interaction effect was found. However, the effect size was very small ($R^2 = .07$; $\beta = .16$). When total CHBs were replaced by PA-CHBs, a significant interaction effect of PA-CHBs and physical activity was found with an R square of .13 (small effect size) and a small standardized coefficient ($\beta = .09$). This means that the proportion of variance in the consumption of alcohol,

which can be explained by physical activity and PA-CHBs (and thus the overall strength of association) is very low. In other words, only seven percent (total CHBs) or 13 percent (PA-CHBs) of the variance in alcohol consumption is due to the two predictors (total CHBs / PA-CHBs and physical activity). When stratified by gender, in the male subpopulation, PA-CHBs and physical activity explained as twice as much ($R^2 = .24$) of the variance in alcohol consumption than in the female subpopulation ($R^2 = .12$). In sum, there might be additional (gender specific) factors that had an influence in this relationship, which were not measured in this study and should be further studied by future research.

Regarding the generalization of the findings, it should be mentioned that most people were students (88.5%). Since socioeconomic status (based on income, education and occupation) determines later health (Adler & Ostrove, 1999), it might be the case that students know more about healthy and unhealthy behaviours and their effect on health than less educated people. Additionally, it is known that students generally have a higher alcohol consumption frequency and quantity than the average population (Poelen, Scholte, Engels, Boomsma, & Willemsen, 2005), so the findings may not apply to other portions of the population. To get a broader insight in the context of CHBs, their relation to alcohol consumption, and the role of physical activity, future research should take this into account and focus also on less (highly) educated people. Furthermore, the sampling procedure via the online participant pool SONA systems could also constitute a limitation to the extent that it is used by behavioural sciences students in order to get required credits, which have to be collected during the first to years of the study. As a consequence, many of these students could have filled in the questionnaire carelessly because they just wanted to get their credits easily, which can be seen in relatively short answer times of some respondents. This might have influenced the results and future research should deal with this issue by, for instance, using another sampling procedure.

Despite some limitations mentioned above, the current study has several strengths that are worth mentioning. Firstly and most important, this study is the first to reveal clear gender confounding with regard to CHB effects and it underlines the importance of specifically formulated CHBs when measuring them. Past studies usually did not use such specific CHBs. For instance, Berli and colleagues (2014) used the original CHB scale by Knäuper and colleagues (2004) and found that CHBs did not add significantly to the prediction of physical activity. They were thus not directly associated with behavioural outcomes. They concluded that "CHBs might not be equally important in different phases of health behaviour change." (p. 470). However, they used general CHBs and not specific to physical activity related ones. In addition, the relationship between CHBs and physical activity was not tested for gender

confounding. If this had been the case, probably different (and significant) results could have been found.

This study also had some methodological strengths. Firstly, due to the use of an online questionnaire as a measurement, a relatively big sample could be gathered. In addition, the alpha values of the whole CHB scale (α = .79) as wells as for both the PA-CHBs subscale (α = .73) and original scale (α = .73) by Knäuper and colleagues (2004) were relatively high. This means that internal consistency reliability was sufficient in the current study. Another strength is that this study focused on young adults (between 18 and 25 years of age) because excessive alcohol consumption is very prevalent in this population (Lyvers, Hasking, Hani, Rhodes, & Trew, 2010; Poelen et al., 2005; Voogt et al., 2013) and this period also sets the stage for future alcohol-related behaviour (Turrisi et al., 2006). Therefore, it is important to know about possible (cognitive) causes of this pattern in order to be able to deal with it.

In sum, this study revealed several interesting insights with regard to the association between CHBs and the consumption of alcohol among young adults. It was the first to investigate the role of physical activity in this relationship and showed a clear influence of gender. It also questions the use of a general CHB scale and instead suggests to use more specific scales, tailored to the context that is the target of examination. This would be more useful because it will result in stronger relations. When aiming at reducing (severe) alcohol consumption among young adults, approaching CHBs can be promising. Informing about especially incorrect CHBs might serve as a starting point in order to accomplish a better awareness and understanding of own (un)healthy behaviours and related health beliefs. Considering physical activity as a means to reduce alcohol consumption can be effective, especially among males. However, it can even have an opposite effect among females. As a result, interventions should take gender differences into account when attempting to handle alcohol consumption among young adults.

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6. Appendix

6.1 International Physical Activity Questionnaire

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

How much time did you usually spend doing vigorous physical activities on one of those days?

Example:

*If you usually spend 60 minutes on a typical day in doing **vigorous** physical activities, you have to answer in this way:*

1 hours per day

0 minutes per day

*If you usually spend 90 minutes on a day in doing **vigorous** physical activities, you have to answer in this way:*

1 hours per day

30 minutes per day

_____ hours per day

_____ minutes per day

Think about all the **moderate activities** that you did in the **last 7 days**. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

How much time did you usually spend doing moderate physical activities on one of those days?

Example:

*If you usually spend 60 minutes on a typical day in doing **moderate** physical activities, you have to answer in this way:*

1 hours per day

0 minutes per day

*If you usually spend 90 minutes on a day in doing **moderate** physical activities, you have to answer in this way:*

1 hours per day

30 minutes per day

_____ hours per day

_____ minutes per day

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ days per week

How much time did you usually spend walking on one of those days?

Example:

*If you usually spend 60 minutes on a typical day in **walking**, you have to answer in this way:*

1 hours per day

0 minutes per day

*If you usually spend 90 minutes on a day in **walking**, you have to answer in this way:*

1 hours per day

30 minutes per day

_____ hours per day

_____ minutes per day

This question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

During the **last 7 days**, how much time did you spend **sitting** on one weekday?

Example:

*If you usually spend 60 minutes on a **weekday in the last 7 days** in **sitting**, you have to answer in this way:*

1 hours per day

0 minutes per day

*If you usually spend 90 minutes on a **weekday in the last 7 days** in **sitting**, you have to answer in this way:*

1 hours per day

30 minutes per day

_____ hours per day

_____ minutes per day

6.2 Compensatory Health Beliefs Scale

Different people believe different things about their health. Below is a list of beliefs that someone might have about staying healthy. **Please read each sentence carefully and tell us how much you agree or disagree with it** by selecting on one of the following responses: Totally disagree; Somewhat disagree; Neither agree nor disagree; Somewhat agree; or Totally agree.

Relaxing on the weekend can make up for stress during the week.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Using artificial sweeteners compensates for extra calories.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Drinking alcohol in the evening can be compensated by bicycling or walking home afterwards.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Exercising can compensate for smoking.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

It is OK to go to bed late if one can sleep longer the next morning (only the number of hours count).

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Not drinking alcohol during the week can make up for the effects of drinking too much alcohol during the weekend.

- ❍ Totally disagree

- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Skipping the main dish can make up for eating dessert.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Relaxing in front of the TV can compensate for a stressful day.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Eating whatever one wants in the evening is OK if one did not eat much during the day.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Sleeping in on the weekends can compensate for too little sleep during the week.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Eating healthy can make up for the effects of regularly drinking alcohol.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Exercising can make up for the bad effects of stress.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Being physically active can compensate for the effects of regularly drinking alcohol.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

The effects of drinking coffee can be balanced by drinking equal amounts of water.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Drinking alcohol on one day can be compensated by being physically active the next day.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Sleep compensates for stress.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

It is alright to drink a lot of alcohol as one drinks lots of water to flush it.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Starting a new diet tomorrow compensates for breaking a diet today.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

If I am physically active during the week, it is OK to drink more alcohol during the weekend.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

Smoking from time to time is OK if one eats healthy.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

It is OK to skip breakfast if one eats more during lunch or dinner.

- ❍ Totally disagree
- ❍ Somewhat disagree
- ❍ Neither agree nor disagree
- ❍ Somewhat agree
- ❍ Totally agree

6.3 Alcohol Consumption Scale

Before you answer the next questions, it is important you are aware of what a unit of alcohol entails. Every drink has its own glass. Wine comes in a wineglass, beer in a pint and liquor in a shot glass. This is called one unit. If the drink comes in the right glass, every drink should hold the same amount of alcohol.



Half a pint: 1 unit Small glass of wine: 1 unit Shot: 1 unit

A pint: 2 units Large glass of wine: 2 units

Please answer the following questions in units. In the table below, you'll find some examples.

Kind of drink	Number of units
½ pint	1
Pint	2
Small glass of wine	1
Large glass of wine	2
Bottle of wine (0,75l.)	7,5
Mix-drink	1
Shot	1
Bottle of liquor	22

As you can see in the table, one small wineglass is one unit of alcohol. If you had three small glasses of wine, your answer will be 3 units, because 3 x 1 = 3.

Have you ever had an alcoholic drink?

- ❍ Yes
- ❍ No

On how many days of the **four weekdays** (Monday, Tuesday, Wednesday, Thursday) do you usually drink alcohol?

- ❍ 4 days
- ❍ 3 days
- ❍ 2 days
- ❍ 1 day
- ❍ Less than 1 day
- ❍ I never drink on a weekday

How many units of alcohol do you usually drink on a **weekday** on which you drink?

- ❍ 11 units or more per day
- ❍ 7-11 units per day
- ❍ 6 units per day
- ❍ 5 units per day
- ❍ 5 units per day
- ❍ 4 units per day
- ❍ 3 units per day
- ❍ 2 units per day
- ❍ 1 unit per day
- ❍ 0 units per day

On how many of the **three weekend days** (Friday, Saturday, Sunday) you usually drink alcohol?

- ❍ 3 days
- ❍ 2 days

- ❍ 1 day
- ❍ Less than 1 day
- ❍ I never drink alcohol on weekend days

How many units of alcohol do you usually drink on a **weekend day** on which you drink?

- ❍ 20 units or more per day
- ❍ 15-19 units per day
- ❍ 11-14 units per day
- ❍ 7-10 units per day
- ❍ 6 units per day
- ❍ 5 units per day
- ❍ 4 units per day
- ❍ 3 units per day
- ❍ 2 units per day
- ❍ 1 unit per day
- ❍ 0 units per day

In the last 4 weeks, how often did you drink **six or more units** of alcohol on **one occasion** (for example on a party or on an evening)?

- ❍ 1 time in the last 4 weeks
- ❍ 2 times in the last 4 weeks
- ❍ 3 times in the last 4 weeks
- ❍ 4 times in the last 4 weeks
- ❍ 5 times in the last 4 weeks
- ❍ 6 times in the last 4 weeks
- ❍ 7 times in the last 4 weeks
- ❍ 8 times in the last 4 weeks
- ❍ 9 or more times in the last 4 weeks