WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 5, 12-25. Research Article ISSN 2277–7105

SMOKING, ALCOHOL CONSUMPTION, MOOD, CARDIOVASCULAR FUNCTION, AND SELECTIVITY IN ATTENTION AND MEMORY

***Andrew P. Smith, PhD.**

School of Psychology, Cardiff University, 70 Park Place, Cardiff CF10 3AT, UK.

Article Received on
13 January 2024,

Revised on 02 Feb.2024,
Accepted on 24 Feb. 2024

DOI: 10.20959/wjpr20245-31539

***Corresponding Author**
Andrew P. Smith, PhD.
School of Psychology, Cardiff University, 70 Park Place, Cardiff CF10 3AT, UK.

ABSTRACT

Background: Smoking and alcohol consumption are two major public health problems. Research has investigated associations between these factors and physical and mental health. Their acute effects on cognitive performance have also been examined. Chronic use in older adults is also associated with neuropsychological problems. Less is known about the effects of these health-related behaviours in young adults, and the present study examined whether smoking and high alcohol consumption modify selectivity in memory and attention, mood and cardiovascular function. **Method:** 120 university students (50% male) took part in the study. Measurements were taken in the morning between 9.30 and 11.30 am, and questionnaires measuring health-related behaviours were completed. Blood pressure and heart rate were measured, mood was rated before and after the battery of performance tasks, and tests measuring selectivity in attention and memory were performed. **Results:** Blood pressure was greater in the high alcohol group (> 13 units a week). High alcohol consumption was also associated with a smaller recall priority effect. Smoking was associated with a greater recall priority effect. There was also a significant interaction between smoking and alcohol consumption for the recall priority effect, with high alcohol consumers who were both smokers and non-smokers showing a small priority effect, whereas low alcohol consumers who were smokers showed a greater priority effect than low alcohol non-smokers. **Conclusion:** The present analyses showed that both smoking and level of alcohol consumption had little effect on mood, cardiovascular parameters and selectivity in attention and memory. The exception was the recall priority task, which measures resource allocation to high and low-priority components in memory. Alcohol and smoking showed

opposite effects, and these results need to be extended by examining a more detailed profile of these two health-related behaviours.

KEYWORDS: Smoking; Alcohol; Mood; Heart rate; Blood pressure; Selective Attention; Biased probability choice reaction time; Category Instances; Stroop Task; Task priority; University students.

INTRODUCTION

Prevalence of smoking and alcohol consumption

Approximately 15% of the UK population are smokers, with men being more likely (17%) to smoke than women (14%), and smoking being most prevalent in the 25 to 34 year age group.[1] Smoking in the UK has fallen from 40% in the 1980s to about 20% in 2013[2] to 15% in 2016.[1] Results from the European Health Interview Survey show that the UK has a relatively low smoking prevalence, with the overall prevalence in the EU countries being 24%. In the UK in 2017, 58% of adults (above 16 years) drank alcohol in the previous week, with 15% drinking more than eight (men) or six units (women) on their heaviest consumption day. Thirty-one per cent of men and 16% of women drank at a level (more than 14 units a week), suggesting increased risk of harm.[3] UK alcohol consumption has decreased between 2000 and 2015, and the UK is a mid-table country in international comparisons of drinking. Epidemiological studies in the USA have shown that over 45 million adults used both tobacco and alcohol, and 6.2 million reported both an alcohol use disorder and dependence on nicotine.[4]

Effects of smoking and drinking alcohol on physical disease

The harm caused by the consumption of alcohol is a top-priority public health problem.[5] Alcohol and tobacco are major causes of preventable deaths[6] and are frequently used together.[7] In the UK in 2015/2016, 474,000 hospital admissions were attributable to smoking, and there were 79,000 deaths (16% of all deaths) due to smoking in that time period. In 2016/17, there were 337,000 admissions to hospital in the UK that were attributable to alcohol. This was 17% higher than ten years earlier, and 62% of the patients were male, with the number increasing with age up to 45-54 years and then declining.[3] The two most common reasons for alcohol-related admission to the hospital were cancer (25%) and unintentional injuries (22%). In England in 2016, 5,507 deaths (67% male) were specifically due to alcohol, and 57% of the deaths were in the age range of 50-69 years. 82% of the alcohol-specific deaths were due to liver disease.

Those dependent on tobacco are also more dependent on alcohol than the general population, and those dependent on alcohol are more likely to be smokers.[8] The co-use of alcohol and tobacco leads to many similar health problems. For example, both smoking and alcohol are associated with chronic liver disease, cancers, and cardiovascular disease,[9] and these health effects are greater when tobacco and alcohol are used together.[10] Other effects are specific to smoking or alcohol consumption. For example, alcohol contributes to injury and death through its effect on car crashes and other aspects of safety. Tobacco and alcohol use are also associated with other substance use,[11] with some suggesting that smoking and alcohol are gateway drugs that lead to a wider range of drug-taking.[12]

Effects of smoking and drinking alcohol on mental health

Both tobacco and alcohol use are associated with mental health problems, such as increased rates of anxiety, affective disorders, other substance use abuse/dependence and psychosis.[13] Such findings have also been observed in students.[14] Other research has examined specific aspects of well-being, such as life satisfaction[15] or happiness[16], with the general finding being that smokers report less positive well-being, which may then maintain smoking behaviour.[17] Academic attainment is often related to mental health, and some results show that smoking is associated with lower academic attainment,[18] although not all studies have found this.[19]

Studies in Europe, the USA and Australia have also shown a high prevalence of alcohol use disorders and alcohol dependence among university students[20] compared to their non-university peers.[21] Individuals with high levels of alcohol consumption may also be more likely to report stress, depression, and anxiety.[22] Poor mental health has often been associated with academic pressure and irregular sleep patterns[23] and leads to lower academic performance.[24] A considerable proportion of university students drink alcohol at hazardous levels, which is often associated with poor academic performance and mental health outcomes.[25]

Alcohol is an established risk factor for depression, and some studies have shown that up to 10% of male depression is associated with alcohol consumption.[26] However, moderate levels of alcohol consumption are often associated with lower susceptibility to disease,[27] better cognition, higher levels of subjective well-being and fewer depressive symptoms when compared with total non-consumption.[28] Indeed, moderate consumption is associated with greater sociability, which in turn is associated with higher levels of well-being.

Smith[29] carried out three studies examining smoking, alcohol consumption, well-being and academic attainment of students. The Student Well-being Process Questionnaire (WPQ) was used to measure well-being, and academic attainment was measured using perceived work efficiency and the Grade Point Average (GPA). The first study examined the effects of units of alcohol consumed in a week, frequency of alcohol consumption, alcohol consumers versus non-consumers and drinking more alcohol than the recommended safe level (14 units a week). Nearly 900 university students participated in the study. Analyses adjusted for the effects of established well-being and attainment predictors. Smoking had a significant effect on attainment but not well-being. Neither the frequency of consuming alcohol nor the number of units of alcohol had any significant effects, and the interaction between alcohol and smoking was not significant. Non-consumers of alcohol reported greater work efficiency but also higher negative outcome scores. Those who consumed more than the recommended safe limit for alcohol (14 units a week) reported lower scores for positive well-being and work efficiency but had less course stress.

The second study examined associations between binge drinking, attainment and well-being. Only one effect was significant in this study, with regular binge drinkers reporting lower work efficiency than less frequent binge drinkers, who in turn had lower efficiency than those who never carried out binge drinking. The third study examined the frequency of hangovers, attainment, and well-being. Again, there was only one significant effect, and again, this was on perceived work efficiency. Those who regularly had a hangover reported the lowest work efficiency, followed by those who sometimes had a hangover, with those who never had a hangover reporting the greatest efficiency. This research has several limitations. First, surveys like this tend to underestimate alcohol consumption (perhaps particularly among women)[30] and smoking (perhaps particularly among young men).[31] The number of heavy drinkers and smokers in the sample was also relatively small, and larger effects may be observed in those addicted to alcohol and who smoke for much of the time.

Acute effects of smoking and alcohol on mood and cognitive performance

There has been considerable research on the acute effects of alcohol and smoking on mood and performance.[32,33] Both areas of research present both positive and negative effects. For example, smoking may be used to reduce stress and lead to a positive effect on behaviour. However, dependency and withdrawal may then have negative effects, and subsequent smoking may be removing such impairments rather than having an absolute benefit.

Similarly, the initial benefits of small doses of alcohol may be replaced by negative effects seen with higher doses, which are often followed by hangover effects following heavy consumption.

Smoking and alcohol consumption habits and cognitive performance

Research shows that chronic smoking leads to neuropsychological impairments in older adults.[34, 35] This has also been observed in adolescents,[36] although another study[37] found no effects of the smoking habit of university students on selective attention and aspects of memory. Research on the effects of alcohol on younger samples has often focused on binge drinking, heavy alcohol use and hangovers. Binge drinking has been associated with poorer cognition[38, 39] and impairs the alerting and executive function components of the attention network but not orientation.[40]

The present study

The present research examined associations between smoking and alcohol consumption and the performance of tasks involving selectivity in attention and memory. Mood and cardiovascular parameters were also recorded. This article presents a secondary analysis of the baseline data from a study investigating lunch, time of day and selectivity in memory and attention. Initial analysis showed that lunch and time of day did not change the performance of tasks involving the selective processing of information in attention and memory.

The performance tasks used were developed in research on the effects of noise.[41-44] Noise reduces the effect of a distracting colour name in the Stroop Colour-Word test[45], which was used in the present study. Noise also improves recall of high-priority information at the expense of information with a lower priority, and this task was also used here.[46] Selectivity in memory can be measured using a category instances task, which was also used in the present study.[47] In this task, a category name is presented (e.g. An animal) followed by either a good example of that category (e.g., a Dog) or a weaker example (e.g., a Stoat). The stronger example is responded to more quickly, and this effect was greater when the person performed in noise. A biased probability choice reaction time task was also used, and in this task, one stimulus was more probable than the others. Reaction times to the more probable stimulus are faster, and this effect was greater in noise.[48]

In summary, the present research used tasks known to be sensitive to changes of state induced by exposure to noise to investigate whether there were any differences in selectivity in

memory and attention of smokers and those with different levels of alcohol consumption. Previous analyses had shown that significant indicators of selectivity in memory and attention were observed.[49] These measures were not influenced by lunch, time of day, personality, and hunger and were not related to mood and cardiovascular parameters.[50, 51]

The aim of the analyses presented here was to examine whether the selective attention and memory tasks were influenced by smoking, level of alcohol consumption or a combination of the two. This might occur due to differences in arousal, resource allocation or distraction from task-irrelevant thoughts. Mood and cardiovascular measures were also analysed to determine whether there were effects of smoking and alcohol consumption on these outcomes.

METHOD

A detailed account of the methodology has been given in an earlier paper.[49] and a summary is given below. The study was carried out with the informed consent of the volunteers and the approval of the Psychology Ethics Committee.

Study Design

Participants attended a familiarisation session on a day prior to the test session. A test session was carried out in the morning, with half of the participants starting at 09.30 and the rest at 10.30.

Participants

One hundred and twenty university students (half male; mean age of 20.4 +/- 2.4 years) participated in the study.

Measurement of blood pressure and heart rate

Heart rate and blood pressure were measured before the test battery.

Mood rating

Mood was rated both before and after the performance tests using bi-polar visual analogue rating scales (e.g. Drowsy-Alert, Happy-Sad, Tense-Calm).

Four-choice biased probability reaction time task.

This involved pressing the corresponding key on a response box when one of the letters A, B, C or D was shown on the computer screen. The letters were presented in the four corners of

the computer screen. Three of the letters (B, C, and D) were presented 50 times, and the other (A) 100 times.

Stroop Task

This task had four conditions:

- Name the colour of a square shown in the centre of the screen.
- Name the colour name presented in black in the centre of the screen.
- Name the colour with a distracting colour word (RED – correct response blue)
- Name the word and ignore the colour (RED – correct response red)

  The participant pressed the appropriate keys on a response box corresponding to the colours red, blue, green and yellow.

Category Instances Task

A category name (e.g. An animal) was shown on the screen, followed by either a dominant instance of that category (e.g. Dog) or a non-dominant instance (e.g. Stoat) or a non-instance (e.g. Table). The participant had to respond "True" if the word was an instance and "False" if it was not an instance.

Memory for high/low priority information

Eight words were presented in one of the four corners of the computer screen (two per corner). The high-priority task was to recall the order of the words, and the low-priority task was to recall the location of the words. At the end of the presentation, the participants were given a list of 8 words and had to arrange them in order and put them in the location where they were shown.

Questionnaires

At familiarisation, the volunteers completed a series of questionnaires, including one asking about smoking and alcohol consumption.

RESULTS

Smoking and alcohol consumption: Descriptive statistics

Twenty-five per cent of the sample were smokers. The mean number of units of alcohol consumed a week was 13.0, with a range from 0-55.

Multivariate Analysis of Variance (MANOVA)

The between-subject factors were smoking and high/low alcohol consumption (based on a median split). There were more smokers in the high alcohol group (N=16) than in the low alcohol group (N=12). The dependent variables were the three mood factors (alertness, hedonic tone and anxiety), heart rate, systolic blood pressure, diastolic blood pressure, Stroop interference (CI-C; WI-w), category instance dominance effect (RT non-dominant-RT dominant), priority recall effect (Order-location recall) and the biased probability effect (lower probability RT- higher probability RT). The multivariate tests showed a significant effect of the alcohol group (Wilks' Lambda = 0.746 F =2.50 $p < 0.005$ partial eta squared = 0.254). The multivariate tests for smoking and the smoking x alcohol interaction were not significant.

Univariate analyses showed that higher alcohol consumption was associated with higher systolic ($F = 3.94$, $p < 0.05$; low alcohol mean = 119.1; high alcohol mean =124.4) and higher diastolic ($F = 5.96$, $p < 0.05$; low alcohol mean = 70.5; high alcohol mean = 76.2) blood pressure. The recall priority effect was significantly smaller in the high alcohol consumption group $F = 9.86$, $p < 0.005$; low alcohol mean = 1.82; high alcohol mean = 0.33). None of the other variables showed a significant difference between low and high-alcohol consumers.

Smoking was associated with a significantly greater recall priority ($F = 4.90$, $p< 0.05$; smoker mean = 1.60; non-smoker mean = 0.55). None of the other variables showed a significant difference between smokers and non-smokers.

There was one significant interaction between smoking and alcohol groups. This was for recall priority, where high alcohol consumers showed a smaller priority effect that did not vary with smoking status, and smokers who were low alcohol consumers had a bigger priority effect than non-smokers who were low alcohol consumers ($F = 4.13$ $p< 0.05$; Non-smokers: low alcohol mean = 0.81; high alcohol mean = 0.29; Smokers: low alcohol mean =; 2.83, high alcohol mean = 0.37). None of the other variables showed a significant interaction between alcohol and smoking groups.

DISCUSSION

The present analyses showed very few associations between smoking, alcohol consumption and selectivity in attention and memory, mood and cardiovascular functioning. One of the significant findings was the association between high alcohol consumption and increased

blood pressure, which has been observed in large-scale epidemiological studies.[4] The only significant task from the attention and memory battery was the memory task with components with different priorities. Smoking was associated with a greater focus on the higher priority task, whereas high alcohol consumption showed the opposite effect. This led to a significant interaction between smoking and alcohol consumption, with smokers with low alcohol consumption showing the greatest priority effect and high alcohol consumers the smallest priority effect. Differences in the high-low priority components have been observed in noise, with noise producing the same profile as that observed in smokers.

One must now ask whether the methodology led to the absence of effects in the other tasks. The results from the earlier analyses[49] showed that the groups were well-matched in terms of factors such as other health-related behaviours, demographics, and eating habits. Analysis of the baseline data revealed that the selective effects of task parameters were present in all tasks.[49] Consumption of lunch increased heart rate, showing that physiological changes were produced by the meal.[49] Hedonic tone changed as a function of the time of day and meal consumption,[49] and the effects of personality and hunger were also observed, although they were largely restricted to mood.[50, 51] These results show that the dependent variables were sensitive measures. The absence of more extensive effects of smoking and alcohol consumption probably reflects the relatively short duration of these habits and their magnitude. Future studies should look at more extreme groups who smoke a large number of cigarettes, drink more alcohol frequently, binge drink, and have been doing this for a longer period of time.

CONCLUSION

Alcohol consumption and smoking are two major public health problems, and research has investigated associations between them and physical and mental health. Acute effects of smoking and alcohol consumption on cognitive performance have also been investigated, and long-term use is associated with neuropsychological problems in older adults. Less is known about the effects of alcohol consumption and smoking in young adults, and the present study examined whether these health-related behaviours modify selectivity in attention and memory, mood and cardiovascular function. Blood pressure was higher in the group who consumed > 13 units of alcohol a week. High alcohol consumers also showed a smaller recall priority effect, whereas smoking was associated with a greater recall priority effect. A significant interaction between smoking and alcohol consumption was present for the recall

priority effect, with smokers in the low alcohol group showing the largest priority effect. Smoking and level of alcohol consumption had little effect on mood, cardiovascular parameters and the other selectivity in attention and memory measures. These results need to be extended by examining a more detailed profile of these two health-related behaviours and by considering long-term use in older adults.

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