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Probing the Paradox: Investigating the Impact of Affect, Exercise Type, and Cannabis Use on the Alcohol-Exercise Relationship in College Students

VANESSA T. STALLSMITH†, CIANNA J. PIERCEY†, MAGGIE M. MATACZYNSKI†, HOLLIS C. KAROLY‡, and NOAH N. EMERY‡

Department of Psychology, Colorado State University, Fort Collins, CO, USA

†Denotes graduate student author, ‡Denotes professional author

ABSTRACT

International Journal of Exercise Science 17(3): 623-632, 2024. Alcohol has previously shown a paradoxical positive relationship with exercise behaviors. However, the relationship has not been explored according to type of exercise (aerobic vs. anaerobic), nor has the research considered other contextual variables that commonly co-occur with alcohol use, such as cannabis and mood. This study sought to expand upon previous research to understand how the alcohol-exercise relationship may vary based on exercise type. Additionally, this study included cannabis use and mood as moderators of the alcohol-exercise association. Cross-sectional survey data was collected from college students (N = 335). Negative binomial regression was used to test associations between exercise and alcohol consumption, cannabis use, positive affect (PA), negative affect (NA), and moderating effects of these factors on the alcohol-exercise relationship. Effect sizes are reported from an Incidence Rate Ratio (IRR). Sex assigned at birth (male = 1, female = 0; IRR = 1.34, p = .017), PA (IRR = 1.57, p = .001), and alcohol consumption (IRR = 1.94, p = .037) exhibited positive relationships with exercise. Significant main effects were not observed for negative affect (IRR = 1.17, p = .230), or cannabis use (IRR = 1.00, p = .988). There was a significant interaction between positive affect and alcohol consumption (IRR = 0.87, p = .044) predicting exercise minutes. Alcohol was positively associated with exercise for those with low positive affect (n = 42, b = 12.61, p = .096) and this effect was attenuated as levels of positive affect increased (mean positive affect: n = 232, b = 0.55, p = .926; high positive affect: n = 61, b = -15.86, p = .146). These findings suggest that low positive affect may contribute to the positive link between alcohol use and exercise (especially aerobic exercise) in young people.

KEY WORDS: Physical activity, mood, aerobic, anaerobic

INTRODUCTION

Alcohol use among college students is prevalent and presents a myriad of risks to students' health, safety, and mental wellness (38). College-aged individuals are likely to explore health-promoting or health-deterring behaviors (12), such as alcohol use. This may lead to increased risk for developing alcohol use disorder (AUD) (2). It is possible that some common health-behaviors, such as exercise, can have a protective effect against alcohol consumption. However, research has identified a paradoxical positive relationship between exercise and alcohol, with

more physically active individuals reporting an increased frequency and quantity of alcohol consumption compared to less physically active individuals (25, 28).

Early research first noted this paradox amongst collegiate athletes (7, 18), and recent work has corroborated this across various populations (10, 20). However, some studies show no significant relationship between alcohol and exercise behaviors (1, 27). A recent study, which included objective measurements for both alcohol use (using a Secure Continuous Remote Alcohol Monitor) and exercise (using an activity monitor) also found no association between daily physical activity and daily drinking (37). Thus, the relationship is likely nuanced and may involve complex moderators. For example, research has neglected to explicitly examine differences in alcohol use between aerobic and anaerobic exercisers. Most exercise research focuses on aerobic exercise, but anaerobic exercise (e.g., weightlifting) has drastically increased in popularity in recent years, and anaerobic activities exert different demands and effects on the body compared to aerobic exercise. Therefore, it seems likely that the alcohol-exercise relationship may differ depending on exercise type.

Mood is another logical variable to investigate as a possible moderator of the alcohol-exercise relationship, given the well-established finding that mood is fundamentally linked to substance use (9, 30), and exercise (8, 14). While there are several theories about how mood is linked to these behaviors (4, 5), the underlying premise is that both behaviors are used for mood management (i.e., to increase positive affect and/or decrease negative affect). Studies have revealed that aerobic exercise is linked to improved mood and decreased symptoms of depression and anxiety (22, 29), and has even been touted as the "most important natural mood modulator" (21, 34). However, very few studies have been conducted on anaerobic exercise and mood, especially within the context of alcohol-use behaviors. Most studies that have investigated these variables have focused on exercise as a clinical intervention for alcohol use disorder, which may not be readily translatable to non-treatment seeking individuals. Henderson and colleagues (13) explored the nuanced relationship between mood, exercise, and alcohol use in non-treatment seeking young adults and found that daily exercise and alcohol use were negatively associated at the between-person level in those with higher levels of both pleasant-activated and unpleasant-activated affective states. However, this study did not explore the distinction between aerobic and anaerobic exercise.

Another important moderating variable in the alcohol-exercise relationship is cannabis, as cannabis is one of the most used substances among people who drink alcohol (32). As legalization for medicinal and recreational cannabis has increased in the U.S. at the state-level, cannabis consumption has increased as well (32, 39). This trend is particularly notable in college students (3). Thus, cannabis may be a meaningful moderator in the alcohol-exercise relationship in young people. The limited existing research on the topic has found that cannabis users frequently use cannabis while exercising, and that those who do combine cannabis and exercise report more minutes of exercise each week compared to those who do not use cannabis while

exercising (39). Research in this area is limited (1, 13), but given the overlap between alcohol and cannabis use in college populations, it warrants further investigation.

The present study expands upon previous alcohol-exercise research by adding important contextual variables (cannabis use, mood) as moderators of the exercise-alcohol association and exploring these relations in the context of anaerobic and aerobic exercise. We hypothesize that the positive relationship between alcohol and exercise will be stronger in individuals who report higher levels of positive affect and lower levels of negative affect, consistent with prior research (13). We suspect that this relationship will differ by exercise type (aerobic vs anaerobic), however we lack prior data to inform directionality of the expected effect. Finally, we expect that cannabis use will moderate the association between alcohol use and exercise, but also lack prior data to inform a directional hypothesis.

METHODS

Participants

Participants (N = 335) were undergraduates recruited from the Psychology Department subject pool. All participants indicated that they consented to participate prior to completing the study survey. The Institutional Review Board at Colorado State University approved the protocol. This research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science (24). Participants were included in the present analysis if they endorsed using alcohol and cannabis (see Table 1).

Protocol

Recruited undergraduate students from the Psychology Department subject pool completed an online survey which asked questions about their demographics, alcohol use, trait negative affect, trait positive affect, cannabis use, and exercise behaviors. Detailed descriptions of measures are listed below.

Self-report questionnaires: A demographics questionnaire was administered to collect information on age, sex assigned at birth, gender identity, ethnicity, and race. Data on alcohol use was collected via questions regarding drinking frequency and amount consumed per drinking day. Additionally, both trait negative affect (α = .88) and trait positive affect (α = .92) were assessed by items from subscales of the PANAS-X (35). This scale asks participants to rate the extent to which they identify with a positive emotion (i.e., joyful) or a negative emotion (i.e., hostile) on a 5-point scale. Ratings were summed separately to calculate a score for positive affectivity, separate from negative affectivity. The PANAS-X has been shown to be highly internally consistent (0.86 – 0.90) and stable. Also, it is reported to have good criterion validity (36). Next, cannabis use data was collected via questions regarding frequency of method, and was adapted from previous studies examining legal-market cannabis use (6, 16). Finally, exercise minutes were assessed by the questions "How many TOTAL minutes do you spend doing aerobic exercise in an average week?" and "How many TOTAL minutes do you spend doing

anaerobic exercise in an average week?," with a drop-down response option of 0 to 600 minutes in 15-minute increments for each question.

Statistical Analysis

To test the hypothesized moderating effects of affect and cannabis use on the alcohol-exercise relationship, we estimated three negative binomial regression models in which exercise behavior was regressed on alcohol consumption, affect, and cannabis use as well as interaction terms between alcohol and other focal predictors. This was a secondary analysis of data collected as part of another study, and with 335 participants we were powered to detect small effect sizes in the context of a regression model. The three models had identical predictors, but each had a different outcome variable: total exercise minutes, aerobic exercise minutes and anaerobic exercise minutes. Predictors were mean-centered. Simple slopes were calculated for the significant interaction terms to examine the effect of moderators at the mean and +/- 1 SD. Due to the outcomes being count variables with considerable positive skew (i.e., skewness for total exercise minutes = 1.37), we used negative binomial regression models, which are optimal for handling positively skewed, count data (30).

RESULTS

Detailed descriptive statistics are listed in table 1.

Effect sizes are reported from an Incidence Rate Ratio (IRR), which quantifies the relative difference in incidence rates between two groups. In general, an IRR close to one (0.90-1.10) indicates a small effect, an IRR between 0.70 and 0.90 or 1.10-1.30 indicates a medium effect, and an IRR below 0.70 or above 1.30 indicates a large effect. First, we ran a model in which total exercise minutes (aerobic and anaerobic) was the outcome. Sex assigned at birth (female = 0; IRR = 1.34, p = .017), positive affect (IRR = 1.57, p = .001), and alcohol consumption (IRR = 1.94, p = .037) exhibited positive relationships with total exercise minutes. Significant main effects were not observed for negative affect (IRR = 1.17, p = .230), or cannabis use (IRR = 1.00, p = .988). As depicted in Figure 1, there was a significant interaction between positive affect and alcohol consumption (IRR = 0.87, p = .044) predicting exercise minutes. Alcohol was positively associated with exercise for those with low positive affect (n = 42, b = 23.55, p = .120) and this effect was attenuated as levels of positive affect increased (mean positive affect: n = 232, b = 1.43, p = .905; high positive affect: n = 61, b = -29.13, p = .189). In other words, individuals with low positive affect showed a positive relationship between alcohol use and exercise, while those with high levels of positive affect showed a negative relationship between alcohol use and exercise. No other significant predictors or interactions emerged (ps > .146).

Table 1. Respondent characteristics.

Characteristics	*N*	%	M	SD
Age			19.20	1.38
Sex Assigned at Birth				
Female		66.27		
Male		33.73		
Gender				
Cis woman		63.88		
Cis man		33.43		
Trans woman	0	0.00		
Trans man		0.30		
Gender non-conforming		2.39		
Ethnicity				
Hispanic/Latino/a/e/x		14.07		
Non-Hispanic/Latino/a/e/x		85.93		
Race				
American Indian or Alaska Native		0.60		
Asian		0.90		
Black or African American		2.10		
Native Hawaiian or Pacific Islander		0.60		
White		87.70		
Multi-racial		6.57		
Alcohol Use Frequency				
One time per week		20.0		
Two times per week		25.7		
Three times per week		14.3		
Four times per week		2.7		
Five times per week		2.1		
Six times per week		1.5		
Daily		1.2		
Less than once per month		6.3		
One time per month		3.0		
Two times per month		7.8		
Three times per month		15.5		
Drinks per drinking day			3.38	2.48
Number of aerobic exercisers	323	96.4		
Number of anaerobic exercisers	261	77.9		
Number of participants who did both aerobic and anaerobic exercise	260	77.6		
Exercise minutes per week overall			129.49	115.43
Aerobic exercise minutes per week			150.45	141.69
Anaerobic exercise minutes per week			108.53	130.26
Weekly flower cannabis use frequency			3.16	2.76
Negative affect			2.26	0.73
Positive affect			3.17	0.74

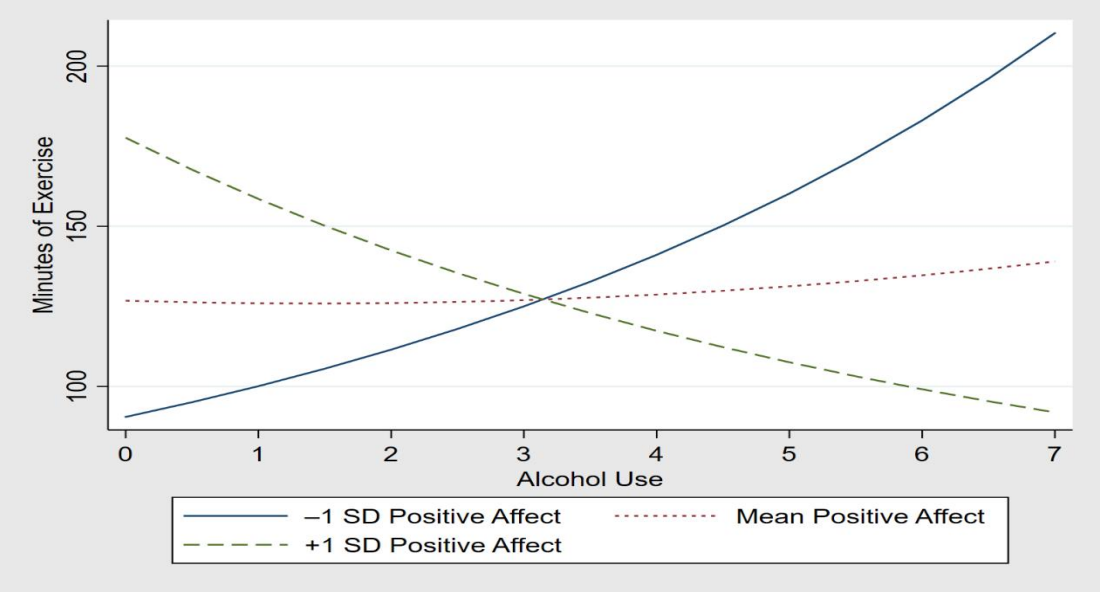

Figure 1. Moderating effects of positive affect on the alcohol-exercise association (total exercise minutes).

Next, we further probed the alcohol-exercise relationship by investigating specific exercise types (aerobic and anaerobic) separately. First, aerobic exercise minutes were used as the outcome variable. Positive affect (*IRR* = 1.49, *p* = .003), and alcohol consumption (*IRR* = 1.96, *p* = .034) exhibited positive relationships with aerobic-only exercise minutes. No main effects were observed for negative affect (*IRR* = 1.24, *p* = .102), sex assigned at birth (female = 0; *IRR* = 1.16, *p* = .226), or cannabis use (*IRR* = 1.02, *p* = .623). There was a significant interaction between positive affect and alcohol consumption (*IRR* = 0.88, *p* = .050) predicting exercise minutes. Similar to the interaction observed in the total exercise minutes model, alcohol was positively associated with aerobic exercise for those with low positive affect (*n* = 42, *b* = 10.48, *p* = .240) and this effect was attenuated as positive affect increased (mean positive affect: *n* = 232, *b* = -3.05, *p* = .674; high positive affect: *n* = 61, *b* = -20.64, *p* = .118). No other significant predictors or interactions emerged (*p*s > .146).

Next, anaerobic-only exercise minutes were used as the outcome variable. Sex assigned at birth (female = 0; *IRR* = 1.61, *p* = .020) and positive affect (*IRR* = 1.72, *p* = .016) exhibited positive relationships with anaerobic-only exercise minutes. No significant main effects were observed for negative affect (*IRR* = 1.06, *p* = .785), alcohol consumption (*IRR* = 1.87, *p* = .250), or cannabis use (*IRR* = 0.97, *p* = .573). No significant interaction emerged.

DISCUSSION

Results of the current study add to existing knowledge on the paradoxical positive association between alcohol use and exercise among college students. As expected, in the model in which total exercise minutes was the outcome variable, those who drank more also exercised more, consistent with previous findings (1, 25). This effect also emerged in the aerobic-only model, but

not in the anaerobic-only model, suggesting that this effect is driven by aerobic exercise. Further exploration of the interaction effect (in both the total minutes and aerobic-only models) revealed that the association between alcohol and exercise emerged only for individuals at low levels of positive affect. Thus, low positive affect appears to be a potential driver of the positive association between alcohol use and exercise (especially aerobic exercise) in young people. It is important to note that in this sample, only a small proportion of individuals in the low positive affect group demonstrated high alcohol use and high exercise, so larger sample sizes (including more heavy-drinking, frequent exercisers) are needed to better understand this nuanced finding. Notably, in the high-positive-affect group, exercise and alcohol showed an inverse relationship, and the strength of this association was weaker. Also as expected, those experiencing more positive affect exercised more in this sample, congruent with prior literature (11, 19).

We have several proposed explanations for why exercise behaviors may differ based on levels of positive affect. First, there is consensus in the literature that exercise confers physiological changes that result in improved mood state, lowered levels of anxiety and stress, and feeling of mastery and self-efficacy (23, 24). It is plausible that those with low positive affect may seek the psychological benefits one receives from exercise to avoid low mood. Second, the finding that those who drink more also exercise more may be explained by the compensatory behavior hypothesis. The term "drunkorexia" has emerged to describe people—typically college students—who "restrict caloric intake and/or excessively exercise to mitigate the calories from alcohol" (34). Another explanation may be that college students are overestimating alcohol consumption and exercise behaviors among their peers and may justify their own behaviors as being in line with their peers (15). Finally, our results may be uniquely representative of the region and university where the study took place. Colloquially, Colorado is known for having physically active inhabitants. Drinking and exercising has been normalized across the state, as evidenced by après-ski (a popular social activity which includes drinking after a day of skiing), and breweries that offer activities such as yoga, hiking, and bicycling.

Interestingly, the finding that those who drink more also tend to exercise more only emerged when aerobic-exercise (not anaerobic-exercise) minutes were the outcome. This finding seems consistent with several of the explanations noted above (i.e., pairing alcohol with aerobic recreational activities, using aerobic exercise to compensate for caloric intake from alcohol).

Counter to our hypothesis, cannabis did not moderate the alcohol-exercise association. This finding stands in contrast to several recent studies that have demonstrated significant relations between cannabis and exercise (26, 39). However, this is still an emerging area of research and considerable further exploration is needed to better understand potential relationships between cannabis and exercise. The current sample was not recruited based on regular or frequent cannabis use, and further research should test these associations among individuals who use cannabis more heavily.

It should be noted that the present study was cross-sectional and required participants to engage in subjective, retrospective recall of exercise, substance use, and affect. Future studies should

implement ecological momentary assessment methods, which would enhance ecological validity and generate richer, more detailed data. Future studies would also benefit from implementing objective measurements of exercise, such as an accelerometer or heart rate monitor. This could help reduce potentially inflated estimates of exercise behavior that may arise in subjective measures due to poor recall or social desirability bias. Additionally, future studies may benefit from gathering information on alcohol use and exercise motives to further understand the associations between the two. The present study is also limited by the relatively homogenous sample of undergraduate students. Future studies should explore these questions in a representative, community sample. Finally, this study included a low number of participants who experienced low positive affect, high exercise engagement, and high alcohol consumption. To explore this unique group further, it will be important to utilize targeted recruitment for individuals that exhibit those characteristics to help elucidate the dynamics of their interrelated behaviors.

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