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Age and gender as moderators of the relationship between physical activity and alcohol use

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Abstract

Objective—Understanding moderators of the relationship between physical activity (PA) and alcohol use is important for clarifying the mechanisms underlying these behaviors and informing health promotion interventions. This study examined age and gender as two candidate moderators of the PA-alcohol use link.

Method—As part of a correlational, cross-sectional population-based study of US 34,653 adults, participants were administered surveys assessing demographics, alcohol use, moderate and vigorous PA, and other characteristics. Composite indices of the frequency and quantity of alcohol use and PA were utilized in analyses.

Results—Age moderated the association between past-year vigorous PA and alcohol use ($p \leq .01$). Vigorous PA was positively associated with alcohol use in individuals under 50 years of age ($p \leq .05$), but not in individuals over 50 years of age ($p \geq 0.05$). Gender moderated the association between past-year moderate PA and alcohol use ($p < .001$). The relation was stronger in males ($\beta = .72$) than in females ($\beta = .41$). Each of the findings remained significant even when controlling for demographics, psychiatric variables, and other potential confounds.

Conclusion—Among the American population of adults, age appears to moderate the relationship between vigorous PA and alcohol use, whereas gender appears to moderate the relationship between moderate PA and alcohol use. These findings shed light on the underlying mechanisms that may account for increased alcohol use in exercisers and may have clinical implications for alcohol screening and interventions in adults who lead active lifestyles.

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Contributors

Nadra Lisha completed the analyses and wrote the first draft. Authors Nadra Lisha, Matthew Martend, and Adam Leventhal all contributed to the manuscript and have approved of the final manuscript.

Conflict of Interest

All authors have no conflict of interest.

Keywords

PA; Alcohol use; Age; Health Promotion; Population-Based Survey; BRFSS

Physical activity (PA) and alcohol use have a substantial impact on health (French, Popovici, & Maclean, 2008). One might assume that PA serves as a protective factor against excessive alcohol use, but research on PA and alcohol use has been largely inconclusive (Blair, Jacobs, & Powell, 1985; Elder, Leaver-Dunn, Wang, Nagy, & Green, 2000; Laaksonen, Luoto, Helakorpi, & Uutela; 2002). One explanation of these mixed findings is that the nature of the relationship between physical activity and alcohol use might be dependent on particular socio-demographic characteristics, which tend to vary across study samples. Thus, identifying the characteristics that moderate the relationship between physical activity and alcohol use is important for clarifying this empirical question that remains in the literature. Furthermore, if a certain proportion of individuals who heavily engage in physical activity are identified to be at risk of abusing alcohol, it will be important to target this group for alcohol interventions.

Possible moderators of the relationship between physical activity and alcohol use have remained largely unexamined. The relationship between physical activity and alcohol use may differ by sex for several reasons. For example, some evidence suggests that gender differences exist in the way in which alcohol impacts other aspects of life. A negative association between alcohol consumption and enjoyment of substance-free activity has been found in women but not men (Murphy, Barnett, Goldstein, & Colby, 2007). Murphy, McDevitt-Murphy, and Barnett (2005) found that in college students, alcohol use was associated with lower life satisfaction and anticipated future satisfaction in women. However, in men, alcohol use was related to higher social satisfaction. Although these studies were limited to college students, it is possible that drinking negatively impacts life satisfaction and well-being more strongly in men than women. For these reasons, gender may moderate the relationship between physical activity and alcohol use such that a stronger relationship exists in men.

Although studies examining the level of PA typically adjust for age (Laaksonen et al., 2002; Pate, Heath, Dowda, & Trost, 1996), none have explicitly examined age as a moderator of the alcohol use-PA relationship. The relation may differ by age, though, because the socio-environmental contexts affecting exercise and alcohol use change across the lifespan. Studies using college students have consistently found a positive association between the two (Dunn & Wang, 2003; Moore & Werch, 2008). Youth are generally more engaged in social networks, have a greater quantity of social interactions, and are more involved in organized sport than older adults (Hartup & Stevens, 1999). Older adults are more likely to exercise alone (Dishman, 1994) and engage in less social situations conducive to excessive alcohol consumption (Haraldsdottir & Andersen, 1994). Thus, socio-environmental contexts conducive to PA and alcohol use may be more prevalent in younger adults.

The present study hypothesized that the relationship between PA and alcohol use would be moderated by gender and age. Specifically, we predicted that the relationship would be stronger in males than females, and younger versus older adults. For exploratory purposes, we examined the three way interaction between PA, gender, and age in predicting alcohol use.

1. Method

1.1. Sample and procedure

Participants were respondents in the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC; Wave 2, 2004–2005) (Grant, Moore, Shepard, & Kaplan, 2003). The participants were civilian, non-institutionalized individuals aged 18 and above, and constituted a representative sample of the adult population of the United States. One adult was selected to be interviewed in each household ($N=43,093$). The overall response rate for wave one was 81.0%; and 86.7% ($N=34,653$) for wave two.

2. Measures

2.1. Physical activity

Following McTiernan et al.'s (2006) approach, a composite variable of *vigorous PA* in the last 12 months was created using the product of two items measuring frequency and duration, "How often in the last 12 months did you USUALLY do VIGOROUS activities that caused you to sweat HEAVILY or caused LARGE increases in your breathing or heart rate?" (0=never, 1=1 to 2 times in the last year, 2=3 to 6 times in the last year, 3=7 to 11 times in the last year, 4=once a month, 5=2 to 3 times a month, 6=2 to 3 times a month, 6=once a week, 7=2 times a week, 8=3 to 4 times a week, 9=nearly every day, 10=every day), and "About how long did you USUALLY do these VIGOROUS activities each time?" (minutes).

Similarly, a composite variable was created for *moderate PA* in the last 12 months. This item was created using the product of, "About how often in the last 12 months did you USUALLY do LIGHT or MODERATE activities that caused only LIGHT sweating or a SLIGHT TO MODERATE increase in your breathing or heart rate?" and "About how long did you USUALLY do these MODERATE activities each time?" (minutes).

2.2. Alcohol use

One alcohol use measure was used to approximate participants' level of alcohol consumption. Following Heffernan's (1998) approach, the past 12 months alcohol composite variable was created using the product of two items, "During the last 12 months, about how often did you drink any kind of alcoholic beverage?", and "How many drinks did you USUALLY have on days when you drank during the last 12 months?"

2.3. Age

For the purpose of the study, all subjects were classified into the following seven age groups: (1) 20–25 (7.9%), (2) 26–30 (8.0%), (3) 30 s (19.8%), (4) 40 s (21.4%), (5) 50 s (17.0%), (6) 60 s (11.7%), and (7) ≥ 70 s (14.2%) (Kunz & Graham, 1998).

2.4. AUDADIS-IV

The Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS-IV; Grant et al., 2003) was used to apply *DSM-IV* criteria to determine substance use, mood, and anxiety disorders over lifetime; incorporated as covariates (APA, 1994).

3. Statistical analysis

Linear regression analysis was used to examine univariate relations between PA and alcohol use. To test whether gender moderated PA-alcohol relations, regression models including a PA variable (vigorous or moderate), gender, and their interaction as predictors and alcohol

use as the outcome were performed. Models examining age as a moderator and the three-way interaction were tested in the same fashion.

For all analyses, two parallel models were performed: using moderate and vigorous PA as predictors. Simple effects analyses were used to deconstruct significant interactions by examining associations between alcohol use and PA in separate subsamples stratified by age or gender accordingly. Each model was tested both unadjusted and after adjusting for demographic (income, age/gender [gender was the covariate for models examining age as the moderator and age was the covariate for models examining gender as the moderator], ethnicity/race, marital status, education, urbanicity) and psychiatric (lifetime history of anxiety, manic, personality, alcohol use, and drug use disorder) covariates. All analyses were conducted using SURVEY procedures in SAS version 9.2 (SAS, 1999).

4. Results

4.1. Univariate relations between PA and alcohol use

See Table 1 for descriptive characteristics of the sample. Vigorous PA was positively associated with alcohol use in both unadjusted models, $\beta=.10$, $p<.0001$, and adjusted models, $\beta=.06$, $p<.0001$. Moderate PA was significantly associated with alcohol use in both unadjusted models, $\beta=.08$, $p<.0001$, and adjusted models, $\beta=.04$, $p<.0001$.

4.2. Relationships between vigorous PA and alcohol use by age and gender

For vigorous PA, there was a significant interaction between vigorous PA and age in both unadjusted models, $\beta=.01$, $p<.0001$, and adjusted models, $\beta=.01$, $p<.001$. However there was not a significant interaction with gender ($ps>.05$).

Simple effect analyses in the subsample by age group showed that in the unadjusted models, the relationship between vigorous PA and alcohol use was statistically significant ($ps<.01$) for all ages, although the effect sizes were stronger among younger ages (Table 2). In adjusted models, a similar pattern was noted. Higher levels of vigorous PA were significantly associated with increased alcohol use only in the under 50 age groups ($p<.01$) with the most robust relation evident in the 20–25 year old bracket. In contrast, the relationship was not statistically significant in subsamples of adults over age 50.

4.3. Relationships between moderate PA and alcohol use by age and gender

There was a significant interaction between moderate PA and gender in both unadjusted models, $\beta=.11$, $p<.0001$, and models adjusted models, $\beta=.06$, $p<.001$. However there was not a significant interaction with age ($ps>.05$).

Simple effects analysis of the interaction between gender and moderate PA on alcohol use revealed that the relationship was stronger in men ($\beta=.72$) than women ($\beta=.41$) in the unadjusted models. In the adjusted models; the results remained; men were found to have a stronger relationship between moderate PA and alcohol use ($\beta=.39$) than women ($\beta=.16$).

4.4. Three-way interaction between PA, age, and gender in predicting alcohol use

The three-way interaction between PA, age, and gender was not significant in both the unadjusted or adjusted models for both vigorous and moderate PA (Table 2).

5. Discussion

The present study extends literature on the PA-alcohol use link by examining the moderating effect of age and gender. Consistent with our hypotheses, age significantly moderated the

association between vigorous PA and alcohol use. Vigorous PA evidenced stronger relationships in younger participants. The relations were strongest in adults aged 20–25, moderate in those 26–50, and weakest in adults over age 50. Furthermore, gender significantly moderated the moderate PA-alcohol use link, with stronger associations in men. Overall, moderated effects remained in models after adjusting for demographic and psychiatric characteristics. Age and gender respectively did not significantly moderate the effects of moderate PA and vigorous PA.

Social-environmental contexts play a significant role in drinking behaviors and PA, and vary by age. Evidence indicates that older adults are less likely to exercise with others (Dishman, 1994) and take part in social situations involving alcohol (Moore et al., 2005). Thus, social-environmental contexts that facilitate both drinking and vigorous exercise may be more common in young adults. However, it is unclear why these effects did not generalize to moderate PA.

One reason that gender might moderate the relationship between moderate PA and alcohol use is that men are more likely than women to engage in recreational sports. For example, men might be more likely to join sports leagues that encourage drinking behavior among males, while females are more likely to engage in exercise as part of a substance-free leisure-time activity (Murphy et al., 2007).

The present study has limitations. The study utilized a cross-sectional correlational design. Cultural and historical differences across age cohorts rather than developmental processes could account for age differences. Items were self-report and examined composite patterns of behavior. It would have been preferable to examine whether effects were consistent across alternate self-report indices or objective/biochemical measures. Range restrictions could limit the ability to detect alcohol-activity associations in older groups. However, inspection of the standard deviation of these variables indicates that reductions in variability with increasing age were much less extreme than the reduction in the size of exercise-drinking associations. Finally, this study lacked specific data on socio-personal-environmental.

To our knowledge, this is the first study examining age and gender as moderators of the association between PA and alcohol use in a large, national sample of adults. The study enhanced previous investigations by examining moderate and vigorous PA separately. As hypothesized, we found that the association involving vigorous PA was stronger in younger adults than older adults. The current results point toward future longitudinal studies and examinations of putative mechanisms of the moderation. Results suggest that younger individuals who engage in more vigorous PA as well as males engaging in moderate PA consume more alcohol. Thus, it may behoove health professionals to screen for alcohol use problems among vigorously active young adults and moderately active men, who may otherwise appear healthy. Additionally, alcohol interventions may need to be disseminated for potentially overlooked groups.

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Table 1

Demographic characteristics by age category.

	Age 20–25	26–30	31–40	41–50	51–60	61–70	70+
Sex (% male)	45.56	39.16	40.53	44.60	43.90	42.75	36.52
N (% of total sample)	7.85	7.94	19.81	21.42	16.99	11.72	14.26
(number)	2721	2750	6866	7424	5889	4061	4942
Ethnicity (%)							
White	49.72	51.35	50.90	57.15	61.00	63.43	70.62
Black	18.71	18.47	19.57	19.19	20.56	19.92	15.80
American Indian	1.54	1.38	1.66	1.72	2.02	1.85	1.25
Asian	3.56	3.56	3.73	2.98	2.34	1.95	1.60
Hispanic	26.46	25.24	24.13	18.95	14.08	12.85	10.72
Vigorous PA frequency, M (SD)	6.30 (3.06)	6.19 (3.09)	5.90 (3.22)	5.77 (3.30)	5.14 (3.51)	4.19 (3.73)	2.53 (3.50)
Length of vigorous PA, M (SD)	92.53 (116.53)	83.10 (115.54)	78.46 (110.53)	77.91 (110.66)	65.85 (98.90)	51.67 (83.04)	30.25 (62.28)
Vigorous PA (composite), M (SD)	731.17 (1082.48)	647.35 (1054.85)	95.83 (984.92)	588.84 (982.46)	473.25 (841.93)	349.28 (638.05)	190.88 (448.38)
Typical alcohol frequency, M (SD)	3.99 (3.0)	3.61 (2.92)	3.56 (3.02)	3.62 (3.25)	3.42 (3.41)	2.83 (3.46)	2.21 (3.35)
Typical number of drinks	2.74 (2.87)	2.11 (2.87)	1.93 (2.3)	1.68 (2.06)	1.37 (1.77)	0.99 (1.41)	0.59 (0.93)
Typical use (composite), M (SD)	16.14 (21.52)	11.51 (15.01)	10.58 (16.42)	9.80 (14.92)	8.23 (13.83)	6.06 (10.56)	3.59 (7.29)
Moderate PA frequency, M (SD)	8.27 (2.13)	8.23 (2.17)	8.17 (2.17)	8.16 (2.22)	8.11 (2.37)	8.16 (2.51)	8.45 (2.82)
Length of moderate PA, M (SD)	102.60 (139.17)	97.01 (128.92)	81.10 (128.92)	89.76 (127.44)	76.41 (112.15)	65.55 (98.81)	45.64 (73.63)
Moderate PA (composite), M (SD)	885.58 (1313.05)	843.01 (1303.79)	775.38 (1214.19)	755.87 (1183.62)	627.57 (1026.85)	518.71 (862.32)	336.45 (605.51)

Table 2

Interactive effects of vigorous PA, age, and gender on alcohol use, and simple effects analysis.

	Unadjusted		Adjusted ^a	
	B	p	β	p
Vigorous PA×age interaction×gender	.01	.15	.01	.24
Vigorous PA×gender interaction	.02	.06	.01	.12
Vigorous PA×age interaction	.01	<.0001	.01	<.001
Effect for 20–25 year old group (N=2721)	.14	<.0001	.14	<.0001
Effect for 26–30 year old group (N=2752)	.11	<.0001	.06	<.01
Effect for 31–40 year old group (N=6866)	.10	<.0001	.06	<.0001
Effect for 41–50 year old group (N=7423)	.10	<.0001	.06	<.0001
Effect for 51–60 year old group (N=5888)	.04	<.01	.02	.21
Effect for 61–70 year old group (N=4061)	.05	<.001	.02	.18
Effect for 70+ year old group (N=4942)	.07	<.0001	.02	.22
Moderate PA×age interaction×gender	.01	0.16	.01	0.29
Moderate PA×gender interaction	.11	<.0001	.06	<.001
Moderate PA×age interaction	.01	0.24	.00	0.81
Effect for males	.72	<.0001	.39	<.0001
Effect for females	.41	<.0001	.16	<.0001

Note. N=34653.

^a Adjusted for income, gender or age (depending on whether age or gender is already included as the moderator), ethnicity/race, marital status, education, urbanicity, and lifetime history of anxiety, manic, personality, alcohol use, and drug use disorder.