



The positive association between physical activity and alcohol use in African American adults

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ABSTRACT

African Americans have highest incidence and mortality from obesity-related cancers. Physical activity (PA), minimal alcohol use, and maintaining a low body mass index (BMI) are important cancer prevention behaviors, though there is little research on how these behaviors are associated with one another in African Americans. The purpose of this study is to assess the relationship between PA, alcohol use, and BMI using secondary data from an African American cohort recruited from Houston-area churches. Self-administered questionnaires measured self-reported PA, alcohol use, height, weight, and sociodemographic factors. Univariate and multivariable analyses assessed the relation between PA, alcohol use, BMI, controlling for covariates. Participants (N = 1009) were mostly female (77%), employed (72%), and college graduates (55%). Most (53%) reported both light-to-moderate alcohol use & moderate-to-high levels of PA. There was a statistically significant positive linear association between PA and alcohol use (Pearson's $r = 0.15$, $p < 0.001$). We also found that every one hour increase per week in PA was associated with 3% increased odds of being a heavy drinker (>2 drinks/day men, >1 drink/day women), as compared to an abstainer (Adjusted OR = 1.03, 95%CI 1.01–1.06). There was a statistically significant inverse association between PA and BMI, but no statistically significant association between alcohol use and BMI. In this sample of African Americans, PA and alcohol use were positively associated, mirroring results among Non-Hispanic Whites. However, alcohol use and BMI were not statistically significantly associated. Cancer and obesity prevention for African Americans should stress PA promotion while emphasizing messaging to curtail any associated increases in alcohol use.

1. Introduction

African Americans have some of the highest incidence and mortality rates from obesity-related cancers (DeSantis et al., 2019). In addition to having some of the highest rates of obesity in the U.S. (Flegal et al., 2016; Ogden et al., 2015), African Americans also have high rates of physical inactivity (Crespo et al., 2000; Tucker et al., 2011). While physical activity is associated with a reduced risk of obesity (Chin et al., 2016; McGrath et al., 2017; Reiner et al., 2013; Wareham et al., 2005), it is also independently associated with lower cancer risk (Kushi et al., 2012; Nunez et al., 2017).

Minimizing alcohol intake is another important cancer prevention behavior that gets limited attention in health promotion messaging

(Baan et al., 2007; Fund and Research, 2007; LoConte et al., 2018). This may be partially due to a controversial history (Marlatt and Witkiewitz, 2002) and industry marketing, as well as industry involvement in the funding of the science around alcohol use (Editors, 2011; Miller and Harkins, 2010; Mitchell et al., 2019; Stenius and Babor, 2010). Additionally, there is public confusion on the status of alcohol as a health risk factor. This is especially true for wine due to research that has shown, and been widely promoted by the media, that light-to-moderate alcohol intake is associated with reduced cardiovascular disease and mortality (Costanzo et al., 2010; Mukamal et al., 2010; O'Keefe et al., 2014; Ronsley et al., 2011). However, evidence from studies of African Americans suggests any amount of alcohol intake actually increases the risk of cardiovascular disease and mortality (Fuchs et al., 2004; Jackson

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et al., 2015; Pletcher et al., 2005; Sempos et al., 2003). Therefore, the few benefits attributed to light-to-moderate alcohol intake in the general population may not be applicable to African Americans. While in other racial/ethnic groups light-to-moderate alcohol intake may be associated with lower BMI (Arif and Rohrer, 2005; Heredia et al., 2021; O'Donovan et al., 2018) and even reduced risk of obesity (Wang et al., 2010) potentially due to uncontrolled confounding, there is a gap in the literature for African Americans populations that investigate this relationship while also controlling for important covariates, especially physical activity and diet. After controlling for these variables, alcohol intake may be associated with increased BMI due to excess calories. Thus, this paper aims to fill in the gap in the literature on the association between alcohol intake and obesity in African Americans controlling for other lifestyle variables such as physical activity and diet that may be influencing the relationship.

As mentioned, physical activity may play a role in the relationship between alcohol intake and obesity. Studies in the general population and amongst predominately White participants have indicated that physical activity and alcohol intake are positively associated (Dodge et al., 2017; French et al., 2009; Piazza-Gardner and Barry, 2012). A few studies have minimally explored this relationship in African Americans, and their results indicate a potential positive association between physical activity and alcohol intake (Adams-Campbell et al., 2000; Pletcher et al., 2005), similar to Whites, though no significant association between physical activity and heavy drinking (Diaz et al., 2017). However, the relationship between alcohol and physical activity was not the main focus in these studies and thus they did not control for any covariates, such as diet. Furthermore, if alcohol intake and physical activity are positively associated, but each has the opposite association with obesity, it is unclear how the two behaviors would interact to impact obesity. Given that little to no alcohol intake, physical activity, and maintaining a healthy weight are all important cancer prevention measures, there is a need to clarify the relationship between these three variables in African Americans.

The purpose of this study was to assess the relationship between alcohol intake and physical activity in an African American sample. We hypothesized that alcohol intake and physical activity would be positively associated. The secondary aims were to assess the interaction of physical activity and alcohol intake on obesity, and how this relationship may vary by sex. We hypothesized that after controlling for covariates, 1) alcohol intake would be positively associated with obesity, contrary to the existing literature in non-Hispanic Whites, and 2) physical activity would be inversely associated with obesity. We had no *a priori* hypotheses about how the interaction between the two behaviors would influence obesity.

2. Methods

2.1. Design

This study was a secondary data analysis of Project CHURCH, a cohort of African American churchgoers in the greater Houston area. In-depth details on Project CHURCH are published elsewhere (McNeill et al., 2018), but briefly, participants for Project CHURCH were recruited from a large Black church with a congregation of over 15,000. Participants recruited from that site had to be 18 years or older, able to read and write in English, live in the greater Houston area, and have a valid telephone number. Data were collected yearly with the latest data, collected in 2012, used for this study. Participants completed written informed consent and received a \$30 gift card for their participation. This study was reviewed and approved by the appropriate institutional committee for the Protection of Human Subjects.

2.2. Data collection & measures

Participants completed a self-reported questionnaire on a computer.

Questionnaires included demographic questions that assessed sex, age, education, annual household income, employment, marital status, and general health status. Questionnaires also included behavioral questions that assessed physical activity, alcohol intake, diet and smoking. Physical activity was assessed with the International Physical Activity Questionnaire [IPAQ] (Hagströmer et al., 2006). Participants were asked to report first the number of days over the previous seven days in which they did vigorous, moderate and/or walking activities, and then asked to estimate how long they usually did these activities each time they did them. We calculated the total minutes of physical activity over the previous week with these data using standardized scoring recommendations (IPAQ Research Committee, 2005). For descriptive purposes only, we categorized participants into high (vigorous intensity activity on ≥ 3 days achieving ≥ 1500 MET minutes/week or ≥ 7 days of any combination of walking, moderate intensity or vigorous intensity activities achieving ≥ 3000 MET minutes/week), moderate (≥ 3 days of vigorous intensity activity and/or walking of at least 30 min/day, or ≥ 5 days of moderate intensity activity and/or walking of at least 30 min/day or ≥ 5 days of any combination of walking, moderate intensity or vigorous intensity activities achieving ≥ 600 MET minutes/week), or low physical activity (meeting neither moderate nor high criteria), per standardized IPAQ scoring procedures (IPAQ Research Committee, 2005). Alcohol intake was assessed with a series of questions that first asked participants if they had any alcoholic beverages in the past year, and if so, to estimate the number of drinks they consumed on an average day of the week (e.g. Monday, Tuesday, etc.) during the past month. We then combined the responses to the seven days together to obtain the average number of alcohol drinks consumed in a week (Sobell and Sobell, 2003). The U.S. Department of Health and Human Services defines moderate drinking as up to 1 drink per day for women and 2 drinks per day for men (U.S. Department of Health and Human Services and U.S. Department of Agriculture, December, 2015), so we categorized drinkers as light-to-moderate (by sex) if they did not exceed these guidelines. If men reported an average of > 2 drinks per day or women reported > 1 drink per day, we categorized them as heavy drinkers. Dietary intake was collected with the Multifactor Screener used by the National Health Interview Survey Cancer Control Supplement, in which participants reported how many times per day, week, or month over the past month they had consumed various foods. Fruit and vegetable intake, and percent energy from fat, were computed using standard procedures (Thompson et al., 2004). We assessed red meat intake with four items that assessed frequency of eating various red meat products and then summed these items to obtain weekly red meat intake. Smoking was assessed with two items that asked about time to first smoking in the morning and number of cigarettes per day. Answers to these two items were used to calculate heaviness of smoking index using standard procedures (Heatherton et al., 1989). Height and weight were measured by study staff and body mass index (BMI) was calculated.

2.3. Statistical analyses

First, we assessed demographic characteristics and descriptive statistics of all main variables among the full sample, and by sex. We examined the association of physical activity and alcohol use using crosstabs/unadjusted multinomial logistic regression for categorical variables and correlation/unadjusted linear regression for continuous variables. This was followed by both multiple linear regression using continuous alcohol use (drinks per week) as the outcome and multinomial logistic regression with categorical alcohol use (heavy and light-to-moderate drinking, with abstainers as the reference) as the outcome. These analyses were done for the full sample, controlling for covariates including sex, education, annual household income, employment, marital status, general health status, fruit and vegetable intake, percent energy from fat, red meat consumption, and smoking. We tested a multiplicative interaction using a cross-product term to determine if sex modified the association between our primary variables. While this

cross-product term was not statistically significant, we choose to provide analyses by sex as well, due to the clinically different findings. To investigate the association between physical activity and alcohol use with BMI as an outcome, we conducted multiple linear regression analyses to assess the independent and joint relationship of physical activity and alcohol use on BMI, while controlling for all the same aforementioned covariates. We examined multiplicative interaction by using a cross-product term, testing an interaction between physical activity and alcohol intake using an F-test in the analyses. We removed interaction terms from the final model that failed to meet significance at $p < 0.05$. All analyses were conducted with SAS 9.4.

3. Results

Table 1 shows the demographic characteristics of the Project CHURCH analytical sample. Most of the sample was female (77%), had completed college (66%) and had an annual household income of \$40,000 or more (74%). Compared to men, women reported less fruit and vegetable intake, percent energy from fat, red meat consumption, smoking, physical activity and alcohol use. Women also had had a higher BMI. Most of the sample (74%) reported moderate or high physical activity levels and light-to-moderate drinking (73%). About half of the sample (55%) self-reported being light-to-moderate drinkers who also met physical activity guidelines (not pictured). Controlling for covariates (sex, education, income, employment, marital status, general health status, fruit and vegetable intake, percent energy from fat, red meat consumption, and smoking), there was a statistically significant, though weak, positive linear association between weekly minutes of physical activity and number of alcohol drinks per week in the overall

Table 1
Demographics of African Americans Project CHURCH participants in Houston.

N (%), unless indicated otherwise	Total (n = 1040)	Men (n = 238)	Women (n = 802)
Age, M (SD)	49 (12.5)	48.2 (13.0)	49.2 (12.3)
Educational level			
HS Grad./Some College	355 (34.1)	89 (37.4)	266 (33.2)
College graduate	445 (42.8)	107 (45.0)	338 (42.1)
Post-graduate	240 (23.1)	42 (17.6)	198 (24.7)
Annual Household income			
Less than \$40,000	268 (26.1)	39 (16.5)	229 (29.0)
\$40,000-\$79,999	405 (39.4)	92 (39.0)	313 (49.5)
\$80,000 or more	354 (34.5)	105 (44.5)	249 (31.5)
Unemployed	289 (27.8)	61 (25.6)	228 (28.4)
Unmarried	580 (55.9)	82 (34.5)	498 (62.3)
General Health Status			
Poor/Fair	152 (14.6)	26 (10.9)	126 (15.7)
Good/Very Good/Excellent	888 (85.4)	212 (89.1)	676 (84.3)
Fruit and Vegetable Intake (M, SD)	4.0 (1.7)	4.5 (1.8)	3.9 (1.7)
Percent Energy from Fat (M, SD)	34.2 (5.3)	35.0 (5.9)	33.9 (5.1)
Red Meat Consumption (M, SD)	3.9 (3.5)	4.7 (4.0)	3.6 (3.3)
Heavy Smoking Index (M, SD)	0.1 (0.5)	0.2 (0.6)	0.1 (0.4)
BMI (M, SD)	31.8 (7.3)	30.9 (6.1)	32.1 (7.6)
BMI			
Underweight/Normal	154 (15.4)	34 (14.5)	120 (15.7)
Overweight	296 (29.7)	82 (35.1)	214 (28.0)
Obese	548 (54.9)	118 (50.4)	430 (56.3)
Physical activity in hours/week (M,SD)	11.7 (11.5)	16.5 (13.5)	10.4 (10.5)
Physical Activity Levels			
Low Activity	259 (25.7)	38 (17.0)	221 (28.1)
Moderate Activity	324 (32.1)	51 (22.9)	273 (34.7)
High Activity	426 (42.2)	134 (60.1)	292 (37.2)
Alcohol Use in drinks/week (M,SD)	3.0 (4.4)	4.3 (5.5)	2.6 (3.9)
Alcohol Use Level			
Abstainer	218 (21.0)	45 (18.9)	173 (21.6)
Light-to-Moderate Drinker	757 (72.8)	177 (74.4)	580 (72.3)
Heavy Drinker	65 (6.2)	16 (6.7)	49 (6.1)

sample (Adjusted estimate = 0.01, 95%CI 0.002, 0.010, $p < 0.01$) and in women (Adjusted estimate = 0.01, 95%CI 0.01, 0.02, $p < 0.001$).

In Table 2 we present data on the relationship between physical activity and alcohol use after controlling for covariates. Individuals with higher levels of physical activity had higher odds of being a heavy drinker (>2 drinks/day for men or > 1 drink/day in women) compared to abstainers (Adjusted Odds Ratio [AOR] = 1.03, 95%CI (1.01, 1.06), though their odds of being a light-to-moderate drinker were not statistically significantly different from being an abstainer. This association appears to be driven by females, as females with higher levels of physical activity had higher odds of being heavy drinkers compared to abstainers (AOR = 1.04, 95% CI 1.01, 1.07). No statistically significant findings were identified in males.

We also examined the relationship between alcohol use and physical activity on BMI, controlling for covariates (Table 3). There was a statistically significant inverse association between physical activity and BMI in the overall sample, even when controlling for alcohol use; that is, as physical activity increased, BMI decreased (Adjusted Estimate = -0.07, 95% CI -0.11, -0.02). However, neither level of alcohol use was statistically significantly associated with BMI in the overall sample after controlling for physical activity and covariates. As there was no statistically significant interaction between PA and alcohol intake on BMI, the interaction term was removed from the model.

4. Discussion

Our study assessed the relationship between physical activity, alcohol and BMI in a cohort of African American churchgoers. As we hypothesized, we found a positive weak linear association between PA and alcohol use; as alcohol use increases, physical activity tends to increase as well. These results mirror the large body of literature that has examined this relationship across various populations, especially in Non-Hispanic White populations (Dodge et al., 2017; Piazza-Gardner and Barry, 2012), as well as a few of the studies that have peripherally assessed this association in African American samples (Adams-Campbell et al., 2000; Pletcher et al., 2005). However, findings using categorical variables showed that only heavy drinking, and not light-to-moderate alcohol use, was statistically significantly associated with physical activity, though estimates were small. This finding is in contrast to a previous study that found physical activity was not associated with heavy levels of drinking (Diaz et al., 2017), though this study did not control for covariates as the association under investigation here was not their primary aim. The relationship between PA and alcohol use appears to be complex and is further complicated by an existing body of literature that fails to clarify the temporal and causal relationship between the two variables (Piazza-Gardner and Barry, 2012). Both casual directions may be possible, with increased physical activity being thought of as a way to expend the extra calories from alcohol, or group sports leading to additional social connections with others and then subsequent social

Table 2
Adjusted multinomial logistic regression to assess the relationship of physical activity with alcohol use categories.

Parameter	Full Sample N = 987		Males N = 219		Females N = 768	
	Heavy Drinker	LTM Drinker	Heavy Drinker	LTM Drinker	Heavy Drinker	LTM Drinker
OR (95% CI); Ref: Abstainer						
Physical Activity (hours/week)	1.03 (1.01, 1.06)	1.00 (0.99, 1.01)	1.03 (0.98, 1.09)	1.01 (0.98, 1.04)	1.04 (1.01, 1.07)	1.00 (0.98, 1.02)

Notes: Model uses multinomial logistic regression; Models controlled for sex (full sample only), education, annual household income, employment, marriage status, general health status, fruits and vegetable intake, percent energy from fat, red meat consumption, and smoking.

Table 3

Adjusted linear regression analyses to assess the relationship of alcohol use and physical activity with BMI.

Parameter	Full Sample N =	Males N = 215	Females N =
	947		732
	Estimate (95% CI)		
Physical Activity (hours/week)	-0.07 (-0.11, -0.02)	-0.05 (-0.11, 0.01)	-0.07 (-0.13, -0.02)
Alcohol use (Ref: Abstainer)			
Light-to-Moderate Drinker	0.46 (-0.71, 1.63)	-0.27 (-2.41, 1.88)	0.49 (-0.90, 1.87)
Heavy Drinker	-1.52 (-3.73, 0.69)	-2.09 (-5.86, 1.68)	-1.25 (-3.91, 1.42)

Notes: Model uses linear regression; Alcohol use \times Physical activity interaction term was not significant, so it was removed from the model; controlled for sex (full sample only), education, annual household income, employment, marriage status, general health status, fruits and vegetable intake, percent energy from fat, red meat consumption, and smoking.

drinking opportunities (Dodge et al., 2017). It is also possible that the observed relationship is one of uncontrolled confounding, despite our and others' efforts to control for a myriad of relevant demographic and lifestyle variables. Higher levels of leisure-time physical activity and alcohol intake might both be characteristics of adults with higher socioeconomic status (Collins, 2016; Gidlow et al., 2006). However, our study controlled for socioeconomic factors, including income, employment and education. Other characteristics, such as sensation-seeking (French et al., 2009) or extroversion (Dodge et al., 2017), have also been posited as potential confounders, though we were not able to explore their effect in our study. More research is needed with large samples of African Americans, while controlling for important socioeconomic status, lifestyle and personality variables, in order to further clarify the relationship between physical activity and alcohol use.

We also found, as we hypothesized and expected from the body of literature (Chin et al., 2016; McGrath et al., 2017; Reiner et al., 2013; Wareham et al., 2005), that in African Americans more physical activity was associated with lower levels of BMI. However, we did not find an association between alcohol use and BMI, contrary to our hypothesis. In meta-analyses and systematic reviews, it appears that light-to-moderate alcohol intake is associated with reduced risk of obesity, especially in women (Bendsen et al., 2013; Sayon-Orea et al., 2011; Yeomans, 2010), though the evidence is still mixed and drink type (wine, beer, spirits, etc.) appears to play an important role (Traversy and Chaput, 2015). However, the studies included in these reviews have samples that are predominately Non-Hispanic White and thus findings do not necessarily elucidate the associations for these variables in African American populations. Focusing on the limited existing literature on African Americans, it appears that there may also be a negative association between drinking and BMI in African American women (Curtis et al., 1997; Gearhardt and Corbin, 2009; Sa et al., 2019), although none of these studies controlled for diet, one of the most important determinants of BMI and obesity (Bray et al., 2004; Hruby et al., 2016; Rennie et al., 2005). In our study, which fills a gap in the literature by exploring these relationships in African Americans while controlling for various dietary variables, alcohol intake and BMI were not statistically significantly associated. More research is needed to assess the relation of type of alcohol beverage and/or alcohol use patterns with BMI in African Americans. Our study was unique in that we explored an interaction between physical activity and alcohol use on BMI. However, we did not find any statistically significant interaction. In this study we did not assess more distal outcomes such as cardiovascular disease, but it must be noted that in African Americans any amount of alcohol intake may be associated with increased risk of negative cardiovascular outcomes (Fuchs et al., 2004; Jackson et al., 2015; Pletcher et al., 2005; Sempos et al., 2003). Therefore, minimizing alcohol intake in African Americans

remains an important health promotion behavior.

4.1. Limitations

We were only able to collect self-reported physical activity, which has several limitations, including the potential for over-reporting. We were not able to assess domain-specific physical activity, therefore, we were not able to investigate nuanced relationships between domain of physical activity and alcohol use. Similarly, we did not capture type of alcohol beverage nor alcohol use patterns, which have also been shown to be important when assessing the impact of alcohol use on health outcomes (Sayon-Orea et al., 2011). Lastly, this was a cross-sectional study, which precludes investigation of temporality or assessment of a causal relationship between physical activity and alcohol intake. Further research is needed to ensure increases in physical activity are not followed by increases in alcohol intake in a population that experiences some of the highest burden of cancer and chronic disease. Despite these limitations, we investigated important relationships between cancer risk behaviors in a population for whom this research is largely lacking.

5. Conclusions

We found that in African American church members, alcohol intake was weakly but positively associated with physical activity, a finding which aligns with the literature in Non-Hispanic Whites, and that more physical activity was associated with reduced BMI, consistent with the literature across various racial/ethnic groups. Unlike the existing literature, we found that alcohol intake was not associated with BMI in this African American sample. Despite our findings that alcohol intake and BMI were not significantly associated, this should not detract from existing recommendations for cancer and obesity prevention. Cancer and obesity prevention interventions with African Americans should continue to emphasize physical activity promotion and include messaging on minimizing alcohol intake.

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7. Ethical review

This study contained human subjects/participants. This study was reviewed and approved by the MD Anderson Institutional Review Board.

8. Consent to participate

Written informed consent was obtained from all individuals prior to participation in this study.

CRedit authorship contribution statement

Natalia I. Heredia: Conceptualization, Investigation, Visualization, Writing - original draft. **Nga Nguyen:** Data curation, Formal analysis. **Bryan A. Martinez:** Writing - review & editing, Visualization. **Ezemenari M. Obasi:** Writing - review & editing. **Lorna H. McNeill:** Conceptualization, Funding acquisition, Writing - review & editing.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

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