

## ORIGINAL RESEARCH

# Sugar-sweetened beverage consumption and sleep duration among adult men: the role of race and ethnicity

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**Abstract**

Less attention has been given to the relationship between the consumption of sugar-sweetened beverages and sleep among adult men, even though they are a group that consumes a large amount of sugar-sweetened beverages and who has worse sleep duration than women. The purpose of the current study is to explore the association between the consumption of sugar-sweetened beverages and sleep duration and to investigate how the relationship differs by race and ethnicity among adult men. The current study employed a secondary dataset—the National Longitudinal Survey of Youth 1979 for Children and Young Adults. A total of 2609 participants were selected for analysis. A moderation model was employed to explore the moderating effect of race and ethnicity on the relationship between sugar-sweetened beverage consumption and sleep duration. The consumption of sugar-sweetened beverages among adult men was negatively related to their sleep duration ( $p < 0.01$ ). The association between the consumption of sugar-sweetened beverages and sleep duration among adult men was moderated by Hispanic identity ( $p < 0.05$ ). Unlike for White adult men, whose sleep duration may be significantly affected by the reduced consumption of sugar-sweetened beverages, addressing other factors such as stress associated with discrimination in the workplace or the job market may be more important to enhance Hispanic adult men's sleep duration. Alternative options such as unsweetened teas, 100% fruit juice, or water may be emphasized in education may be emphasized to substitute at least some sugar-sweetened beverages to improve adult men's poor sleep duration.

**Keywords**

Sugar-sweetened beverage; Sleep; Adult men; Race and ethnicity

## 1. Introduction

The consumption of sugar-sweetened beverages has been found to negatively impact multiple facets of health, including but not limited to sleep duration [1–3]. Sugar-sweetened beverages are defined as beverages that are sweetened with some form of added sugar, such as high-fructose corn syrup, fructose, or glucose, and may include soda, sports or energy drinks, or sweetened coffee or tea [4]. There are demonstrated gender and racial/ethnic differences in sugar-sweetened beverage consumption and sleep duration, with men drinking larger quantities of sugar-sweetened beverages and sleeping fewer hours on average than women [5–12]. Additionally, Black or African American people and other people of color tend to consume larger quantities of sugar-sweetened beverages and to sleep fewer hours on average than white people [7, 13–22]. Sleep duration has been associated with multiple deleterious health outcomes, including but not limited to depression, diabetes, heart disease, hypertension, inflammation, and stroke [3, 20, 22–24]. Thus, examining

consumption of sugar-sweetened beverages and sleep duration is important for their impacts on multiple facets of physical and mental well-being.

Evidence suggests that men consume sugar-sweetened beverages in higher quantities and frequencies than women [8, 10, 11]. In one study, men consumed nearly twice as much carbonated beverages by volume per day than women, nearly four times as much energy drinks by volume, and more than nine times as much sports drinks by volume, compared to women [10]. Regarding race/ethnicity, Black and Hispanic or Latino(a) adults drink more sugar-sweetened beverages than white adults in terms of quantity and frequency of consumption [7, 12, 14, 15, 19]. In one survey, Black or African American adults were three times as likely as white adults to be considered frequent consumers of sugar-sweetened sodas (Rehm *et al.* [19], 2008). Moreover, although the average daily consumption of sugar-sweetened beverages decreased in one study for all adults between 2003 and 2018, non-Hispanic white adults were significantly less likely to consume any sugar-sweetened beverage on a given day compared to

Hispanic adults [14]. These findings suggest that men of color are at particular risk for the detrimental health outcomes associated with sugar-sweetened beverage consumption, due to the high prevalence of consumption among men of all races and people of color.

On average, men also sleep fewer hours per night than women. Although women are equally, if not more, prone to certain sleep issues than men (*e.g.*, frequent nighttime awakenings, clinical insomnia), men have been found to report shorter sleep duration, longer sleep onset latency (*i.e.*, the amount of time it takes to fall asleep), and decreased sleep efficiency [5, 6, 9, 25–27]. Moreover, similarly to sugar-sweetened beverage consumption, much evidence suggests that Black or African American people, and to a lesser extent other people of color, have a shorter average sleep duration than white people [12, 16–18, 20–22]. In multiple studies, Black or African American adults were significantly more likely than white adults to report sleeping fewer than five hours per night on average [13, 16, 21, 22, 26]. In another study that tracked sleep duration over three nights, Black men slept one fewer hour than white men on average [18]. Last, in a nationwide survey of U.S. adults, Asian adults were almost four times as likely as white adults to report sleeping fewer than five hours per night on average [21]. These findings suggest that men and people of color, especially Black and African American people, are at increased risk for the negative effects of short sleep duration compared to women and white people.

The current study examines the relationship between the consumption of sugar-sweetened beverages and sleep duration among adult men and possible disparities based upon men's race/ethnicity. Individuals' sleep duration and the type of food and drink they consume, including sugar-sweetened beverages, greatly influence their physical and mental health, and having good mental and physical health is important for a person's ability to work and their overall satisfaction with their lives [1, 2, 27–30]. Due to discrimination and other gender-based factors, adult men are employed at higher rates than are adult women, both globally and in the U.S. only [23, 24], and thus they may be responsible for financially providing for themselves and their families. Thus, they might not have adequate time for sleep. In addition, they may consume unhealthy sugar-sweetened beverages with caffeine in response to their short sleep duration, or, their consumption of sugar-sweetened beverages may affect their sleep duration. Although there is a large body of studies that support the relationship between the consumption of sugar-sweetened beverages and deleterious health outcomes [1, 2], less attention has been given to the relationship between the consumption of sugar-sweetened beverages and sleep among adult men, even though they are a group that consumes a large amount of sugar-sweetened beverages and who has a shorter average sleep duration than women [5–12, 25, 26, 31]. In addition, sleep duration and the consumption of sugar-sweetened beverages differ across racial and ethnic groups [13, 16, 17, 19–22]. Despite this, little research has examined the effect of race/ethnicity on the relationship between sugar-sweetened beverage consumption and sleep duration among adult men specifically; examining racial/ethnic differences in sleep quality and duration has only become more common in recent years, and was not often

considered in early sleep research [28]. Therefore, this study examines disparities in race and ethnicity on the relationship between the consumption of sugar-sweetened beverages and sleep duration among adult men. More specifically, the purpose of the current study is: (1) to explore the association between the consumption of sugar-sweetened beverages and sleep duration among adult men; and (2) to investigate disparities in race and ethnicity regarding the relationship between adult men's consumption of sugar-sweetened beverages and sleep duration.

## 2. Materials and methods

### 2.1 Participants and sampling

The current study employed a secondary dataset—the National Longitudinal Survey of Youth 1979 for Children and Young Adults (NLSY79 CY)—which is a nationally representative sample of Americans. The U.S. Bureau of Labor Statistics coordinated the data collection and survey distribution. For this study, information about sleep duration, the consumption of sugar-sweetened beverages, and basic sociodemographic data including race/ethnicity comes from data collected in 2014. As this study only seeks to address adult men's health, only men over the age of 18 years were included in the final sample. In addition, adult men who refused to respond to the survey or who declined to participate were not included in the present analysis. Thus, a total of 2609 participants met the inclusion criteria and were selected for analysis.

### 2.2 Measures

#### 2.2.1 Sleep duration

Sleep duration, or hours of sleep a night, were reported by the participants. Participants were asked to state how many hours they slept on a typical weeknight. Thus, sleep duration in this study refers to the number of hours of sleep on an average weeknight, and a higher number of sleep hours indicates a longer sleep duration.

#### 2.2.2 Soft drinks and sugar-sweetened beverage consumption

Soft drinks and sugar-sweetened beverages in this study refer to any type of soft drink, soda or other beverage that is sweetened with sugar. Therefore, diet soft drinks or sodas and carbonated water were not regarded as sugar-sweetened beverages in the current research. Participants were asked to report how many times they consume a sugar-sweetened beverage in a typical week. Seven response options were provided to participants: (1) I do not typically drink soft drinks containing sugar; (2) one to three times per week; (3) four to six times per week; (4) one time per day; (5) two times per day; (6) three times per day; and (7) four or more times per day. A higher score on this measure indicated that participants consumed a higher number of sugar-sweetened beverages.

#### 2.2.3 Race and ethnicity

White, Black and Hispanic adult men were included in this study.

## 2.2.4 Sociodemographic variables

Other sociodemographic variables that may influence adult men's sleep duration were included as control variables. Age, marital status, educational attainment, employment status, and residence were controlled for in this study. Marital status has two categories (married and non-married), and education also has two dimensions (higher education and non-higher education). Employment status also was classified into two categories (employed and unemployed), as was residence (urban area and rural area).

## 2.3 Analysis strategies

A moderation model [32, 33] was employed to address this study's research questions. The moderating effect of race and ethnicity on the relationship between sugar-sweetened beverage consumption and sleep duration among adult men was tested. According to Baron & Kenny's moderation model, three steps were employed to investigate the moderating effect of race and ethnicity on the relationship between sugar-sweetened beverage consumption and sleep duration among adult men, and the processes to be tested are as follows: (a) the relationship between sugar-sweetened beverage consumption and sleep duration among adult men; (b) the association between race/ethnicity and sleep duration; and (c) the moderating interaction effect of race/ethnicity on sleep duration. The three steps are presented in Fig. 1. The Statistical Package for the Social Sciences 23.0 (SPSS) (IBM SPSS Statistics, IBM Corp., Armonk, NY, USA) was used for analysis.

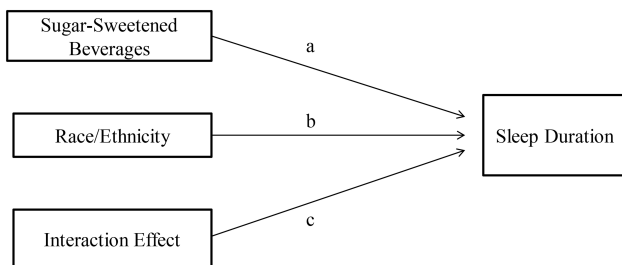


FIGURE 1. Moderation analysis.

## 3. Results

Descriptive statistics are shown in Table 1. Adult men slept for approximately 6.8 hours per night and consumed sugar-sweetened beverages, including soft drinks and soda containing sugar, about four times per week. This is interpreted based on seven response options that were provided to respondents. Participants' average age was 26.9 years old and nearly half were White (46.9%), followed by Black (31.2%), or Hispanic (21.9%). Almost one-fifth of participants were married and about one-fourth had received higher education. Approximately 85% of participants were employed or lived in an urban area.

The three steps indicating a significant moderating effect of race and ethnicity on the relationship between sugar-sweetened beverage consumption and sleep duration among adult men

TABLE 1. Descriptive statistics.

Variable	Total (n = 2609) % or mean (SD)
Hours of sleep	6.78 (1.41)
Sugar-sweetened beverages	2.74 (1.69)
Age (in years)	26.87 (5.15)
Race/Ethnicity	
Whites	46.90%
Blacks	31.2%
Hispanics	21.9%
Marriage	19.5%
Higher educ	85.1%
Residence (Urban area)	84.8%

*Note: The average amount of sugar-sweetened beverages consumed was interpreted in the results section based on a scale with seven response options (1–7). SD: standard deviation.*

are presented in Table 2. In model 1, the consumption of sugar-sweetened beverages among adult men was negatively related to their sleep duration ( $\beta = -0.05, p < 0.05$ ). Further, being Hispanic was also significantly associated with sleep duration ( $\beta = -0.19, p < 0.05$ ). For other sociodemographic variables, age and employment were negatively related to sleep duration, respectively ( $\beta = -0.03, p < 0.001$ ;  $\beta = -0.34, p < 0.001$ ) while higher education was positively associated with sleep duration ( $\beta = 0.18, p < 0.05$ ). The effects of sugar-sweetened beverage consumption and being Hispanic remained significant when the interaction effect was considered in Model 2 ( $\beta = -0.08, p < 0.01$ ;  $\beta = -0.47, p < 0.01$ ). Moreover, Hispanic moderated the association between the consumption of sugar-sweetened beverages and sleep duration ( $\beta = 0.11, p < 0.05$ ). Fig. 2 indicates a moderating effect of being Hispanic on the relationship among adult men. High frequency of sugar-sweetened beverage consumption indicate that adult men drank such beverages at a higher volume than the average of all participants, while low frequency means the opposite. White adult men tended to sleep more hours if they consumed fewer sugar-sweetened beverages compared to those who consumed more sugar-sweetened beverages. More specifically, White adult men had 0.27 hours' higher sleep duration if they consumed sugar-sweetened beverages less frequently. However, for Hispanic adult men, there was little difference on sleep duration between those who drank sugar-sweetened beverages more frequently and those who drank them less frequently, with only a difference of 0.02 hours of

**TABLE 2. Regression results of unstandardized coefficients (standard error). Predicting adult men's sleep.**

Variables	Model 1	Model 2
(Constant)	7.15 (0.21)	7.32 (0.25)
Sugar-sweetened beverages	-0.05 (0.02)*	-0.08 (0.03)**
Age	-0.03 (0.01)***	-0.03 (0.01)***
Marriage	-0.04 (0.08)	-0.05 (0.08)
Higher education	0.18 (0.08)*	0.17 (0.08)*
Employment	-0.34 (0.10)***	-0.34 (0.10)***
Residence (Urban area)	-0.12 (0.10)	-0.12 (0.10)
Race/Ethnicity		
Blacks	-0.08 (0.08)	-0.26 (0.16)
Hispanics	-0.19 (0.09)*	-0.47 (0.16)**
Moderating effect		
Sugar-sweetened beverages*Blacks		0.07 (0.05)
Sugar-sweetened beverages*Hispanics		0.11 (0.05)*

Note: \* $p < 0.05$ . \*\* $p < 0.01$ . \*\*\* $p < 0.001$ . Model 2 tested the C step considering the moderating effect.

sleep between the two groups.

#### 4. Discussion

This study revealed that sugar-sweetened beverages had a negative impact on adult men's sleep duration. Sleep is one critical factor that influences an individual's health [22, 27, 34, 35], but sleep duration has been given less attention compared to other types of health among adult men. As sleep greatly affects both physical and mental health [22, 34, 35] and ultimately one's quality of life, it is important to identify what factors influence sleep duration. Generally, frequent consumption of soft drinks or soda with sugar are not recommended because it may result in health problems including obesity and diabetes [1, 2]. Although adults' consumption of sugar-sweetened beverages has either decreased or remained stable over time, men still consume sugar-sweetened beverages at higher rates than women, despite the health risks presented by sugar-sweetened beverages [1, 2, 8, 10, 19]. Along with this unhealthy habit, their sleep duration is somewhat shorter than women's [5, 6, 25, 26, 36].

While there have been many studies examining determinants of sleep duration and quality, less is known about the association between the consumption of certain food and drinks and sleep, particularly among adult men. Given the higher consumption of sugar-sweetened beverages and shorter sleep duration among adult men, this study fills a research gap by indicating that drinking sugar-sweetened beverages more frequently is associated with fewer hours of sleep among adult men. Drinking sugar-sweetened beverages more frequently may also be associated with a more frequent and higher overall consumption of caffeine, which may interfere with sleep duration. Provided that adult men consume sugar-sweetened beverages at higher rates than women [8, 10, 19] and their sleep duration is already lower than women's on average [5, 6, 9, 25, 36], this higher consumption of sugar-sweetened beverages may degrade adult men's sleep duration. Thus, one way

to improve adult men's sleep duration would be to advocate for the cessation of consuming sugar-sweetened beverages, but this is likely not a practical approach or an approach that is likely to succeed, as adults have been exposed to advertisements promoting the consumption of sugar-sweetened beverages since youth [14, 15, 37, 38]. Alternative options may be to substitute at least some sugar-sweetened beverages with unsweetened teas, 100% fruit juice, or water to improve adult men's poor sleep duration.

Consistent with previous research [13, 16, 17, 20, 21], this study also confirmed racial and ethnic disparities in adult men's sleep duration. Hispanic adult men tended to sleep for fewer hours than White adult men. Perhaps one explanation for this phenomenon is that White men are more likely to have jobs that allow for fewer hours and a more standard schedule, as well as access to more paid time off and higher wages [39–43], which can allow for more free time and less financial stress, and thus shorter sleep duration [44, 45]. Hispanic men and other men of color are also at risk for experiencing racial- or ethnic-based discrimination in the workplace [46–48]. These factors can lead to increase stress related to work and finances. These employment factors may impede Hispanic men's sleep duration and sleep quality. Thus, to improve Hispanic adult men's sleep quality, it is imperative to provide Hispanic adult men with better employment opportunities that include fewer hours, higher pay, and more opportunities for paid vacation time, as well as to address the racial and ethnic discrimination factors that influence White men's higher wages, paid leave time, and more standard schedules [39–43].

These racial and ethnic disparities may be more deeply understood in the context of the relationship between sugar-sweetened beverage consumption and sleep duration among adult men. This study revealed that being Hispanic moderated the association between sugar-sweetened beverage consumption and sleep duration among adult men. Regardless of the consumption of sugar-sweetened beverages, Hispanic men's sleep duration was lower than White adult men. More-

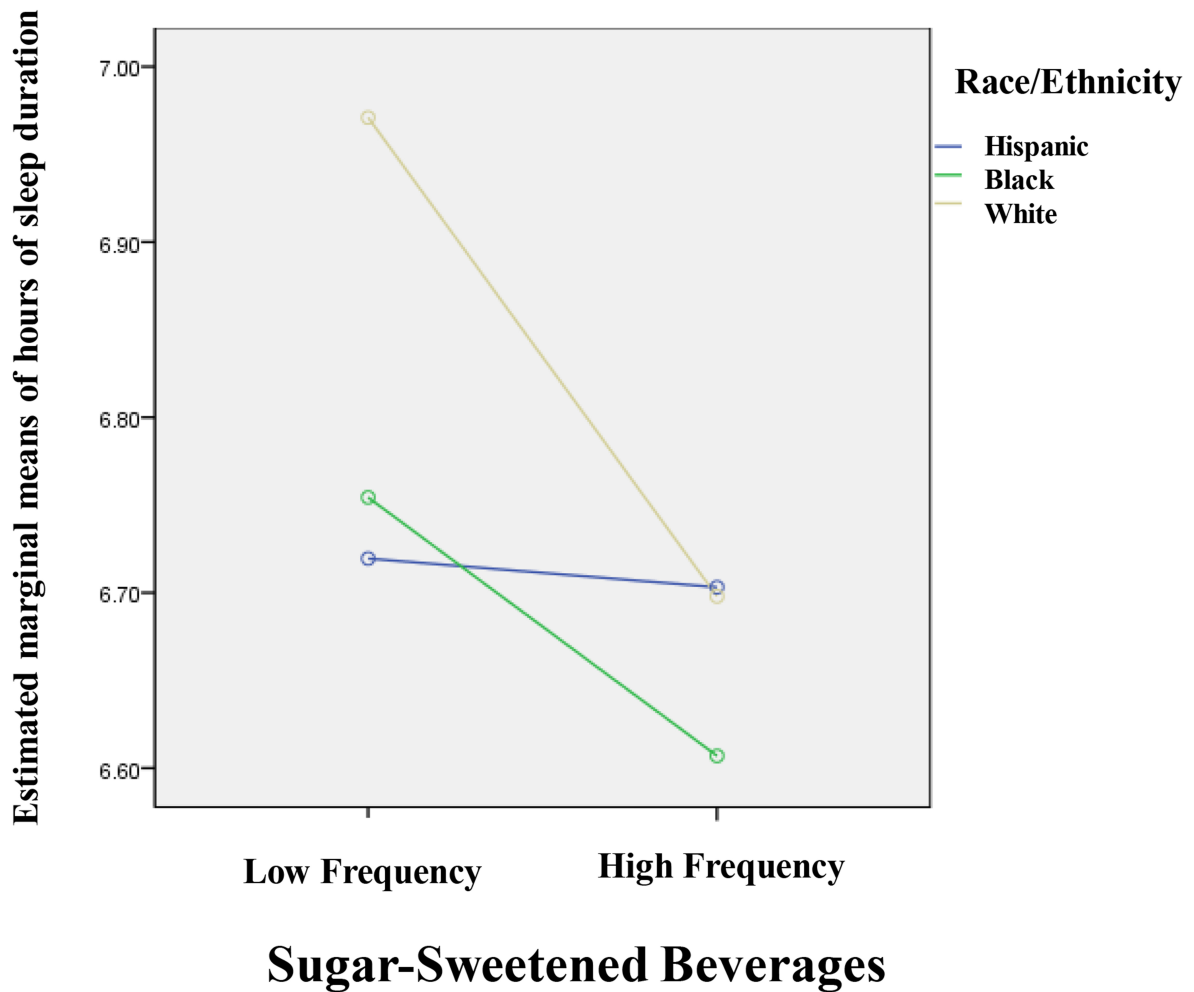


FIGURE 2. Sugar-sweetened beverages and race/ethnicity on sleep duration across adult men.

over, Hispanic men's sleep duration was not influenced by the amount of sugar-sweetened beverages they consumed. Given the lack of a relationship between sugar-sweetened beverage consumption and sleep duration among Hispanic adult men, it is important to increase their total hours of sleep or sleep duration in other ways, rather than addressing their consumption of sugar-sweetened beverages. However, White adult men's sleep was greatly influenced by their consumption of sugar-sweetened beverages. In other words, education regarding the importance of reducing one's consumption of sugar-sweetened beverages should be targeted more to White adult men than to Hispanic adult men. The frequency of adult men's sugar-sweetened beverage consumption significantly affected average sleep duration among White men but not Hispanic men. As frequent consumption of sugar-sweetened beverages may damage one's health, including the quality and duration of sleep, expanding education regarding the importance of reducing or ceasing the consumption of sugar-sweetened beverages is important for all White, Hispanic, and Black men. However, the effect of such actions would be stronger for White adult men's quality of sleep.

The consumption of sugar-sweetened beverages often begins early in life, in part because adults have been exposed to a large amount of advertisements and widespread availability of sugar-sweetened beverages since childhood [37, 38, 49,

50]. Thus, early intervention or education emphasizing the negative impact of sugar-sweetened beverages on sleep is important, and programs targeting the reduction of sugar-sweetened beverage consumption may be especially helpful for younger White men and children. For Hispanic adult men, simply reducing their consumption of sugar-sweetened beverages would not be effective to ameliorate their sleep, as we did not find a significant relationship between sleep duration and sugar-sweetened beverage consumption for this group. Thus, other approaches to improve their sleep duration should be targeted toward Hispanic men, and more research is needed to develop and test the effectiveness of such interventions.

## 5. Limitations

This study fills a gap in the previous literature by considering racial and ethnic disparities in the relationships between sugar-sweetened beverage consumption and sleep duration among adult men. However, we recommend that readers understand some limitations when interpreting the findings of the current study. First, because this study's data comes from 2014, this study could not consider the time during or since the COVID-19 pandemic, which influenced both sleep length and dietary habits, such as the amount and frequency of consumption of sugar-sweetened beverages. Thus, we suggest that future stud-

ies show the relationship between sugar-sweetened beverage consumption and sleep duration by using data collected in 2020 or later. Second, respondents self-reported the amount they consumed sugar-sweetened beverages. Thus, we could not control for social desirability bias that may have influenced participants' responses. Further, the secondary data did not provide specific information regarding which sugar-sweetened beverages were specifically drunk, such as names of beverages they drank. Thus, we are unable to discuss the impact of specific sugar-sweetened beverages in more detail. Third, as this study focused on only adult men, it is not possible to show differences among men of other age groups. We suggest that further research examine age differences between sugar-sweetened beverage consumption and sleep duration among men.

## 6. Conclusions

Lack of sleep is an important issue to address for adult men, as it can result in higher stress, burnout in the workplace, and other detrimental health outcomes [3, 27, 34, 35, 44, 45, 51]. In particular, men of color are more likely than white men to experience workplace discrimination and receive lower wages and other benefits [43, 46–48]. Thus, unlike White adult men, whose sleep duration may be significantly affected by the reduced consumption of sugar-sweetened beverages, addressing other factors such as stress associated with discrimination in the workplace or job market may be more important to enhance Hispanic adult men's sleep duration.

## AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

## AUTHOR CONTRIBUTIONS

JL—Study Design, Data Analysis. JL and JA—Writing Original Draft, Manuscript Review and Editing. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

## ACKNOWLEDGMENT

Not applicable.

## FUNDING

This research received no external funding.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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**How to cite this article:** Jaewon Lee, Jennifer Allen. Sugar-sweetened beverage consumption and sleep duration among adult men: the role of race and ethnicity. *Journal of Men’s Health*. 2023; 19(8): 53-59. doi: 10.22514/jomh.2023.070.