Sugar-Sweetened Beverage Consumption and Implications for Aviation Preflight Indoctrination Students

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BACKGROUND: Research has shown that excessive sugar-sweetened beverage (SSB) consumption has been associated with being overweight and obese and the military is not immune to this disorder. Being overweight/obese is one of the characteristics that comprise a condition known as Metabolic Syndrome (MetS). The global prevalence of MetS in the military population is estimated to be 21%, which varies depending upon the armed forces type and specialty. The purpose of this study is to identify the subset of the aviation population that may develop MetS at some future point and to put forth suggestions on how best to combat this and maintain operational readiness.

METHODS: Data were collected by means of an anonymous 44-item survey administered and completed by 302 students enrolled in Aviation Preflight Indoctrination at the Naval Air Station Base in Pensacola, FL.

RESULTS: Results indicated that 70.86% of students reported SSB consumption, with 95.3% preferring caffeinated to decaffeinated SSBs. 11.7% of personnel met the "at risk criteria" of consuming SSBs four times per week or greater (four 12-oz cans or more per week).

DISCUSSION: Findings from this study indicate that approximately 11.7% of aviation pilots or flight officers are "at risk" of developing MetS. Given that it takes up to 4 yr to train a new fighter pilot, this could become a significant readiness issue on par with the impact seen with pilots leaving the services through natural attrition.

KEY TERMS: metabolic syndrome, pilots, beverages, sugar, obesity.

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Research has shown that excessive sugar-sweetened beverage (SSB) consumption has been associated with being overweight and obese, and SSB with caffeine has been shown to significantly increase the consumption of the SSB.[14] Being overweight/obese is one of the characteristics that comprise a condition known as Metabolic Syndrome (MetS). MetS has increased since 1988 but has remained relatively stable over the past decade; the prevalence of MetS in men and women in the United States is 35%.[6,10,20] MetS is a compilation of disorders that affects 19.5% of individuals between 20–39 yr old and 48.6% of individuals older than 60 yr. It is strongly linked to cardiovascular disease, Type II diabetes, stroke, and chronic liver disease. Research into the impact of sugar consumption suggests that high (greater than 20%) energy intake from total sugar may be associated with an increased risk of MetS.[25] In fact, a Harvard study found that drinking one to two sugary drinks per day increased the risk of developing MetS by 20% compared with those who consumed less than one sugary drink per month.[18]

The military is not immune to this. The global prevalence on MetS in the military population is estimated to be 21%.[1] Research has found that MetS estimation varied depending upon the armed forces type and specialty, ranging from 0.8–57%.[23] The Department of Defense (DoD) reported that

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obesity among active-duty service members was 21.6% in 2021 and has identified that there has been an increase in obesity from 2020–2021 by 12%, with prevalence being higher among men than women and among older members in comparison to younger members.[5] Researchers have found that there is a significant correlation for obesity with demographics such as: enlisted, over the age of 35, married with the spouse in the same location, and of African American or Hispanic descent.[24]

According to the Centers for Disease Control and Prevention (CDC), SSBs are not healthy for regular consumption due primarily to the high sugar content. While caffeine has been shown to be safe for consumption by adults (up to 400 mg · d^{-1}), it can have negative effects on health when consumed in excess or in combination with other substances. The addition of caffeine to SSBs has significant impact on SSB consumption as the reduction of insulin sensitivity enhances the physiological craving effects of consumption.[26] Research suggests that chronic consumption of SSB may contribute to the development of hyperactivity, neurocognitive deficits in adulthood, and even shortening a person's lifespan.[2,12,17] SSB consumption has also been associated with unhealthy behaviors by those who consume them.[16,22] There is a large body of evidence linking long-term excess consumption of SSBs (e.g., sodas, colas, soft drinks) to a broad range of other negative physical and mental health outcomes.[8] Studies have shown that chronic high sugar consumption interferes with hormones, especially those that are related to satiety.[29] Obesity is characterized by certain biochemistry changes in the body such as resistance to the effects of insulin, leptin, and other neurotransmitters and hormones that not only effect hunger responses but also the biological reward response.[9] Chronic high levels of sugar consumption may also cause damage to the intestinal barrier and lead to an inflammatory reaction and even liver disease.[28] Furthermore, there is also evidence that prolonged consumption of SSBs may increase the risk of colorectal cancer.[11]

The impact that MetS presents in U.S. military servicemembers is dire and poses an operational readiness threat. The CDC reports the DoD spends $1.5 billion a year on healthcare costs associated with obesity-related disorders and characteristic qualities for current and former service members and their families.[3] Lost days at work due to poor nutritional choices cost the DoD an additional $103 million a year.[4]

In naval aviation, the pipeline from recruitment to being designated as an aviator who can expertly fly and execute operational missions may take 5+ yr to become operationally ready, depending upon aircraft. For pilots, it can take 2 yr after joining the service and completing basic military training just to earn their wings, as flight school takes 2 yr and has a 25% attrition rate.[27] Once designated, pilots spend an additional year learning their specific aircraft before moving to an operational squadron. Once there, it takes another year to be qualified to lead real-world operational missions. The above time to complete training is an estimate since, even though the U.S. Navy (USN) has made strides to shorten the time by employing virtual- and mixed-reality trainers, the average wait time in 2022 was about 1 yr.[7]

To maintain operational readiness, it is imperative that DoD stakeholders explore nutritional gaps in the military and further support evidence-based solutions aimed at mitigating the physiological consequences associated with excessive SSB consumption. The purpose of this study is to identify the subset of the aviation population that may develop MetS at some future point and to put forth suggestions on how best to combat this and maintain operational readiness of the USN. The findings are intended to be service-centric, but the recommendations may be applicable to other DoD services regardless of the population.

METHODS

Subjects

A total of 302 naval aviation candidates from the Naval Air Station Base in Pensacola, FL, participated in this quantitative/qualitative study, in which they were asked to reveal both the frequency and quantity of SSB consumption. Inclusion criteria consisted of aviation candidates who were designated as either USN or U.S. Marine Corps Student Naval Aviators or Student Naval Flight Officers. The study protocol was approved by the Naval Aerospace Medical Institute, the Navy Medicine Operational Training Center, and the Institutional Review Board at the Naval Medical Research Unit—Dayton in compliance with all applicable federal regulations governing the protection of human subjects. All 302 subjects presented with surveys elected to complete them, resulting in a 100% response rate.

Equipment

To gain insight into the SSB intake of naval aviation candidates, a 44-item assessment tool was created by modifying a validated tool called the Consortium Nomisma-Areté. The Consortium Nomisma-Areté has been widely used to assess caffeine consumption in European adults, and it was deemed to be well-suited for investigating SSB consumption in this study's population of interest.

Statistical Analysis

A priori power analysis was conducted to determine the necessary sample size for the current study. The projected sample size required to complete this study was set at 300 subjects. No specific groups were excluded (e.g., age, gender). With an anticipated effect size of $r^2 > 0.06$, power = 0.80, and *P*-value maintained at 0.05, the required sample size for multiple regression analyses was determined to be 290. Since the survey was designed as a check box and numerical fill-in-the-blank, multiple-choice, the subjects' responses appear as alphanumeric codes. Data was analyzed using IBM® SPSS® software.

The inclusion threshold for the sugar consumption of study subjects was based on the American Heart Association's recommendation to limit added sugar to no more than 6 tsp (25 g) and 9 tsp (36 g) for women and men, respectively.[13] Therefore, the consumption of one 12-oz commercially available SSB, such

as Coke, Pepsi, Dr. Pepper, or Mountain Dew, met the criteria for inclusion. The American Heart Association has also recommended that SSB be consumed at a frequency of no more than three 12-oz cans of SSBs per week.[15] For purposes of this study, the operational definition for an "at risk" consumer was determined to be the consumption of SSB four times per week or greater (four 12-oz cans or more per week). The focus of this study does not include commercially available sports drinks nor popular energy drinks.

RESULTS

The demographics for the study subjects were 90.73% men ($N = 274$) and 9.17% women ($N = 28$). They ranged in age from 21–35 yr old (mean = 23.68, SD = 1.99). The racial makeup consisted of 81% Caucasian ($N = 245$), 8% Asian ($N = 23$), 6% Hispanic ($N = 17$), 4% African American ($N = 11$), and 1% Native American ($N = 3$). All subjects had earned at least a baccalaureate degree and 1.32% ($N = 4$) had an advanced degree.

The study results revealed that 70.86% of 302 students ($N = 214$) reported SSB consumption, with 95.3% ($N = 204$) of those preferring caffeinated to decaffeinated SSBs as their beverage of choice. Two lines of questioning were used to determine consumption patterns. The first question asked, in an average week, over the last year, what best described the respondent's consumption pattern. Options included: every day, 4–5 times a week, 2–3 times a week, once a week, 1–3 times a month, and rarely. Out of the 214 respondents who reported SSB consumption, 11.7% ($N = 25$) of personnel met the "at risk criteria", 5.1% ($N = 11$) reported consuming SSBs every day, and 6.5% ($N = 14$) reported consuming SSBs 4–5 times a week. The second question asked respondents to identify how many cans of SSB they consumed in an average week over the last year. Options were: between 7–10 cans (2–3 $L \cdot wk^{-1}$), between 4–6 cans (1–2 $L \cdot wk^{-1}$), approximately 3 cans (1 $L \cdot wk^{-1}$), between 1–2 cans, and less than 1 can. Of the 214 respondents who reported SSB consumption, 11.7% ($N = 25$) of personnel met the "at risk criteria", with 3.3% ($N = 7$) reporting consuming between 7–10 cans per week and 8.4% ($N = 18$) reporting consuming between 4–6 cans per week.

In addition to the frequency of consumption, the survey asked subjects to identify why they consumed the SSBs. The self-reported primary motivations for consuming SSB include: 1) refreshment/enjoy the taste (weighted average 4.42); 2) to stay awake longer (2.24); 3) to increase motivation/energy level (2.21); and 4) to help study/increase concentration (2.20).

DISCUSSION

Considering the findings, this study indicates that approximately 11.7% of this population may be at risk for developing MetS at some future point based upon their current self-reported consumption pattern of SSBs and the high self-reported motivation (i.e., liking the taste) to consume if the current consumption pattern is retained. While surveys can provide valuable information, they are subject to self-report bias and may not provide a complete picture of an individual's diet. If findings from this study are indicative of the overall force, this suggests that approximately 1200 flyers, or roughly the number of aviators produced by the Naval Air Training Command over the course of 1 yr, may be "at risk" of developing MetS at sometime during their aviation career and as a result may possibly be removed from the cockpit for a preventable condition.[21] Given that it takes up to 4 yr to train a new fighter pilot in the USN and U.S. Marine Corps, this could become a significant readiness issue on par with the impact seen from pilots leaving the services through natural attrition.[19]

To solve this growing ailment, the DoD should reduce their collective preference for SSBs. The first step to do this is to identify the populations at risk for developing MetS. This effort may already be ongoing as the medical records and annual fitness testing are key data points. Adding questions on the annual wellness exam documenting SSB consumption frequency may be advantageous in collecting long-term dietary trends for future analysis.

From an educational perspective, this effort will require concerted action on several levels, beginning with significantly improved education. A series of educational requirements instructing potential pilots of the dangers of SSBs should be established to inform them about the effects of excessive sugar and caffeine consumption on the body. Focusing on healthy food and beverage choices is an important strategy to keeping the military healthy and fit. A pilot must be informed and able to make conscientious choices about the substances and products they consume during training and both on and off duty. It is not the recommendation of the author of this study that the DoD or services take active steps to control the actions of pilots; instead, they should incentivize more responsible and healthy choices through rigorous required education.

It is the opinion of the author that one way to achieve this is for the DoD, in consultation with the CDC, to develop a continuous education program to teach pilots about the risks of SSBs and their direct long-term implications for the pilot's personal well-being and ability to continue meeting standards pursuant to long-term career service. An example program suitable to fulfill this recommendation would be for pilots and candidates to complete a health and well-being training course accessible from Joint Knowledge Online and provide the certification of completion to the medical examiner responsible for conducting their annual physical, as well as to their direct commanding officer. This requirement would guarantee that such individuals are provided with the necessary information and then afforded the opportunity to demonstrate healthier choices in reaching for non-SSBs or other beverages containing lower levels of sugar on an annual basis, as demonstrated in their annual physical or other required physical training evaluation.

Finally, the above suggestions are not specifically focused on aviators. The overall educational paradigm put forth may be used across professions and services to combat MetS. It is

suggested that military public health professionals review this to ensure that healthy food and beverage choices are readily available to fuel their optimal performance. Further research should be undertaken by other communities and services to better frame the MetS risks to operational readiness of the DoD.

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