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Sugar-sweetened beverages and poor sleep quality in adults from resource-limited settings in Peru

Bebidas azucaradas y mala calidad del sueño en adultos de entornos de recursos limitados en Perú

Sodas and poor sleep quality

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ABSTRACT

Introduction: To describe the association between sugar-sweetened beverages (SSBs) consumption and sleep patterns (sleep quality, daytime sleepiness, and sleep difficulties) among adults in a resource constrained setting.

Methods: A secondary analysis of a population-based study, conducted in northern Peru, was performed. SSBs consumption was assessed using a semiquantitative food frequency questionnaire. Sleep quality was assessed with the Pittsburgh Sleep Quality Index; whereas daytime sleepiness was assessed using the Epworth scale, and self-reported sleep difficulties were also included. Associations were evaluated with multivariable Poisson regression analyses, reporting prevalence ratios (PR) and 95% confidence intervals (95%CI).

Results: Data from 1603 adults, mean age 48.2 (standard deviation [SD]: 10.6) years, and 50.3% females, were analysed. A total of 17.9% reported the consumption of soda at least once a week, whereas only 10.2% reported the consumption of sugar-added juice. The prevalence of poor sleep quality, sleep difficulties and daytime sleepiness was 19.4%, 38.6%, and 6.5%, respectively. The consumption of soda was found to be associated with poor sleep quality (PR = 1.33; 95%CI: 1.05 – 1.70) and daytime sleepiness (PR = 1.56; 95%CI: 1.02 – 2.37), whereas consumption of sugar-added juice was only associated with self-reported sleep difficulties (PR = 1.29; 95%CI: 1.08 – 1.55).

Conclusions: Soda consumption only but not sugar-added juice consumption was associated with a greater prevalence of poor sleep quality and daytime sleepiness. Sugar-added juice consumption was associated with self-reported sleep difficulties. There is a need to better understand the role of sugar-sweetened beverages on sleep patterns and health.

Keywords: Sleep quality; Diet; Sugar-sweetened beverages.

RESUMEN

Introducción: Describir la asociación entre el consumo de bebidas azucaradas y los patrones de sueño (calidad del sueño, somnolencia diurna y dificultades del sueño) en adultos en un entorno limitado de recursos.

Metodología: Se realizó un análisis secundario de un estudio poblacional, realizado en el norte del Perú. El consumo de bebidas azucaradas se evaluó usando un cuestionario semicuantitativo de frecuencia de alimentos. La calidad del sueño se evaluó con el índice de calidad del sueño de Pittsburgh; mientras que la somnolencia diurna se evaluó utilizando la escala Epworth, incluyéndose dificultades de sueño autoreportadas. Las asociaciones se evaluaron con análisis de regresión de Poisson multivariable, informando razones de prevalencia (RP) e intervalos de confianza al 95% (IC 95%).

Resultados: Se analizaron datos de 1603 adultos, edad media 48.2 (desviación estándar [DE]: 10,6) años y 50,3% de mujeres. Un total de 17,9% informó el consumo de sodas al menos una vez a la semana, mientras que solo el 10,2% informó el consumo de jugo azucarado. La prevalencia de mala calidad del sueño, dificultades del sueño y somnolencia diurna fue del 19,4%, 38,6% y 6,5%, respectivamente. Se encontró que el consumo de soda estaba asociado con una calidad de sueño deficiente (RP= 1,33; IC 95%: 1,05–1,70) y somnolencia diurna (PR = 1,56; IC 95%: 1,02–2,37), mientras que el consumo de jugo azucarado se asoció sólo a dificultades de sueño (RP = 1,29; IC 95%: 1,08–1,55).

Conclusión: El consumo de sodas solo pero no el consumo de jugo azucarado se asoció con una mayor prevalencia de mala calidad del sueño y somnolencia diurna. El consumo de jugo azucarado se asoció con dificultades de sueño. Es necesario comprender mejor el papel de las bebidas azucaradas en los patrones de sueño y la salud.

Palabras clave: Calidad del sueño; Dieta; Bebidas azucaradas.

KEY MESSAGES

- Greater soda consumption was associated with both higher prevalence of poor sleep quality and daytime sleepiness.
- Sugar-added juice was associated only with greater prevalence of subjective symptoms (self-reported sleep difficulties).
- 20% of participants reported consumption of soda at least once per week, whereas that estimate was 10% for sugar-added juice.
- Our study suggests the necessity of more complex studies to disentangle the relationship between sugar-sweetened beverages and sleep characteristics.

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INTRODUCTION

Sleep is a vital function of the human body in charge of restoring the depleted energy from daily activities. More than 30% of the adult population have reported poor sleep quality, mainly due to a short duration of sleep.[1] Poor sleep quality has been associated with poor quality of life and worse mental health, as well as with cardiometabolic diseases such as type 2 diabetes (T2D), hypertension (HT), and eventually, coronary heart disease and stroke; and overall cardiovascular-related mortality.[2,3]

Poor sleep quality has been related to human behaviors, including diet. The underlying mechanisms of this association shows that the relationship is bidirectional.[4] Previous studies have reported an association between short sleep duration and a higher intake of calories and body mass index (BMI);[5] thus, short sleep duration leads an increase of the frequency of unhealthy dietary habits (i.e., uncontrolled snacking and night cravings), and hormonal dysregulations that affect the appetite and the body composition.[6,7] On the other hand, diet affects the quality of the sleep directly by blocking the action of adenosine, a neurotransmitter that promotes relaxation and indirectly by disrupting the production and activity of hormones such as cortisol that might lead to insomnia.[8] However, studies assessing the effects of dietary choices on sleep quality are limited. Furthermore, most of the studies have addressed the effect of diet as a whole (i.e., Mediterranean diet) or measured a specific component (i.e., caffeine and melatonin), but studies on groups of foods or drinks with a potential greater impact on sleep quality are less common.[4]

Sugar-sweetened beverages (SSBs) consumption have been reported to be the main source of added sugars in diet[9] which could alter the sleep pattern.[10] Of note, SSBs consumption has been associated with sleep disturbances, irrespectively of their caffeine content.[11,12] However, most of the studies had focused on the impact of SSBs on the sleep duration instead of the sleep quality. Moreover, this association with SSBs has been explore in specific populations such as adolescents,[13] young adults, mainly students,[14] and pregnant women,[15] even though the sleep quality tends to deteriorate with age.

Despite the efforts to reduce the consumption of SSBs, it continues to be on the rise, particularly in low- and middle-income countries (LMICs).[16] A report in Peru, for example, found that more than 90% of children aged <24 months of age received homemade sugar-sweetened beverages.[17] Moreover, among adults, a survey reported that the mean consumption of ready-to-drink and homemade SSB was high, especially in men, and urban settings.[18] Consequently, this study aimed to explore the association between SSBs consumption and sleep quality, as well as other sleep indicators, among adults living in these settings. We hypothesize that those consuming greater amounts of SSBs would have poor sleep quality.

METHODS

A secondary analysis of a population-based cross-sectional study conducted between 2016 and 2017 was performed.[19] Data was collected in a semi-urban setting in Tumbes, a region located in northern Peru. According to the 2017 national census, Tumbes had approximately 243,000 inhabitants in an area of 4670 km^2.[20] In addition, nearly 19% of the population are considered to live under the poverty line, life expectancy is nearly 75 years, and approximately 6.5% of the population are 65 and older.[21] Since aging and low socioeconomic status are described as risk factors for sleep disturbances,[22] we considered data from this population relevant to the purpose of the study.

The study population was identified via random sampling, single-stage and stratified by sex using the 2014 census of the region. To prevent clustering of behavioral factors, only one participant per household was invited to participate in the study.[19]

The inclusion criteria for participation in the study were: adults aged 30 to 69 years, full-time resident of Tumbes (≥6 months living in the area), able to provide informed consent, and no physical disabilities preventing from anthropometric assessment. The exclusion criteria included: being unable to complete the questionnaires, signs of active infection such as active tuberculosis, bedridden, diagnosis of Alzheimer's disease or Parkinson, and pregnancy. For the present study, we also excluded those who did not answer the questions regarding sleep difficulties, daytime sleepiness, and sleep quality.

The SSBs consumption was both assessed separately (i.e., "soda consumption", main exposure, and "sugar-added juice consumption"). The consumption of each group of SSBs was measured using a standardised semiquantitative food frequency questionnaire asking, *"During the last* *month, how frequently you consumed soda (local examples were included)”.*[23] A similar question was applied but using sugar-added juice, instead of soda. Responses for each of the questions were measured considering the following categories: never, 1-3 times per month, 1 time per week, 2 to 4 times per week, 5 to 6 times per week, 1 time per day, and more than 1 time per day. If the participant reported an intake of more than 1 time per day, the frequency per day was also collected. For analysis, we categorised the consumption of each group of SSBs as ≥1 per week vs. <1 per week.

The main outcome of the study was the sleep quality assessed by the validated Spanish version of Pittsburgh Sleep Quality Index (PSQI).[24] Briefly, the PSQI has a total of 21 questions (scored 0 to 21) that address the following seven components: sleep duration, sleep latency, habitual sleep efficiency, sleep disturbances, daytime dysfunction, use of sleeping medication, and subjective sleep quality. As previously established,[24] poor sleep quality was considered as an overall score >5 points.

On the other hand, daytime sleepiness and sleep difficulties were considered secondary outcomes. Daytime sleepiness was considered if a score higher than 10 was obtained using a validated Peruvian version of the Epworth questionnaire.[25] The self-report of “sleep difficulties” was assessed as a composite of two questions: *“In the last month, have you had difficulties to fall asleep?”* and *“In the last month, how frequently did you wake up during the night?”,* and dichotomised in yes/no.

As potential confounding variables we considered the following: sex (male vs. female); age (categorised as <40, 40-49, 50-59, ≥60 years); education level, in years (primary [<7 years], secondary [7-11 years], and superior [12+ years]); wealth index, based on the assets of the household and split into terciles (low, middle and high); employment status, based on current work (yes/no); currently smoking, based on the use of at least one cigarette per day (yes/no); binge drinking, defined as the consumption of less than 6 bottles of beer or its equivalent in a regular day vs. ≥ 6 bottles of beer or its equivalent in a regular day (no/yes); physical activity according to the short version of the International Physical Activity Questionnaire (low vs moderate/high); overweight/obesity, using the body mass index evaluation ≥ 25 kg/m^2 (no/yes),

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and central obesity, defined as a waist circumference ≥90 cm for men and ≥80 cm for women, according to IDF guidelines.[26]

After written informed consent, well-trained staff administered the questionnaires face-to-face using tablets with the software Open Data Kit (ODK) installed. Height and weight were measured in duplicate, whereas waist circumference was evaluated in triplicate, using standardised techniques with a calibrated stadiometer, a bioimpedance weight scale (TBF – 300, TANITA Corporation, Tokyo, Japan) and a waist tape.

The software used for all the analysis of this study was STATA v16.0 for Windows (StataCorp, College Station, TX, USA). We calculated the mean and standard deviation (SD) for continuous variables and proportions for categorical variables. The prevalence of poor sleep quality was estimated as well as the prevalence of each exposure: soda consumption and sugar-added juice consumption. Differences across PSQI, daytime sleepiness and sleep difficulties categories were assessed using Chi-square test. Differences across continuous variables were assessed using Student t test. Then, crude and adjusted Poisson regression models with robust variance were used to quantify the association between each variable of interest and the PSQI. The adjusted model was fitted considering the following potential confounders: age, sex, education level, employment status, smoking, binge drinking, physical activity, and overweight/obesity. Prevalence ratios (PR) and corresponding 95% confidence intervals (95% CI) were calculated to appraise associations. The strengthening the reporting of observational studies in epidemiology (STROBE) guideline for cross-sectional studies was utilised to report our findings.

The protocol and informed consent of the original study was approved by the Ethical Committee from the Universidad Peruana Cayetano Heredia, in Peru (approval number: 63585) and The London School of Hygiene and Tropical Medicine, in the United Kingdom (approval number: 11783). A dataset without personal identifiers was used for analysis to maintain anonymity.

RESULTS

The original study invited 2114 adults to participate; however, 486 declined, 16 were excluded and 3 did not complete the study procedures, resulting in a total of 1609 participants [19], aged between 30 and 69 years old. After removing those without PSQI scores (n = 3), a total of 1606 participants were included for this analysis. In this sample, the mean age was 48.2 (SD 10.6) years, and females comprised the 50.3% of the participants.

A total of 287 (17.9%) reported consumption of soda at least once per week, whereas 164 (10.2%) reported consumption of sugar-added juice. Male participants, those who reported secondary or superior education, highest wealth index group, employed, currently smoking, binge drinking and moderate to high physical activity levels had a greater consumption of soda. On the other hand, only male participants, those employed, and those reporting moderate to high physical activity reported a significantly greater consumption of sugar-added juice (Table 1).

Overall, 312 (19.4%; 95%CI 17.5% – 21.4%) had poor sleep quality according to the PSQI questionnaire, and 620 (38.6%, 95%CI 36.2 – 41.0) reported sleep difficulties; but only 105 (6.5%, 95%CI 5.3% – 7.9%) had daytime sleepiness according to the Epworth scale.

Univariate analysis evidenced that females, aged older than 50 years, had only primary or no education, and currently unemployed were more likely to report a poor sleep quality, daytime sleepiness, and sleep difficulties. Those who reported binge drinking habit were also more likely to have poor sleep quality and sleep difficulties. Furthermore, those who were overweight or obese by BMI had poor sleep quality and daytime sleepiness but not sleep difficulties; however, central obesity was associated with the three sleep characteristics (Table 2).

The consumption of soda at least once per week was associated with a 33% greater prevalence of poor sleep quality (PR: 1.33, 95%CI 1.05 – 1.70) and 56% greater prevalence of daytime sleepiness (PR: 1.56, 95%CI 1.02 – 2.37), whereas no association was found with self-reported sleep difficulties. Those who reported a consumption of at least once a week of sugar-added juice had a 29% greater prevalence of self-reported sleep difficulties (PR: 1.29, 95%CI 1.08 – 1.55); however, no association between sugar-added juice and sleep quality nor daytime sleepiness was observed (Table 3).

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Table 1: Characteristics of the study population according to sweetened beverage consumption

	Soda consumption			Sugar-added juice consumption		
	<1 per week n=1319	≥1 per week n=287	p-value	<1 per week n= 1442	≥1 per week n= 164	p-value
Sex, n (%)			<0.001			0.002
Male	628 (47.6)	170 (59.2)		698 (48.4)	100 (61.0)	
Female	691 (52.4)	117 (40.8)		744 (51.6)	64 (39.0)	
Age, n (%)						
<40 years	349 (26.5)	90 (31.4)	0.024	387 (26.8)	52 (31.7)	0.534
40-49 years	383 (29.0)	97 (33.8)		437 (30.3)	43 (26.2)	
50-59 years	352 (26.7)	56 (19.5)		366 (25.4)	42 (25.6)	
60+ years	235 (17.8)	44 (15.3)		252 (17.5)	27 (16.5)	
Education, n (%)			0.003			0.722
Primary	450 (34.1)	68 (23.7)		469 (32.5)	49 (29.9)	
Secondary	596 (45.2)	151 (52.6)		670 (46.5)	77 (47.0)	
Superior	273 (20.7)	68 (23.7)		303 (21.0)	38 (23.1)	
Wealth index, n (%)			<0.001			0.283
Lowest	465 (35.2)	73 (25.4)		487 (33.8)	51 (31.1)	
Middle	459 (34.8)	90 (31.4)		498 (35.5)	51 (31.1)	
Highest	395 (30.0)	124 (43.2)		457 (31.7)	62 (37.8)	
Employment, n (%)			0.021			0.005
No	442 (33.5)	76 (26.5)		481 (33.4)	37 (22.6)	
Yes	877 (66.5)	211 (73.5)		961 (66.6)	127 (77.4)	
Smoking, n (%)			<0.001			0.356
No	1257 (95.30)	257 (89.5)		1362 (94.5)	152 (92.7)	
Yes	62 (4.7)	30 (10.5)		80 (5.5)	12 (7.3)	
Binge drinking, n (%)			<0.001			0.310
No	885 (67.1)	152 (53.0)		937 (65.0)	100 (61.0)	
Yes	434 (32.9)	135 (47.0)		505 (35.0)	64 (39.0)	
Physical activity, n (%)			0.001			0.008
Moderate/high	798 (60.5)	205 (71.4)		885 (61.4)	118 (72.0)	
Low	521 (39.5)	82 (28.6)		557 (38.6)	46 (28.0)	
Body mass index, n (%)						
<25 kg/m^2	355 (26.9)	70 (24.4)	0.380	377 (26.1)	48 (29.3)	0.390
25+ kg/m^2	964 (73.1)	217 (75.6)		1065 (73.9)	116 (70.7)	
Central obesity, n (%)			0.238			0.064
Non obese	280 (21.2)	52 (18.1)		289 (20.0)	43 (26.2)	
Obese	1039 (78.8)	235 (81.9)		1153 (80)	121 (73.8)	

Table 2: Characteristics of the study population according to sleep characteristics

	Sleep quality			Daytime sleepiness			Sleep difficulties		
	Good N = 1294	Poor N = 312	p-value	No N = 1501	Yes N = 105	p-value	No N = 986	Yes N= 620	p-value
Sex, n (%)			<0.001			0.004			<0.001
Male	684 (52.9)	114 (36.5)		760 (50.6)	38 (36.2)		573 (58.1)	225 (36.3)	
Female	610 (47.1)	198 (63.5)		741 (49.4)	67 (63.8)		413 (51.9)	395 (63.7)	
Age categoric, n (%)			<0.001			0.015			0.006
<40 years	374 (28.9)	65 (20.8)		422 (28.1)	17 (16.2)		294 (29.8)	145 (23.4)	
40-49 years	395 (30.5)	85 (27.2)		450 (29.9)	30 (28.6)		300 (30.4)	180 (29.0)	
50-59 years	306 (23.7)	102 (32.7)		370 (24.7)	38 (36.2)		226 (22.9)	182 (29.4)	
60+ years	219 (16.9)	60 (19.2)		259 (17.3)	20 (19.0)		166 (16.8)	113 (18.2)	
Education, n (%)			<0.001			0.021			0.008
Primary	388 (30.0)	130 (41.7)		475 (31.7)	43 (41.0)		290 (29.4)	228 (36.8)	
Secondary	623 (48.2)	124 (39.7)		697 (46.4)	50 (47.6)		474 (48.1)	273 (44.0)	
Superior	283 (21.8)	58 (18.6)		329 (21.9)	12 (11.4)		222 (22.5)	119 (19.2)	
Wealth index, n (%)			0.686			0.761			0.239
Lowest	427 (33.0)	111 (35.6)		503 (33.5)	35 (33.3)		324 (32.9)	214 (34.5)	
Middle	446 (34.5)	103 (33.0)		516 (34.4)	33 (31.4)		328 (33.3)	221 (35.7)	
Highest	421 (32.5)	98 (31.4)		482 (32.1)	37 (35.2)		334 (33.8)	185 (29.8)	
Employment, n (%)			0.001			0.205			<0.001
No	392 (30.3)	126 (40.4)		490 (32.6)	28 (26.7)		261 (26.5)	257 (41.5)	
Yes	902 (69.7)	186 (59.6)		1011 (67.4)	77 (73.3)		725 (73.5)	363 (58.5)	
Smoking (currently), n (%)			0.396			0.389			0.097
No	1223 (94.5)	291 (93.3)		1417 (94.4)	97 (92.4)		922 (93.5)	592 (95.5)	
Yes	71 (5.5)	21 (6.7)		84 (5.6)	8 (7.6)		64 (6.5)	28 (4.5)	
Binge drinking, n (%)			<0.001			0.129			<0.001
< 6 beer bottles per day	804 (62.1)	233 (74.7)		962 (64.1)	75 (71.4)		580 (58.8)	457 (73.7)	
≥ 6 beer bottles per day	490 (37.9)	79 (25.3)		539 (35.9)	30 (28.6)		406 (41.2)	163 (26.3)	
Physical activity, n (%)			0.682			0.743			0.006
Moderate/high	805 (62.2)	198 (63.5)		939 (62.6)	64 (61.0)		642 (65.1)	361 (58.2)	
Low	489 (37.8)	114 (36.5)		562 (37.4)	41 (39.0)		344 (34.9)	259 (41.8)	

Soda consumption, n (%)			0.128			0.100			0.611
<1 per week	1072 (82.8)	247 (79.2)		1239 (82.5)	80 (76.2)		806 (81.7)	513 (82.7)	
1+ per week	222 (17.2)	65 (20.8)		262 (17.5)	25 (23.8)		180 (18.3)	107 (17.3)	
Sugar-added juice consumption, n (%)			0.389			0.448			0.101
<1 per week	1166 (90.1)	276 (88.5)		1350 (89.9)	92 (87.6)		895 (90.8)	547 (88.2)	
1+ per week	128 (9.9)	36 (11.5)		151 (10.1)	13 (12.4)		91 (9.2)	73 (11.8)	
BMI categoric, n (%)			0.026			0.014			0.556
<25 kg/m^2	358 (27.7)	67 (21.5)		408 (27.2)	17 (16.2)		266 (27.0)	159 (25.7)	
25+ kg/m^2	936 (72.3)	245 (78.5)		1093 (72.8)	88 (83.8)		720 (73.0)	461 (74.3)	
Central obesity, n (%)			0.010			0.008			0.003
Normal	284 (22.0)	48 (15.4)		321 (21.4)	11 (10.5)		227 (23.0)	105 (16.9)	
Obese	1010 {78.0)	264 (84.6)		1180 (78.6)	94 (89.5)		759 (77.0)	515 (83.1)	

Table 3: Crude and multivariable regression models of SSBs and sleep characteristics

	Crude model PR (95% CI)	Adjusted model* PR (95% CI)
Poor sleep quality (1+ per week vs <1 per week)		
Soda consumption	1.21 (0.95 – 1.54)	**1.33 (1.05 – 1.70)**
Sugar-added juice consumption	1.14 (0.84 – 1.56)	1.22 (0.90 – 1.65)
Daytime sleepiness (1+ per week vs <1 per week)		
Soda consumption	1.44 (0.93 – 2.21)	**1.56 (1.02 – 2.37)**
Sugar-added juice consumption	1.24 (0.71 – 2.17)	1.33 (0.77 – 2.30)
Sleep difficulties (1+ per week vs <1 per week)		
Soda consumption	0.96 (0.81 – 1.13)	1.07 (0.91 – 1.26)
Sugar-added juice consumption	1.17 (0.98 – 1.41)	**1.29 (1.08 – 1.55)**

* Model adjusted for age, sex, education level, wealth index, employment status, smoking, binge drinking, physical activity, and BMI categorized.

DISCUSSION

Our findings showed that greater soda consumption was associated with both higher prevalence of poor sleep quality and daytime sleepiness, whereas sugar-added juice was associated only with greater prevalence of self-reported sleep difficulties. In addition, almost 20% of participants reported consumption of soda at least once per week, whereas that estimate was 10% for sugar-added juice.

One plausible explanation is that soda, typically containing added sugars along with caffeine and carbonation, may impact multiple dimensions of sleep quality simultaneously, including sleep latency, continuity, and daytime dysfunction. In contrast, sugar-added juice, lacking caffeine and carbonation, might selectively affect certain components of sleep, such as latency or disturbances, without significantly altering the overall sleep experience. Previous research supports this differential impact: studies have shown that consumption of sugary and caffeinated beverages, particularly sodas, is consistently associated with longer sleep onset latency, more sleep disturbances, and poorer overall sleep quality.[27-30] Conversely, while 100% pure fruit juice consumption was not associated with sleep quality in a recent study among adolescents,[27] previous evidence has suggested a possible link between fruit juice intake and earlier bedtimes.[31] The literature available regarding the association between SSBs and sleep quality often considers the different SSBs combined as one exposure and PSQI as the main outcome. There are limited studies addressing the effect of the intake of soda and sugar-added juice separately nor studies that separate SSBs according to their caffeine content. According to a relatively recent systematic review,[32] several studies found a significant association between the consumption of SSBs, including energy drinks and soda, and poor sleep quality. However, most of the studies included in the review were conducted in children and adolescents. There are few epidemiological studies addressing this issue among older populations. For instance, in a population-based study among middle-age female Japanese workers, Katagiri et al[33] found that those who reported consumption of SSBs of at least once a week were 1.2 times more likely to have poor sleep quality. Among university students, Boozari et al[12] and Matsunaga et al[14] found a positive correlation between SSBs consumption and the PSQI score, meaning that those with higher SSBs consumption were more likely to have poor sleep quality. Moreover, Boozari et al found consistent results in non-obese subcategories, suggesting that obesity (defined by BMI) does not necessarily intervene in this association [12]. In other study, pregnant women who reported a consumption of 0.4 servings of SSBs per day, the risk of poor sleep was higher (aOR 2.1, 95%CI 1.2 – 3.6).[15] These studies attribute their findings to the sugar and caffeine content of the SSBs, which might interfere with the physiologic circadian rhythm causing sleep disturbances.[10,34] However, their conclusions should be taken cautiously due to their cross-sectional nature.

On the other hand, Oliveira and Marques-Vidal[35] found no significant association between a wide range of dietary markers, including sugar consumption, and overall sleep quality in a large middle-aged population. These discrepancies could be due to differences in study populations, beverage classifications (e.g., soda versus fruit juice), or unmeasured confounding factors such as caffeine content, carbonation, or timing of consumption relative to sleep onset. It is also possible that the psychophysiological effects of soda (such as stimulation from caffeine) contribute more strongly to multidimensional sleep disruption compared to sugar alone. Taken together, our results align with the broader literature indicating that not all sugary beverages exert the same effects on sleep and highlight the need for future studies examining specific beverage types, their compositions, and timing of consumption in relation to sleep outcomes.

The consumption of SSBs in LMICs, especially in Latin America and the Caribbean, has shown a steady increase within the past years.[16] Even though the proportion of participants who consumed any SSBs was low compared to other studies,[36] we found an association of between soda consumption and poor sleep quality and daytime sleepiness, as well as an association between sugar-added juice and self-reported sleep difficulties. We consider that the fast nutritional transition undergoing in resource-constrained settings, such Tumbes and other cities from LMICs, leads to suboptimal food choices including SSBs that contribute to the early development of risk factors for many negative health outcomes. Furthermore, our study highlights a potential mechanism of how SSBs lead to poor cardiometabolic health by directly affecting the quality of sleep and without necessarily through an obesity mediated pathway. Health promotion interventions should focus on reducing the consumption of SSBs to improve sleep disturbances and further contribute to preventing cardiometabolic conditions such as hypertension, diabetes, and stroke.

Building on these findings, broader public health strategies should consider the emerging evidence linking dietary factors such as SSB consumption not only to metabolic outcomes but also to sleep quality. Recent initiatives, such as the "Quick Buys" proposed by Galea et al.,[37] emphasise cost-effective interventions for non-communicable disease prevention, including measures aimed at reducing free sugar intake through food reformulation, front-of-pack labelling, and public education campaigns. Although direct taxation of sugar-sweetened beverages was not classified as a quick buy due to limited short-term evidence on obesity outcomes, integrating the impact of SSBs on sleep health into existing frameworks could provide additional justification for more aggressive policy actions. Strengthening current dietary guidelines and public health programs by incorporating sleep quality outcomes may enhance efforts to prevent cardiometabolic conditions, especially in low-resource settings undergoing rapid nutritional transitions.

The present study has strengths compared to previous studies that addressed the association between diet and sleep quality. First, it is a population-based study that considers adults and does not focus on specific groups such as students or workers which could give a better picture of the effect of SSBs consumption on sleep in the general population. Among the limitations of our study, first, since our study is cross-sectional, there is a possibility of reverse causality. Thus, poor sleep quality could lead to a higher consumption of SSBs, which has been proposed previously.[38] Second, this study includes the reliance on self-reported measures, which may introduce recall bias and subjective interpretation of sleep quality. Future research could employ objective measures of sleep, such as actigraphy or polysomnography, to further validate the findings. Third, as a secondary analysis, the sample size was not calculated to address our research question which could result in underpowered regression estimates. However, we found evidence of a significant association between SSBs and different indicators of sleep quality despite a possible lack of power. Finally, there is a potential risk of residual confounding since we did adjust by relevant confounders such as area of residence (rural vs urban), due to lack of data.

CONCLUSIONS

According to our hypothesis, soda consumption but not sugar-added juice or overall consumption of SSBs was associated with a higher prevalence of poor sleep quality and daytime sleepiness. Given the relatively high prevalence of poor sleep quality as well as an increasing consumption of SSBs among adults living in LMICs, it is relevant to conduct prospective, perhaps intervention studies that disentangle the relationship between SSBs and sleep characteristics.

AUTHORS' CONTRIBUTIONS

AR-A and AB-O designed the study. AR-A interpreted results and wrote the first version of the manuscript. AB-O conducted statistical analysis and contributed intellectual content to the manuscript. All the authors approved the final version submitted for publication.

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CONFLICTS OF INTEREST

The authors state that there are no conflicts of interest when writing the manuscript.

DATA AVAILABILITY

Data will be available under reasonable request. However, part of the information is available at Figshare at: https://doi.org/10.6084/m9.figshare.26493139.v1

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