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The association of coffee consumption and oxygen desaturation index during sleep among Japanese male workers

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Abstract

Background and objective Coffee is a major caffeine-containing food source that can be used for treatment of apnea in prematurity. However, few studies have examined the association between coffee consumption and sleep-disordered breathing (SDB). We investigated whether coffee consumption is associated with the oxygen desaturation index (ODI) as a marker of SDB among middle-aged Japanese male workers.

Methods The subjects were 1126 male local government workers aged 22–59 who participated in SDB screening in 2011–2012. Daily coffee consumption was assessed by a self-administered questionnaire. We measured 3% oxygen desaturation (3%ODI) during a night's sleep using a pulse oximeter. A general linear model was used to calculate the multivariate-adjusted means of 3%ODI per quartile of coffee consumption. We further analyzed the data after stratifying by overweight and current smoking status.

Results A inverse association between coffee consumption and 3%ODI was found. The multivariate-adjusted mean of 3%ODI for the lowest and highest coffee consumption groups were 11.9 times/h and 10.6 times/h (p for trend = 0.06), respectively; 14.6 and 11.5 times/h (p for trend = 0.01) in overweight participants; and 12.7 and 11.0 times/h (p for trend = 0.06) in non-smokers. No associations were found in non-overweight and smoking workers.

Conclusions Our results suggest that higher coffee consumption was associated with lower 3% ODI as a marker of SDB in overweight and non-smoking workers.

Keywords SDB · 3%ODI · Coffee · Japanese male worker · Cross-sectional study

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Abbreviations

ODI	Oxygen desaturation index
SDB	Sleep-disordered breathing
3%ODI	3% oxygen desaturation
OSA	Obstructive sleep apnea
BMI	Body mass index
ESS	Epworth Sleepiness Scale
AHI	Apnea-hypopnea index
SHHS	Sleep Heart Health Study

Introduction

Obstructive sleep apnea (OSA) syndrome is characterized by frequent episodes of upper airway collapse during sleep and is associated with hypertension [1], diabetes [2, 3], and cardiovascular diseases [4, 5]. Additionally, OSA patients have a higher prevalence of traffic accidents due to experiencing strong sleepiness and boredom [6]. In the USA, approximately

1 in 5 adults have at least mild OSA, a major category of sleep-disordered breathing (SDB), and 1 in 15 adults have OSA of moderate or worse severity [7]. However, a cross-sectional study among Americans and Japanese [8] showed that the prevalence of SDB was lower among Japanese than Americans. Most of this racial/ethnic difference was explained by a difference in body mass index (BMI). Since SDB might be developing into health problem for Asian populations due to increasing prevalence of overweight/obesity in recent decades [9], research contributing to prevention of SDB is needed.

Coffee is a major food source involving caffeine and chlorogenic acid, both of which associated with higher coffee intake may contribute to preventing diabetes and cardiovascular diseases [10–12]. Caffeine has several pharmacological effects on other pathophysiologies, e.g., as a stimulant in reducing tiredness [13], acting as a stimulating chemoreceptor in the medulla, and aiding respiration [14]. Based on these pharmacological effects, caffeine therapy has been established as a treatment of apnea in prematurity [15]. However, few studies have focused on investigating associations between coffee consumption and SDB.

We therefore examined whether coffee consumption is associated with the oxygen desaturation index as a marker for SDB among middle-aged Japanese male workers.

Methods

Subjects

We conducted this study following a cross-sectional design. The preliminary subjects were 1193 local government personnel aged 22–59 who participated in SDB screening from 2011 to 2012. After excluding women ($n = 35$) and participants who did not provide information on alcohol consumption ($n = 2$) or sleep duration ($n = 30$), a total of 1126 men were enrolled in the present study. Physicians and trained staff explained the protocol in detail to each subject and obtained written informed consent. The ethical committees at Juntendo University approved this study (approval number 15-070).

Assessment of coffee consumption

Daily coffee consumption was assessed using a self-administered questionnaire. Participants were asked to state their average coffee consumption per day via an open-ended questionnaire phrased as follows: "What is your average amount of habitual coffee consumption (per day)?" This question was developed based on an almost identical question for coffee consumption (volume: ml) in the other questionnaire. The validity of the almost identical question for 14 and 20 middle-aged men and women was reasonable. A Spearman rank correlation coefficient of 0.42 between this question and the 7-day dietary records of coffee consumption indicates a reasonable correspondence.

Assessment of oxygen desaturation index and sleep duration

We measured hourly occurrences of ≥ 3% oxygen desaturation (3%ODI) during sleep using a pulse oximeter (Pulse Watch PMP-200Gplus, Pacific Medico, Japan) during a night's sleep. According to a previous study, the apparatus' sensitivity and specificity were 80% and 95%, respectively, for detecting an apnea-hypopnea index (AHI) of ≥ 5 by PSG using a cutoff threshold of 3%ODI (5 times/h) measured by a pulse oximeter (PULSOX-3Si) [16]. As the same threshold was used in the other Japanese cohort study and provided reasonable findings, highlighting the associations of 3%ODI with chronic diseases [17], this device can be considered suitable for SDB assessment. Sleep duration was determined by a sleep log, which was recorded by participants in the morning following pulse oximetry.

Other measurements

We measured several potential confounding factors that may be associated with SDB. We assessed subjective sleepiness using the Epworth Sleepiness Scale (ESS), which is often used to assess sleepiness during the day [18]. Habitual alcohol intake and smoking amount were also assessed by self-administered questionnaire. Participants were asked to report their average consumption of alcoholic beverages and cigarettes per day. Body mass index (BMI) was calculated as the measured weight (kg) in light clothing divided by the square of measured height (m) in stocking feet.

Statistical analysis

Participants were divided into quartiles based on their daily coffee consumption. A general linear model was used to calculate the age-adjusted means of ESS, BMI, sleep-duration, and 3%ODI, as well as proportion of current drinkers and smokers per quartile. We also calculated multivariate-adjusted means of 3%ODI per quartile of coffee consumption after adjusting for age (year), current smoking and alcohol drinking status (yes/no), BMI (kg/m^2), and sleep-duration (hour/day). Median values for each quartile were used to analyze linear trends using a multivariate regression model. We further calculated multivariate-adjusted means of 3%ODI after stratifying by overweight (BMI < 25, ≥ 25 kg/m^2) and current smoking status (smoker/non-smoker), which are major risk factors of SDB. All analyses were carried out using SPSS ver. 21 (IBM, Armonk, NY, USA). All statistical tests were two-tailed, and a confidence threshold of $p < 0.05$ was used.

Results

Table 1 shows the characteristics of participants per quartile of coffee consumption. Coffee consumption was inversely associated with age-adjusted means of sleep duration and positively associated with age-adjusted proportion of current smokers.

Table 2 shows crude as well as age- and multivariate-adjusted means of 3%ODI per quartile of coffee consumption. Coffee consumption was inversely associated with crude and age-adjusted means, an association that attenuated but remained borderline-significant after adjusting for confounding factors. Multivariate-adjusted mean of 3%ODI was 11.9 (times/h) for the lowest coffee consumption group and 10.6 for the highest coffee consumption group (p for trend = 0.06). We further analyzed the association between coffee consumption and 3%ODI after stratifying by overweight and current smoking status (Table 3). A significant inverse association was found in the overweight group and a borderline-significant association in non-smoker groups, but not in the non-overweight and smoker groups. In the overweight group, multivariate-adjusted mean of 3%ODI was 14.6 for the lowest group and 11.5 for the highest group (p for trend = 0.01). In non-smokers, the respective means were 12.7 and 11.0 (p for trend = 0.06).

Discussion

In this study, we found an inverse association between coffee consumption and 3%ODI as a marker of SDB among Japanese male workers. This association tended to be more evident in overweight and non-smoking workers.

A previous study examined the association between coffee consumption and SDB in the USA [19]. According to the Sleep Heart Health Study (SHHS), higher caffeinated soda consumption was associated with severe SDB in females, but coffee consumption in general was not associated with severe SDB. It can be assumed that the population in the SHHS tended to have higher coffee consumption than the population in the present study. Indeed, Japan has a lower coffee supply quantity (kg/capita/year) than western countries including Europe, the USA, and Australia [20]. As major caffeinated beverage sources differed between Japanese and Americans [21, 22], one potential reason for differing results between this study and the SHHS may be different dietary habits. Additionally, we did not adjust for differences in consumption of other types of dietary items. Thus, the findings of

Table 1 Characteristics according to quartiles of coffee consumption

	Coffee consumption				
	Q1 (low)	Q2	Q3	Q4 (high)	p for trend
	368	201	338	219	
Age (year)	41.3	41.4	41.1	42.1	0.43
BMI (kg/m^2)	26.4	26.1	26.2	26.1	0.35
Sleep duration (hour)	7.0	7.0	6.9	6.7	0.03
Current drinkers (%)	70.4	77.1	72.5	65.2	0.14
Current smokers (%)	26.1	38.3	45.3	46.0	< 0.01
ESS (points)	5.9	5.4	5.5	5.3	0.06

Q1, ~ 190 mL; Q2, 200~360 mL; Q3, 380~500 mL; Q4, 540 mL

Age-adjusted means and proportions

Table 2 Multivariate-adjusted means of 3%ODI per quartile of coffee consumption

	Coffee consumption				
	Q1	Q2	Q3	Q4	p for trend
Total population					
n	368	201	338	219	
Crude mean	12.2	11.1	10.6	10.4	0.02
Age-adjusted mean	12.2	11.1	10.7	10.3	0.01
Multivariate-adjusted mean	11.9	11.2	10.8	10.6	0.06

Adjustment for age (year), current smoking and alcohol drinking status (yes/no), and BMI and sleep duration (hour/day)

Table 3 Multivariate-adjusted means of 3%ODI per quartile of coffee consumption after stratifying by overweight and current smoking status

Non-overweight					
n	158	78	143	100	
Crude mean	8.9	8.2	7.5	8.8	0.72
Age-adjusted mean	8.9	8.3	7.6	8.8	0.69
Multivariate-adjusted mean[a]	8.6	8.2	7.7	9.0	0.84
Overweight					
n	210	123	195	119	
Crude mean	14.7	13.0	12.9	11.8	0.02
Age-adjusted mean	14.7	13.0	12.9	11.6	0.01
Multivariate-adjusted mean[a]	14.6	13.0	13.0	11.5	0.01
Non-smokers					
n	272	124	185	118	
Crude mean	12.8	11.0	11.1	11.1	0.08
Age-adjusted mean	12.8	10.8	11.2	11.0	0.07
Multivariate-adjusted mean[b]	12.7	11.2	11.2	11.0	0.06
Smokers					
n	96	77	153	101	
Crude mean	10.5	11.3	10.1	9.6	0.33
Age-adjusted mean	10.4	11.4	10.1	9.5	0.29
Multivariate-adjusted mean[b]	10.4	11.0	10.2	9.8	0.47

[a] Adjustment for age (year), current smoking and alcohol drinking status (yes/no), and sleep duration (hour/day)

[b] Adjustment for age (year), current alcohol drinking status (yes/no), and BMI and sleep duration (hour/day)

this study may not necessarily hold for other populations, in particular in western countries.

We found a borderline-significant association among non-smokers. Smoking is an important confounding factor in the correlation between coffee consumption and SDB [23]. In general, smokers tended to be higher coffee consumers [24]. Smoking reduces activity of CYP1A2 [25], which metabolizes caffeine; this reduction may offset additional health effects from the caffeine. We also found the association for overweight individuals. Since our subjects were more overweight than the general Japanese population (in 2014, the prevalence of overweight individuals in males among the general Japanese population was 28.7% [21]), the SDB sample size was too low to reveal any association among non-overweight individuals.

The mechanism underlying the association between coffee consumption and SDB is unclear, but one potential medicinal mechanism of caffeine activates a chemical receptor in the medulla oblongata [26]. In addition, caffeine blocks adenosine receptors and inhibits phosphodiesterase activities [27, 28]. These pharmacological effects lead to increased breathing. A clinical trial showed that tidal volume significantly increased following caffeine ingestion in able-bodied and paraplegic patients [29]. Other potential mechanisms suggest that caffeine intake can both improve muscular strength and reduce fatigue [30, 31] and may decrease blood oxygenation in the brain [32, 33]. These pharmacological effects may also be associated with regulating obstructive apnea [34].

The study is subject to some limitations. First, we had to exclude female subjects from the study and there was a higher prevalence of overweight individuals, so the findings are difficult to generalize. Second, due to the cross-sectional study design, we could not infer the causality behind the association between coffee consumption and SDB. Third, we only used a pulse oximeter, not a PSG. Although sensitivity and specificity to detect SDB by pulse oximeter were acceptable [16], pulse oximeter measurements possibly fail to identify SDB in slim patients [35]. This ambiguity in detecting SDB may account for the failure to show the association between 3%ODI and coffee consumption in the non-overweight population (Table 3). Furthermore, caffeine may cause sleep deprivation due to more frequent episodes of arousal and sleep onset latency; this deprivation could be associated with higher arousal index and shorter sleep duration [36, 37]. This indicates a pathogenesis consisting of patients with SDB being likely to be aroused before their ODI became low enough to reach the 3% decline of SpO_2, leading to a higher arousal index and lower 3%ODI levels. Although we also found inverse associations between coffee consumption and sleep duration in this study, we observed a significant association between coffee consumption and 3% ODI even after adjusting for sleep duration, in particular for overweight individuals. Finally, we are not aware of any clinical trials or cohort studies which support the drinking of coffee as a treatment or prevention of SDB among the middle-aged population. This may indicate that our findings are not replicable and based on chance. However, coffee is the major source of caffeine used in the treatment of apnea in prematurity [15]. We therefore suggest that further cohort studies and clinical trials are required to examine the association between caffeinated beverages, e.g., coffee, and SDB among various populations.

In conclusion, higher coffee consumption was associated with lower means of 3%ODI, which is a marker of SDB, and this association was more evident in overweight and non-smoking workers. Further evidence is needed to verify and replicate our findings.

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Author's contributions AT participated in the analysis and interpretation of data and the drafting of the manuscript. KM participated in the analysis, acquisition, and interpretation of data and drafting of the manuscript. IS and TT participated in the study concept and design and the critical revision of the manuscript. YT, SS, EE, HW, and RS participated in the acquisition and interpretation of data.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Tanigawa T, Tachibana N, Yamagishi K, Muraki I, Kudo M, Ohira T et al (2004) Relationship between sleep-disordered breathing and blood pressure levels in community-based samples of Japanese men. Hypertens Res 27:479–484
2. Muraki I, Tanigawa T, Yamagishi K, Sakurai S, Ohira T, Imano H et al (2010) Nocturnal intermittent hypoxia and the development of type 2 diabetes: the Circulatory Risk in Communities Study (CIRCS). Diabetologia. 53:481–488
3. Appleton SL, Vakulin A, Wittert GA, Martin SA, Grant JF, Taylor AW, McEvoy RD, Antic NA, Catcheside PG, Adams RJ (2016) The association of obstructive sleep apnea (OSA) and nocturnal hypoxemia with the development of abnormal HbA1c in a population cohort of men without diabetes. Diabetes Res Clin Pract 114: 151–159

4. Yaggi HK, Concato J, Kernan WN, Lichtman JH, Brass LM, Mohsenin V (2005) Obstructive sleep apnea as a risk factor for stroke and death. N Engl J Med 353:2034–2041
5. Johnson KG, Johnson DC (2010) Frequency of sleep apnea in stroke and TIA patients: a meta-analysis. J Clin Sleep Med 6: 131–137
6. Filomeno R, Ikeda A, Tanigawa T (2016) Developing policy regarding obstructive sleep apnea and driving among commercial drivers in the United States and Japan. Ind Health 54:469–475
7. Somers VK, White DP, Amin R, Abraham WT, Costa F, Culebras A, Daniels S, Floras JS, Hunt CE, Olson LJ, Pickering TG, Russell R, Woo M, Young T, American Heart Association Council for High Blood Pressure Research Professional Education Committee, Council on Clinical Cardiology., American Heart Association Stroke Council., American Heart Association Council on Cardiovascular Nursing., American College of Cardiology Foundation (2008) Sleep apnea and cardiovascular disease: an American Heart Association/American College of Cardiology Foundation Scientific Statement from the American Heart Association Council for High Blood Pressure Research Professional Education Committee, Council on Clinical Cardiology, Stroke Council, and Council On Cardiovascular Nursing. In collaboration with the National Heart, Lung, and Blood Institute National Center on Sleep Disorders Research (National Institutes of Health). Circulation. 118:1080–1111
8. Yamagishi K, Ohira T, Nakano H, Bielinski SJ, Sakurai S, Imano H, Kiyama M, Kitamura A, Sato S, Konishi M, Shahar E, Folsom AR, Iso H, Tanigawa T (2010) Cross-cultural comparison of the sleep-disordered breathing prevalence among Americans and Japanese. Eur Respir J 36:379–384
9. OECD (2014) Obesity update. http://www.oecd.org/health/Obesity-Update-2014.pdf. Accessed 4 Apr 2017
10. Jiang X, Zhang D, Jiang W (2014) Coffee and caffeine intake and incidence of type 2 diabetes mellitus: a meta-analysis of prospective studies. Eur J Nutr 53:25–38
11. Saito E, Inoue M, Sawada N, Shimazu T, Yamaji T, Iwasaki M, Sasazuki S, Noda M, Iso H, Tsugane S (2015) Association of coffee intake with total and cause-specific mortality in a Japanese population: the Japan Public Health Center-based Prospective Study. Am J Clin Nutr 101:1029–1037
12. Grosso G, Stepaniak U, Micek A, Stefler D, Bobak M, Pajak A (2017) Coffee consumption and mortality in three Eastern European countries: results from the HAPIEE (Health, Alcohol and Psychosocial factors in Eastern Europe) study. Public Health Nutr 20:82–91
13. File SE, Bond AJ, Lister RG (1982) Interaction between effects of caffeine and lorazepam in performance tests and self-ratings. J Clin Psychopharmacol 2:102–106
14. Gaytan SP, Saadani-Makki F, Bodineau L, Frugière A, Larnicol N, Pásaro R (2006) Effect of postnatal exposure to caffeine on the pattern of adenosine A1 receptor distribution in respiration-related nuclei of the rat brainstem. Auton Neurosci 126-127:339–346
15. Kreutzer K, Bassler D (2014) Caffeine for apnea of prematurity: a neonatal success story. Neonatology. 105:332–336
16. Nakamata M, Kubota Y, Sakai K, Kinebuchi S, Nakayama H, Ohdaira T et al (2003) The limitation of screening test for patients with sleep apnea syndrome using pulse oximetry. J Jpn Soc Respir Care 12:401–406 [in Japanese with English abstract]
17. Tanigawa T (2011) Obstructive sleep apnea: its prevention and screening may contribute to the prevention of hypertension, diabetes and cardiovascular diseases. EPMA J 2:83–89
18. Johns MW (1991) A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep. 14:540–545
19. Aurora RN, Crainiceanu C, Caffo B, Punjabi NM (2012) Sleep-disordered breathing and caffeine consumption: results of a community-based study. Chest. 142:631–638
20. FAO. Food Balance sheets. http://www.fao.org/faostat/en/#data/FBS. Accessed 1 Jan 2019
21. Ministry of Health, Labour and Welfare. Annual Report of the National Health and Nutrition Survey in Japan, 2014
22. Fulgoni VL 3rd, Keast DR, Lieberman HR (2015) Trends in intake and sources of caffeine in the diets of US adults: 2001-2010. Am J Clin Nutr 101:1081–1087
23. Deleanu OC, Pocora D, Mihălcuță S, Ulmeanu R, Zaharie AM, Mihălțan FD (2016) Influence of smoking on sleep and obstructive sleep apnea syndrome. Pneumologia. 65:28–35
24. Freedman ND, Park Y, Abnet CC, Hollenbeck AR, Sinha R (2012) Association of coffee drinking with total and cause-specific mortality. N Engl J Med 366:1891–1904
25. Pavanello S, Pulliero A, Lupi S, Gregorio P, Clonfero E (2005) Influence of the genetic polymorphism in the 5′-noncoding region of the CYP1A2 gene on CYP1A2 phenotype and urinary mutagenicity in smokers. Mutat Res 587:59–66
26. Uppari N, Joseph V, Bairam A (2016) Inhibitory respiratory responses to progesterone and allopregnanolone in newborn rats chronically treated with caffeine. J Physiol 594:373–389
27. Ukena D, Schudt C, Sybrecht GW (1993) Adenosine receptor-blocking xanthines as inhibitors of phosphodiesterase isozymes. Biochem Pharmacol 45:847–851
28. Howell LL, Morse WH, Spealman RD (1990) Respiratory effects of xanthines and adenosine analogs in rhesus monkeys. J Pharmacol Exp Ther 254:786–791
29. Flueck JL, Schaufelberger F, Lienert M, Schäfer Olstad D, Wilhelm M, Perret C (2016) Acute effects of caffeine on heart rate variability, blood pressure and tidal volume in paraplegic and tetraplegic compared to able-bodied individuals: a randomized, blinded trial. PLoS One 11:e0165034
30. Grgic J, Trexler ET, Lazinica B, Pedisic Z (2018) Effects of caffeine intake on muscle strength and power: a systematic review and meta-analysis. J Int Soc Sports Nutr 15:11
31. Fett CA, Aquino NM, Schantz Junior J, Brandão CF, de Araújo Cavalcanti JD, Fett WC (2018) Performance of muscle strength and fatigue tolerance in young trained women supplemented with caffeine. J Sports Med Phys Fitness 58:249–255
32. Merola A, Germuska MA, Warnert EA, Richmond L, Helme D, Khot S et al (2017) Mapping the pharmacological modulation of brain oxygen metabolism: the effects of caffeine on absolute CMRO measured using dual calibrated fMRI. Neuroimage. 155: 331–343
33. Griffeth VE, Perthen JE, Buxton RB (2011) Prospects for quantitative fMRI: investigating the effects of caffeine on baseline oxygen metabolism and the response to a visual stimulus in humans. Neuroimage. 57:809–816
34. Dalmases M, Torres M, Márquez-Kisinousky L, Almendros I, Planas AM, Embid C, Martínez-Garcia MÁ, Navajas D, Farré R, Montserrat JM (2014) Brain tissue hypoxia and oxidative stress induced by obstructive apneas is different in young and aged rats. Sleep. 37:1249–1256
35. Nakano H, Tanigawa T, Furukawa T, Nishima S (2007) Automatic detection of sleep-disordered breathing from a single-channel airflow record. Eur Respir J 29:728–736
36. Roehrs T, Roth T (2008) Caffeine: sleep and daytime sleepiness. Sleep Med Rev 12:153–162
37. Prather AA, Leung CW, Adler NE, Ritchie L, Laraia B, Epel ES (2016) Short and sweet: associations between self-reported sleep duration and sugar-sweetened beverage consumption among adults in the United States. Sleep Health 2:272–276