

Association between electronic cigarettes-marijuana dual use and sleep duration among US adults: NHANES 2015–2018

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Abstract

Background: Electronic cigarettes (e-cigarettes) use was reported associated with sleep disturbances, and marijuana was a double-edged sword to sleep. Literature about their dual use is limited. This study aimed to investigate the association between dual use of e-cigarettes and marijuana and sleep duration among US adults.

Methods: This cross-sectional study included 6,573 participants aged 18–64 years from 2015 to 2018. Data were obtained from the National Health and Nutrition Examination Survey database. The chi-square test and analysis of variance were used for analyses of binary and continuous variables, respectively. Multinomial logistic regression models were used for univariate and multivariate analyses of e-cigarettes, marijuana use, and sleep duration. Sensitivity analyses were conducted in populations with dual e-cigarette and traditional cigarette use and those with dual marijuana and traditional cigarette use.

Results: Dual e-cigarette and marijuana users had significantly higher odds of not having the recommended sleep duration than those who were using neither (short sleep duration: odds ratio [OR], 2.34; 95% confidence interval [CI], 1.19–4.61; $P = 0.014$; long sleep duration: OR, 2.09; 95% CI, 1.53–2.87; $P < 0.001$, respectively) and short sleep duration than only e-cigarette users (OR, 4.24; 95% CI, 1.75–4.60; $P < 0.001$) in the adjusted model. Dual traditional cigarette and marijuana users had significantly higher odds of long sleep duration than neither users.

Conclusions: The study suggested that the dual use of tobacco products and marijuana was associated with sleep duration, which is not recommended, and results differ based on the type of tobacco products. Since the majority of tobacco users use not only one kind of tobacco product, it is important to conduct longitudinal RCTs to explore the joint effect of dual tobacco use on human health.

Background

Sleep disturbances have been a public health issue for years. However, the problem has plagued nearly a quarter of the world's population and has become a subject of greater concern in recent years. These disturbances include sleep apnea, insomnia, restless leg syndrome, sleepwalking, and poor sleep quality, which may all lead to abnormal sleep duration. Smoking cigarettes has been heavily implicated as the cause of these sleep problems [1-10] and has also been reported to be associated with sleep duration [11,12], which itself is a risk factor for some chronic conditions such as obesity, depression, diabetes, and cardiovascular diseases [13]. These chronic conditions can also lead to poor sleep quality [14-18] and are likely exacerbated by cigarettes smoking [19]. Many people, especially young adults, choose electronic nicotine delivery systems or e-cigarettes over traditional cigarettes nowadays. A nationwide study in the United States examined the characteristics of individuals who used e-cigarettes [20]. The results showed that 27.0% of former e-cigarette users were current users, of which 45.3% were regular e-cigarette users. E-cigarettes are widely promoted as a safer alternative to smoking [21]. However, an increasing number of studies have shown that e-cigarettes are harmless [22,23] and reported to be associated with sleep health

[24-31]. Similar concerns have been raised regarding the use of marijuana, which is also popular among young Americans. The use of cannabinoids is a double-edged sword because they induce both adverse and therapeutic properties. Evidence shows that chronic cannabis administration could disrupt circadian rhythms and reduce the duration of the deepest phase (stage N3) of non-rapid eye movement sleep [32]. However, the effects of cannabinoids on the sleep-wake cycle are inconsistent [33,34]. Given the high rate of cannabis use in Americans, it is crucial to study its effect as well as the combined effect with tobacco products on sleep health. Therefore, this study observed the association between dual use of e-cigarette-marijuana, and sleep duration over an extensive age range (18–64 years) in the US.

Methods

Study population

The data in this study were obtained from the National Health and Nutrition Examination Survey (NHANES) 2015–2018 cycle. NHANES is a nationwide cross-sectional survey in which participants are selected using a stratified multistage probability design, and it is thus representative of the US population. NHANES is unique because it combines interviews and physical examinations. The interviews included demographic, dietary, and health-related questions. The examination component consisted of medical, dental, and physiological measurements as well as laboratory tests administered by highly trained medical personnel [35] (more details via <http://www.cdc.gov/nchs/nhanes.htm>). Figure 1 shows the flowchart for selecting the study participants in the current analysis. Adults aged 18–64 years who participated in the 2015–2018 NHANES surveys and had complete data on sleep duration, e-cigarette use, and marijuana use were included in the analysis. The NCHS Research Ethics Review Board approved this study. The approval number is Continuation of Protocol #2011-17 for the 2015–2018 cycle. All the methods were carried out in accordance with relevant guidelines and regulation.

Study procedure

Sleep duration was assessed through household interviews using a computer-assisted personal interviewing system. Participants were asked, “How much sleep (in hours) do you usually get at night, on weekdays, or workdays?” According to the National Sleep Foundation, the recommended sleep duration for people aged 18–64 years was 7–9 h; thus, we categorized weekday sleep duration as <7, 7–9 h (reference group), and >9 h per night, which we defined as short, normal, and long sleep durations, respectively.

E-cigarette users were asked, “Have you ever used an e-cigarette, even once?” and “During the past 30 days, how many days did you use e-cigarettes?” Participants who had never used an e-cigarette even once were defined as “never users”; those who had used e-cigarettes before but had not them in the last 30 days were defined as “former users,” whereas those who had used e-cigarettes in the last 30 days were termed “current users.”

Marijuana users were defined using the questions: "Have you ever, even once, used marijuana or hashish?" and "How long has it been since you last used marijuana or hashish?" Participants who had not used marijuana or hashish even once were defined as "never users"; those who had used marijuana or hashish before but had not in the last 30 days were defined as "former users," whereas those who had used marijuana or hashish in the last 30 days were termed "current users."

Cigarette users were asked: "Have you smoked at least 100 cigarettes in your entire life?" and "Do you currently smoke cigarettes?". Participants who had not smoked at least 100 cigarettes in their entire lives were "never users." Participants who had smoked at least 100 cigarettes in their lives, but did not smoke now, were defined as "former users," in contrast, those who still smoked were "current cigarette smokers." Smoking status was categorized as "never users", "former users" and "current users" of e-cigarette or traditional cigarette depends on the model.

"Dual use of e-cigarette and marijuana " refers to participants who had used both e-cigarettes and marijuana in the last 30 days. Participants who did not use e-cigarettes or marijuana in the last 30 days were defined as "neither users"; "e-cigarette only users" were those who used e-cigarettes but not marijuana, whereas "marijuana only users" were participants who used marijuana but not e-cigarettes in the last 30 days.

Overweight/obese was defined when the body mass index was ≥ 25 . Snoring or difficulty in breathing was a symptom of sleep disorders. Participants were asked, "In the past 12 months, how often did {you/SP} snort, gasp, or stop breathing while {you were/s/he was} asleep?" Individuals were categorized as "never," "1–4 nights/week," or " ≥ 5 nights/week" according to the frequency of occurrence. Depression severity was calculated using the Physical Health Questionnaire (PHQ) score. PHQ score < 10 classified as minimal to mild depression, PHQ score 10–15 as moderate depression, and PHQ score ≥ 15 as severe depression. Chronic diseases such as diabetes, cardiovascular diseases, and asthma also affected sleep duration and were considered [36-40].

Statistical analysis

The chi-square test and analysis of variance were used for analyses of binary and continuous variables, respectively. Multinomial logistic regression models were used for univariate and multivariate analyses of e-cigarettes, marijuana use, and sleep duration. All multivariable models were adjusted for age, sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, other Hispanic, and others), annual household income ($< \$20,000$ vs. $\geq \$20,000$), overweight/obese, serum cotinine level, cigarette use (current user and former user vs. never user), education (more than high school and high school graduate vs. less than high school), marital status (married/living together and divorced/separated vs. widowed/never married), the severity of depression (severe and moderate depression vs. minimal to mild depression), occupation (with a job vs. jobless/looking for a job), snoring or difficulty breathing (frequently, occasionally, and rarely vs. never), and chronic diseases (yes vs. no). A two-tailed P value < 0.05 indicated a statistically significant difference. The R Program version 3.6.2 (The R Foundation for Statistical Computer, Vienna, Austria; www.r-project.org) was used for all analyses.

Results

Among all the participants, 80.77% were aged 26–64 years, while the rest were aged 19–25 years. And 70.16% were overweight/obese. Only 11.58% had an annual household income <\$20,000. 20.39% of the participants were former e-cigarette users, 7.71% were current e-cigarette users, 28.58% were marijuana current users (data not shown), 4.22% were dual e-cigarette-marijuana current users (Table 1), 4.01% were current dual e-cigarette-traditional cigarette users, and 9.27% were current dual marijuana-traditional cigarette users (See Supplementary Table 1, Additional File 1). Figure 2 shows that there are 119 participant who used both e-cigarette and marijuana in cycle 2015-2016, and the number increased to 153 in cycle 2017-2018. However, the number of those who dual used e-cigarette and traditional cigarette or traditional cigarette and marijuana decreased by years.

Compared with 3,956 participants with normal sleep duration, 1,186 participants with short sleep duration were more likely to be current cigarette users and dual tobacco products current users. Meanwhile, they are also more likely to be older, male, overweight/obese, non-Hispanic black, other Hispanic, widowed or divorced, frequent snorer or who stops breathing at night, to have an education level less than high school or high school graduate, no job or looking for a job, moderate to severe depression, an annual household income <\$20,000, chronic diseases, and higher serum cotinine level. Participants with long sleep duration almost yielded the same results, except they were more likely to be younger, female, not overweight/obese, but not snoring or having difficulty breathing at night (See Table 2 and Supplementary Table 2, Additional File 1).

In Table 3, we found that current marijuana only users had 1.49 times significantly higher odds of long sleep duration than neither users. Dual e-cigarette-marijuana users had 2.26 times higher odds of short sleep duration and 2.56 times higher odds of long sleep duration than those who did not use e-cigarettes or marijuana currently. Similar results were observed when analyzing the association between dual e-cigarette-traditional cigarette use or traditional cigarette-marijuana use and sleep duration (See Supplementary Table 3 & 4, Additional File 1). Meanwhile, traditional cigarette only users had significantly higher odds of both short and long sleep duration than neither users. After adjusting for confounders (including age, sex, race, annual household income, overweight/obese, smoking status, cotinine level, education level, marital status, occupation, depression severity, snort or stop breathing, and chronic diseases), dual e-cigarette-marijuana users had 2.34 and 2.09 times significantly higher odds than those who used neither in the groups with short and long sleep durations, respectively. At the same time, dual e-cigarette-marijuana users had 4.24 times significantly higher odds than those who used only e-cigarette in the groups with short sleep duration (Table 4). In addition, it was found that dual traditional cigarette-marijuana users had 1.98 times significantly higher odds of long sleep duration than neither users (See Supplementary Table 5, Additional File 1). However, no significant differences were observed between dual e-cigarette-traditional cigarette use and sleep duration (See Supplementary Table 6, Additional File 1).

Discussion

In a cross-sectional survey study of 6,573 participants aged 18–64 years in the US, 3.84% were current e-cigarette only users, 24.36% were current marijuana only users, 4.22% were current dual e-cigarette-marijuana users, 4.01% were current dual e-cigarette-traditional cigarette users, and 9.27% were current dual marijuana-traditional cigarette users. And the number of participants who dual used e-cigarette and marijuana increased by year. We also found that former or current e-cigarette users, current marijuana users, dual e-cigarette-marijuana current users, and current traditional cigarette users were more likely to have sleep duration, which is not recommended according to National Sleep Foundation.

Tobacco products use was reported to be associated with sleep disturbance in many recent research [4-12,19,26-31]. And cannabis is often perceived as providing benefits as a sleep aid [41-44]. However, few reported the association between dual use tobacco products and marijuana, especially e-cigarette and marijuana dual use. Kang et al. conducted a study to examine between-group differences in depression and sleep quality based on smoking/vaping status among Korean adults, and showed that e-cigarette and traditional cigarette dual users had significantly higher depression scores (PHQ-9) and significantly lower sleep quality (PSQI-K), respectively, than did cigarette users and non-users [45], Abafalvi et al. reported that dual users of e-cigarette and traditional cigarette were significantly more likely to report adverse effects of vaping than e-cigarette only users (26.2% vs. 11.8%, $p < 0.001$) [46]. Lee et al. were the first to report that dual users of cigarettes and traditional cigarettes had a higher prevalence of depression and suicidality among South Korean adolescents [47]. Berlin et al. Found that dual e-cigarette users in France may have higher nicotine intake overall than exclusive e-cigarette users. Still, they may take in less nicotine from their e-cigarettes [48]. A study conducted by Advani et al. demonstrates that dual use of e-cigarettes and the traditional cigarette was associated with longer sleep latency, and the shared component of nicotine may be a driver [49]. This study found that current traditional cigarette use was significantly associated with not recommended sleep duration (both short and long); however, no significant association of dual e-cigarette-traditional cigarette use was observed with recommended sleep duration (See Supplementary Table 5, Additional File 1). We suppose that it may be because of the decline in the use of traditional cigarettes while using e-cigarettes simultaneously.

Meanwhile, the main purpose of this study is to explore the association between e-cigarette-marijuana dual use and sleep duration, which hasn't been reported before. We found that dual e-cigarette-marijuana use was significantly associated with not recommended sleep duration. However, there was no association between e-cigarette or marijuana only use and sleep duration. The effect of e-cigarette use on sleep health remains unclear. Several studies showed that e-cigarette use was associated with sleep duration [24-31]. For example, Wiener RC et al. reported that participants who currently used e-cigarettes were 1.82 times more likely not to get their recommended sleep duration compared with participants who never used e-cigarettes [26], which was consistent with our results. Marijuana has been reported to be associated with short or long sleep duration in previous studies [41-44,50-53]. Schwenk et al. found that recent cannabis users had greater adjusted odds of reporting both short (adjusted odds ratio (aOR) 1.34, 95% CI: 1.12 to 1.59) and long sleep (aOR 1.56, 95% CI: 1.25 to 1.96). Heavy users, who were those using cannabis for at least 20 of the past 30 days, were even more likely to report sleep durations at the extreme ends of the range [53]. From a sample of approximately 146 million adults in the USA, recent

cannabis use was associated with the extremes of nightly sleep duration, suggesting a dose-response relationship [43]. We didn't observe any significant association between only marijuana or e-cigarette use and short or long sleep duration. But there was a significant association between dual e-cigarette-marijuana use and both short and long sleep duration. And compared to e-cigarette only use, dual use had 4.24 times higher odds of short sleep duration. The results indicate that dual e-cigarette-marijuana users are more likely to have short sleep duration than single tobacco users, and both do not recommend sleep duration than neither users. However, we couldn't confirm the causal relationship between them. Further longitudinal randomized controlled trials (RCTs) are needed to support our results. Unlike dual e-cigarette-marijuana use, dual traditional cigarette-marijuana use was associated with only a long sleep duration.

This study has some limitations. The study lacked information on the weekday sleep hours of the participants. It also lacked data on sleep behavior, such as restless leg syndrome and polysomnography results, to better describe the sleep conditions. Although our study suggested that dual e-cigarette and marijuana use was associated with a sleep duration outside the recommended range, we could not confirm the causal association between them. Furthermore, because all interview data were collected by questionnaires, such as smoking status, recall bias could not be avoided.

Conclusions

Our study suggested that dual e-cigarette-marijuana use was associated with both short and long sleep duration, short sleep duration compared to neither use and e-cigarette only use, respectively. Dual traditional cigarette-marijuana use was associated with long sleep duration compared to neither use. Since most tobacco users use not only one kind of tobacco product, it is important to conduct longitudinal RCTs to explore the joint effect of dual tobacco use on human health. Sleep health has increasingly attracted considerable attention. As doctors in a children's hospital in China, we are also concerned about the impact of smoking or secondhand smoke on children's sleep. This is a future research direction that should be considered in local areas.

Abbreviations

NHANES, National Health and Nutrition Examination Survey

PHQ, Physical Health Questionnaire

RCTs, randomized controlled trials

Declarations

Ethics approval and consent to participate

The NHANES protocol was approved by the US National Center for Health Statistics Research Ethics Review Board, and all participants provided informed consent. Informed consent was obtained from the parents or guardians of all participants.

Consent for publication

Not Applicable (NA).

Availability of data and material

The datasets are available at <http://www.cdc.gov/nchs/nhanes.htm>.

Competing interest

The authors have no conflicts of interest to declare.

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Authors' contributions

LL designed and led the research. ZZP drafted the work and was involved in the writing of the manuscript. QW and YG revised the manuscript. HXW, SSP, SYX, and QZ analyzed the participant data. All authors contributed to the implementation of the study. All authors read and approved the final manuscript.

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References

1. Janson C, Gislason T, De Backer W, Plaschke P, Björnsson E, Hetta J, et al. Prevalence of sleep disturbances among young adults in three European countries. *Sleep*. 1995;18:589-97.

2. Cohrs S, Rodenbeck A, Riemann D, Szagun B, Jaehne A, Brinkmeyer J, et al. Impaired sleep quality and sleep duration in smokers-results from the German Multicenter Study on nicotine Dependence. *Addict Biol.* 2014;19:486-96.
3. Wetter DW, Young TB. The relation between cigarette smoking and sleep disturbance. *Prev Med.* 1994;23:328-34.
4. Deleanu OC, Pocora D, Mihălcuță S, Ulmeanu R, Zaharie AM, Mihălțan FD. Influence of smoking on sleep and obstructive sleep apnea syndrome. *Pneumologia.* 2016;65:28-35.
5. Jaehne A, Unbehaun T, Feige B, Lutz UC, Batra A, Riemann D. How smoking affects sleep: a polysomnographical analysis. *Sleep Med.* 2012;13:1286-92.
6. Liu JT, Lee IH, Wang CH, Chen KC, Lee CI, Yang YK. Cigarette smoking might impair memory and sleep quality. *J Formos Med Assoc.* 2013;112:287-90.
7. McNamara JP, Wang J, Holiday DB, Warren JY, Paradoa M, Balkhi AM, et al. Sleep disturbances associated with cigarette smoking. *Psychol Health Med.* 2014;19:410-9.
8. Liao Y, Xie L, Chen X, Kelly BC, Qi C, Pan C, et al. Sleep quality in cigarette smokers and nonsmokers: findings from the general population in central China. *BMC Public Health.* 2019;19:808.
9. Hsu WY, Chiu NY, Chang CC, Chang TG, Lane HY. The association between cigarette smoking and obstructive sleep apnea. *Tob Induced Dis.* 2019;17:27.
10. Bogati S, Singh T, Paudel S, Adhikari B, Baral D. Association of the pattern and quality of sleep with consumption of stimulant beverages, cigarette and alcohol among medical students. *J Nepal Health Res Counc.* 2020;18:379–85.
11. PhD AN, Rhee JU, Haynes P, Chakravorty S, Patterson F, Killgore WDS, et al. Smoke at night and sleep worse? The associations between cigarette smoking with insomnia severity and sleep duration. *Sleep Health.* 2021;7:177-82.
12. Chang LY, Chang HY, Wu WC, Lin LN, Wu CC, Yen LL. Dual trajectories of sleep duration and cigarette smoking during adolescence: relation to subsequent internalizing problems. *J Abnorm Child Psychol.* 2018;46:1651–63.
13. Yang Q, Durmer JL, Wheaton AG, Jackson SL, Zhang Z. Sleep duration and excess heart age among US adults. *Sleep Health.* 2018;4:448-55.
14. Gangwisch JE, Heymsfield SB, Boden-Albala B, Buijs RM, Kreier F, Pickering TG, et al. Short sleep duration as a risk factor for hypertension: analyses of the first National Health and Nutrition Examination Survey. *Hypertension.* 2006;47:833-9.
15. Gangwisch JE, Heymsfield SB, Boden-Albala B, Buijs RM, Kreier F, Pickering TG, et al. Sleep duration as a risk factor for diabetes incidence in a large U.S. sample. *Sleep.* 2007;30:1667-73.
16. Pilcher JJ, Huffcutt AI. Effects of sleep deprivation on performance: a meta-analysis. *Sleep.* 1996;19:318-26.
17. Wilson S, Argyropoulos S. Antidepressants and sleep: a qualitative review of the literature. *Drugs.* 2005;65:927-47.

18. Yaggi HK, Concato J, Kernan WN, Lichtman JH, Brass LM, Mohsenin V. Obstructive sleep apnea as a risk factor for stroke and death. *N Engl J Med.* 2005;353:2034-41.
19. Lavigne GL, Lobbezoo F, Rompré PH, Nielsen TA, Montplaisir J. Cigarette smoking as a risk factor or an exacerbating factor for restless legs syndrome and sleep bruxism. *Sleep.* 1997;20:290-3.
20. Levy DT, Yuan Z, Li Y. The prevalence and characteristics of E-cigarette users in the U.S. *Int J Environ Res Public Health.* 2017;14:1200.
21. McConnell R, Barrington-Trimis JL, Wang K, Urman R, Hong H, Unger J, et al. Electronic cigarette use and respiratory symptoms in adolescents. *Am J Respir Crit Care Med.* 2017;195:1043–9.
22. Gay B, Field Z, Patel S, Alvarez RM, Nasser W, Madruga M, et al. Vaping-induced lung injury: A case of lipoid pneumonia associated with E-cigarettes containing cannabis. *Case Rep Pulmonol.* 2020;2020:7151834.
23. Rohde JA, Noar SM, Mendel JR, Hall MG, Baig SA, Ribisl KM, et al. E-cigarette health harm awareness and discouragement: Implications for health communication. *Nicotine Tob Res.* 2020;22:1131–8.
24. Russell C, Katsampouris E, Mckeganey N. Harm and addiction perceptions of the JUUL E-cigarette among adolescents. *Nicotine Tob Res.* 2020;22:713–21.
25. Marques P, Piqueras L, Sanz MJ. An updated overview of e-cigarette impact on human health. *Respir Res.* 2021;22:151.
26. Wiener RC, Waters C, Bhandari R, Trickett Shockey AK, Alshaarawy O. The association of sleep duration and the use of electronic cigarettes, NHANES, 2015-2016. *Sleep Disord* 2020:8010923
27. Riehm KE, Rojo-Wissar DM, Feder KA, Mojtabai R, Spira AP, Thrul J, et al. E-cigarette use and sleep-related complaints among youth. *J Adolesc.* 2019;76:48–54.
28. Kianersi S, Zhang Y, Rosenberg M, Macy JT. Association between e-cigarette use and sleep deprivation in U.S. Young adults: results from the 2017 and 2018 Behavioral Risk Factor Surveillance System. *Addict Behav.* 2021;112:106646.
29. Brett EI, Miller MB, Leavens ELS, Lopez SV, Wagener TL, Leffingwell TR. Electronic cigarette use and sleep health in young adults. *J Sleep Res.* 2020;29:e12902.
30. Merianos AL, Jandarov RA, Choi K, Fiser KA, Mahabee-Gittens EM. Combustible and electronic cigarette use and insufficient sleep among U.S. high school students. *Prev Med.* 2021;147:106505.
31. Lee BG, Lee H. Associations between cigarette and electronic cigarette use and sleep health in Korean adolescents: an analysis of the 14th (2018) Korea youth risk behavior surveys. *J Korean Acad Nurs.* 2021;51:380–9.
32. Monti JM, Pandi-Perumal SR. Clinical management of sleep and sleep disorders with cannabis and cannabinoids: implications to practicing psychiatrists. *Clin Neuropharmacol* ahead of print. 2022;45:27–31.
33. Vaseghi S, Arjmandi-Rad S, Nasehi M, Zarrindast MR. Cannabinoids and sleep-wake cycle: the potential role of serotonin. *Behav Brain Res.* 2021;412:113440.

34. Maultsby KD, Luk JW, Sita KR, Lewin D, Simons-Morton BG, Haynie DL. Three dimensions of sleep, somatic symptoms, and marijuana use in U.S. High school students. *J Adolesc Health*. 2021;69:50-6.
35. Chen T-C, Clark J, Riddles MK, et al. National health and nutrition examination survey. 2015–2018: sample design and estimation procedures. *NATIONAL CENTER FOR HEALTH STATISTICS*;2.
36. Yang Q, Durmer JL, Wheaton AG, et al. Sleep duration and excess heart age among US adults. *Sleep Health*. 2018;4:448-455.
37. Liu Y, Wheaton AG, Croft JB, et al. Relationship between sleep duration and self-reported health-related quality of life among US adults with or without major chronic diseases, 2014. *Sleep Health*. 2018;4:265-272.
38. Liu Y, Wheaton AG, Chapman DP, et al. Prevalence of Healthy Sleep Duration among Adults–United States, 2014. *MMWR Morb Mortal Wkly Rep*. 2016;65:137-141.
39. Von Ruesten A, Weikert C, Fietze I, et al. Association of sleep duration with chronic diseases in the European Prospective Investigation into Cancer and Nutrition (EPIC)-Potsdam study. *PLOS One*. 2012;7:e30972.
40. Yang G, Han YY, Sun T, et al. Sleep Duration, Current Asthma, and Lung Function in a Nationwide Study of U.S. Adults. *Am J Respir Crit Care Med*. 2019;200:926-929.
41. Goodhines PA, Gellis LA, Ansell EB, Park A. Cannabis and alcohol use for sleep aid: A daily diary investigation. *Health Psychol*. 2019;38:1036–47.
42. Doremus JM, Stith SS, Vigil JM. Using recreational cannabis to treat insomnia: Evidence from over-the-counter sleep aid sales in Colorado. *Complement Ther Med*. 2019;47:102207.
43. Diep C, Tian C, Vachhani K, Won C, Wijeyesundera DN, Clarke H, et al. Recent cannabis use and nightly sleep duration in adults: A population analysis of the NHANES from 2005 to 2018. *Reg Anesth Pain Med*. 2022;47:100–4.
44. Drazdowski TK, Kliewer WL, Marzell M. College students' using marijuana to sleep relates to frequency, problematic use, and sleep problems. *J Am Coll Health*. 2021;69:103–12.
45. Kang SG, Bae SM. The effect of cigarette use and dual-use on depression and sleep quality. *Subst Use Misuse*. 2021;56:1869–73.
46. Abafalvi L, Péntzes M, Urbán R, Foley KL, Kaán R, Kispélyi B, et al. Perceived health effects of vaping among Hungarian adult e-cigarette-only and dual users: A cross-sectional internet survey. *BMC Public Health*. 2019;19:302.
47. Lee Y, Lee KS. Association of depression and suicidality with electronic and conventional cigarette use in South Korean adolescents. *Subst Use Misuse*. 2019;54:934–43.
48. Berlin I, Nalpas B, Targhetta R, Perney P. Comparison of e-cigarette use characteristics between exclusive e-cigarette users and dual e-cigarette and conventional cigarette users: An on-line survey in France. *Addict (Abingdon Engl)*. 2019;114:2247–51.
49. Advani I, Gunge D, Boddu S, Mehta S, Park K, Perera S, et al. Dual use of e-cigarettes with conventional tobacco is associated with increased sleep latency in cross-sectional Study. *Sci Rep*.

2022;12:2536.

50. Babson KA, Sottile J, Morabito D. Cannabis, cannabinoids, and sleep: A review of the literature. *Curr Psychiatry Rep.* 2017;19:23.
51. Bhagavan C, Kung S, Doppen M, John M, Vakalalabure I, Oldfield K, et al. Cannabinoids in the treatment of insomnia disorder: A systematic review and meta-analysis. *CNS Drugs.* 2020;34:1217-28.
52. Pupko HA. Medical marijuana in treating obstructive sleep apnea. *CMAJ.* 2018;190:E572.
53. Schwenk ES, Gupta RK, Diep C. Recent cannabis use and nightly sleep duration in adults: An infographic. *Reg Anesth Pain Med.* 2022;47:105.

Tables

Table 1

Main characteristics of all participants ($n = 6,573$), NHANES 2015–2018, 18–64 years.

	Number	Weighted percentage
Age		
18-25y	1,375	19.23
26-64y	5,198	80.77
Sex,male		
	3,157	49.83
Race		
Non-Hispanic White	2,032	59.52
Mexican American	1,142	10.97
Other Hispanic	704	7.45
Non-Hispanic black	1,473	12.00
Other	1,222	10.07
Annual household income<\$20,000	1,511	11.58
Overweight/obese,yes	4,576	70.16
Dual e-cigarette - marijuana use		
Neither user	4,592	67.93
E-cigarette only user	208	3.48
Marijuana only user	1,501	24.36
Dual user	272	4.22
Traditional cigarette use		
Never user	4,175	60.25
former user	1,052	19.78
Current user	1,344	19.97
Education level		
Less than high school	1,209	12.02
High school graduate	1,603	24.30
More than high school	3,760	63.68
Marriage status		
Windowed/never married	1,628	25.02
Divorced/separated	759	11.38

Married/living together	3,698	63.60
Occupation		
No job/looking for a job	1,817	22.10
Already have a job	4,749	77.90
Depression (PHQ score)		
Minimal to mild	6,130	93.80
Moderate	290	4.37
Severe	142	1.83
Chronic diseases (CVD, asthma, etc.), yes	1,189	0.19
Snort or stop breathing		
Never	4,768	75.98
1–4 nights/week	1,207	19.49
5 or more nights/week	3,12	4.53
Sleep duration		
<7 h	1,186	16.02
7-9 h	4,667	75.20
>9 h	720	8.78

Table 2

The main characteristics stratified by sleep duration, and the findings regarding sleep duration and electronic cigarette-marijuana dual use, NHANES 2015–2018, 18–64 years.

	Sleep duration			P-value
	Short (<7 h) (n=1,186)	Normal (7–9 h) (n=4,667)	Long (>9 h) (n=720)	
Age, y	40.79 ± 0.46	38.82 ± 0.29	33.82 ± 0.64	<0.001 ^{***}
Sex, male	668 (59.40)	2,205 (49.00)	284 (39.53)	<0.001 ^{***}
Race				<0.001 ^{***}
Non-Hispanic White	282 (49.88)	1,534 (62.52)	216 (51.41)	
Mexican American	175 (11.01)	833 (10.60)	134 (14.05)	
Other Hispanic	141 (9.62)	487 (6.91)	76 (8.04)	
Non-Hispanic black	409 (20.75)	886 (9.61)	178 (16.48)	
Other	179 (8.74)	927 (10.36)	116 (10.02)	
Annual household income <\$20,000	279 (12.17)	999 (9.84)	233 (25.39)	<0.001 ^{***}
Overweight/obese, yes	898 (75.04)	3,229 (69.60)	449 (65.99)	0.00012 ^{***}
Dual e-cigarette-marijuana use				<0.001 ^{***}
Neither user	797 (63.57)	3,335 (69.90)	460 (59.07)	
E-cigarette only user	37 (3.16)	141 (3.41)	30 (4.69)	
Marijuana only user	283 (26.13)	1,037 (23.41)	181 (29.24)	
Dual user	69 (7.14)	154 (3.28)	49 (7.00)	
Traditional cigarette use				<0.001 ^{***}
Never user	671 (50.59)	3,050 (62.44)	454 (59.10)	
former user	187 (20.07)	782 (20.52)	83 (12.98)	
Current user	328 (29.34)	833 (17.04)	183 (27.92)	
Serum cotinine, µg/mL	0.094 ± 0.0070	0.052 ± 0.0039	0.067 ± 0.0073	<0.001 ^{***}
Education level				<0.001 ^{***}
Less than high school	237 (15.05)	789 (10.20)	183 (22.12)	
High school graduate	315 (30.06)	1,047 (21.75)	241 (35.63)	
More than high school	634 (54.89)	2,830 (68.05)	296 (42.25)	

Marriage status				<0.001 ^{***}
Windowed/never married	306 (24.80)	1,108 (23.95)	214 (35.54)	
Divorced/separated	165 (13.52)	513 (10.66)	81 (13.82)	
Married/living together	665 (61.68)	2,734 (65.39)	299 (50.64)	
Occupation				<0.001 ^{***}
No job/looking for a job	278 (20.28)	1152(19.04)	387 (51.62)	
Already have a job	908 (79.72)	3509(80.96)	332(48.38)	
Snort or stop breathing				<0.001 ^{***}
Never	791 (69.63)	3,440 (77.21)	537 (76.78)	
1–4 nights/week	235 (22.94)	838 (18.77)	134 (19.44)	
5 or more nights/week	92(7.43)	197 (4.02)	23 (3.78)	
Depression severity (PHQ score)				<0.001 ^{***}
Minimal to mild	1,077 (90.36)	4,413(95.01)	640 (89.75)	
Moderate	68 (6.20)	173(3.71)	49 (6.63)	
Severe	39 (3.44)	74(1.28)	29 (3.62)	
Chronic diseases (CVD, asthma, etc.)				0.0018 ^{**}
No	814 (78.93)	3,357 (82.73)	410 (74.41)	
Yes	261 (21.07)	766 (17.27)	162 (25.59)	

* $P < 0.05$ ** $P < 0.01$ *** $P < 0.001$.

Values are presented as numbers (%) or mean (mean \pm standard deviation). The numbers may vary because of missing data.

Table 3

Association between sleep duration and dual use of e-cigarette and marijuana, NHANES 2015–2018, 18–64 years (univariate).

Sleep duration

	Short (<7 h) (n=1,186)	Normal (7–9 h) (n=4,667)	Long (>9 h) (n=720)	
	OR (95% CI)	<i>P</i> -value	OR (95% CI)	<i>P</i> -value
Dual E-cigarette - marijuana use				Ref.
E-cigarette only vs. neither	1.06 (0.65, 1.75)	0.80	1.60 (0.68, 3.73)	0.28
Marijuana only vs. neither	1.20 (0.88, 1.64)	0.24	1.49 (1.27, 1.75)	<0.001 ^{***}
Dual vs. neither	2.26 (1.47, 3.47)	0.00020 ^{***}	2.56 (1.95, 3.35)	<0.001 ^{***}
Marijuana only vs. e-cigarette only	1.15 (0.64, 2.07)	0.64	0.91 (0.43, 1.92)	0.80
Dual vs. E-cigarette only	2.14 (1.45, 3.14)	<0.001 ^{***}	1.57 (0.72, 3.44)	0.26
Dual vs. marijuana only	1.86 (1.10, 3.14)	0.021	1.73 (1.35, 2.24)	<0.001 ^{***}

P* < 0.05 *P* < 0.01 ****P* < 0.001.

The model was unadjusted.

Table 4

Association between sleep duration and dual use of e-cigarette and marijuana, NHANES 2015–2018, 18–64 years (multivariate).

	Sleep duration				
	Short (<7 h) (n=1,186)		Normal (7–9 h) (n=4,667)	Long (>9 h) (n=720)	
	OR (95% CI)	<i>P</i> -value		OR (95% CI)	<i>P</i> -value
Dual e-cigarette - marijuana use			Ref.		
E-cigarette only vs. neither	0.85 (0.45, 1.59)	0.61		0.85 (0.29, 2.44)	0.76
Marijuana only vs. neither	1.12 (0.78, 1.61)	0.53		1.46 (0.95, 2.25)	0.08
Dual vs. neither	2.34 (1.19, 4.61)	0.014*		2.09 (1.53, 2.87)	<0.001***
Marijuana only vs. e-cigarette only	0.84 (0.67, 2.77)	0.40		0.99 (0.61, 4.73)	0.32
Dual vs. E-cigarette only	4.24 (1.75, 4.60)	<0.001***		1.67 (0.86, 6.68)	0.095
Dual vs. marijuana only	1.88 (0.97, 4.51)	0.060		1.20 (0.80, 2.53)	0.23

P* < 0.05 *P* < 0.01 ****P* < 0.001. The model was adjusted for age, sex, race, annual household income, overweight/obese, smoking status (traditional cigarette), cotinine level, education level, marital status, occupation, depression severity, snort or stop breathing, and chronic diseases. PHQ: Patient health questionnaire. CVD: Cardiovascular diseases. Ref: reference. OR: Odds ratio. CI: Confidence interval.

Figures

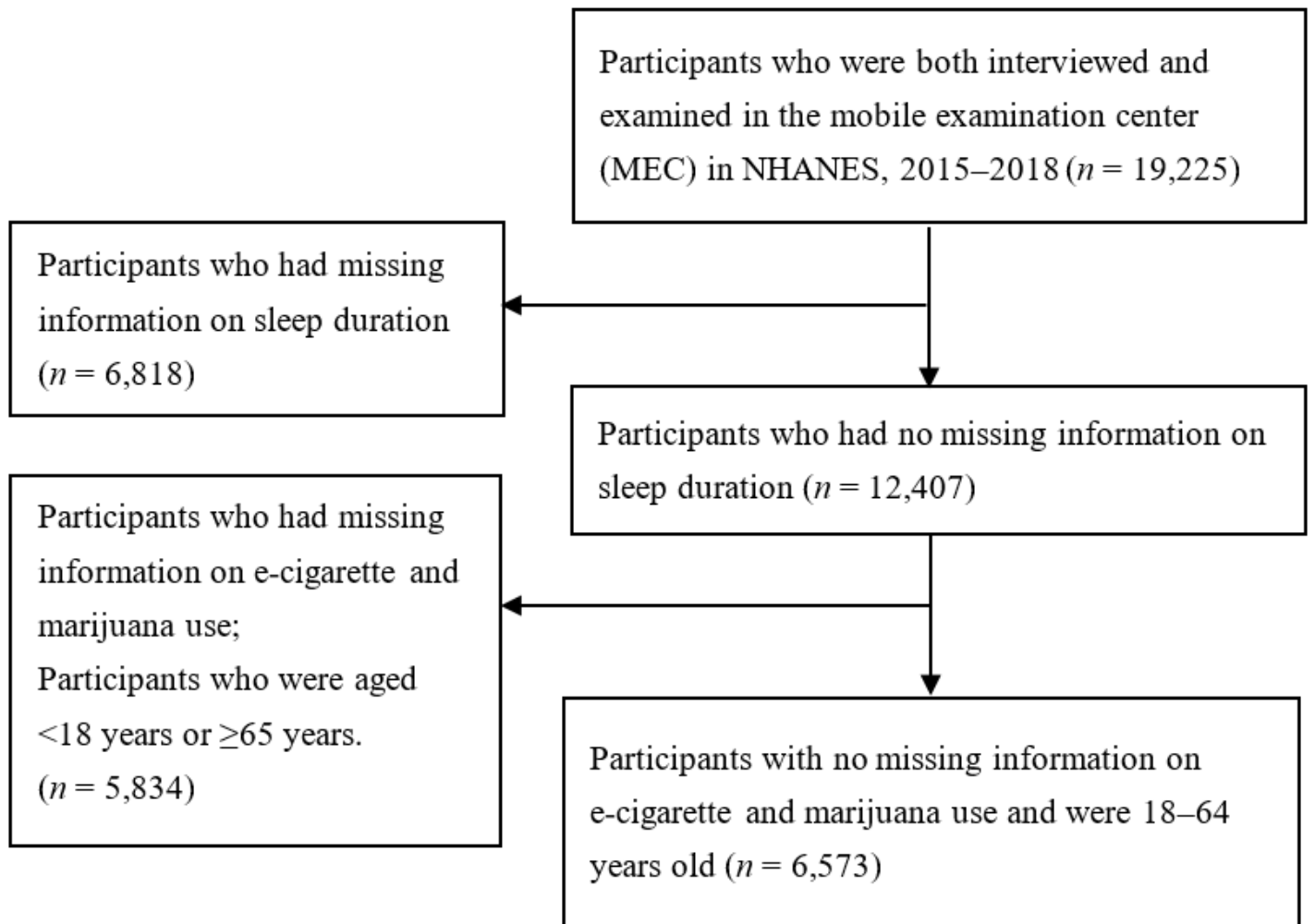


Figure 1

Flowchart for the selection of study participants in the current analysis. NHANES, National Health and Nutrition Examination Survey.

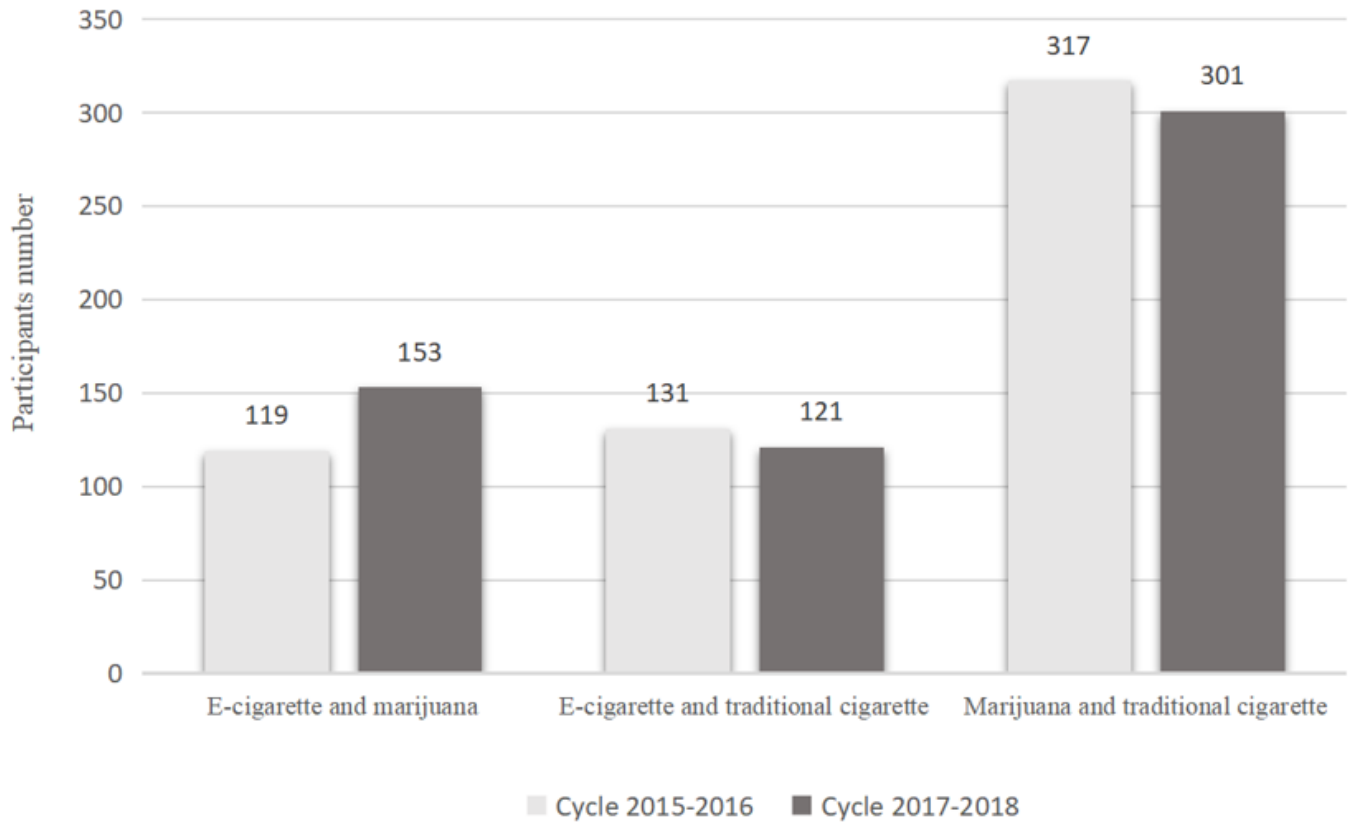


Figure 2

Number of participants who dual use of tobacco products and marijuana in different cycles (2015-2016 and 2017-2018).

Supplementary Files

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- [AdditionalFile1.docx](#)