



# The association between marijuana and e-cigarette use and exercise behavior among adults

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## ARTICLE INFO

### Keywords:

Marijuana  
Cannabis  
E-Cigarettes  
Exercise  
Physical activity  
Self-Rated health

## ABSTRACT

**Background:** As the prevalence of marijuana and e-cigarette use among American adults rises and the perceived risk decreases, more information is needed on the potential costs and benefits of marijuana and e-cigarette use, including patterns of exercise. Prior studies have found mixed results, lacked data on types of exercise, and involved only adolescents and young adults. Thus, the current study explored whether marijuana and e-cigarette use are associated with strength training, walking for exercise, or general physical activity among adults in the United States.

**Method:** 2,591 adults from Wave V of the National Longitudinal Study of Adolescent to Adult Health (2016–2018) comprised the sample. Separate one-way analyses of variance (ANOVAs) and post hoc tests examined whether participants' marijuana and e-cigarette use predicted their exercise, while follow-up analyses of covariance (ANCOVAs) probed significant effects.

**Results:** Results indicated that participants' marijuana and e-cigarette use predicted their walking for exercise, with marijuana users walking the highest number of times per week, followed by non-users, e-cigarette users, and dual users. However, this effect only approached significance after controlling for covariates. There were no significant differences in strength training or general exercise between groups.

**Conclusion:** These findings challenge the stereotype that marijuana and e-cigarette users are less active than non-users, and future research should examine the potential mechanisms of these findings.

## 1. Introduction

The prevalence of marijuana (cannabis) and e-cigarette use among American adults has risen in recent years (Hasin et al., 2015; Rifai et al., 2020) while the perceived risk has decreased (Keyhani et al., 2018; Trumbo & Harper, 2013). Daily or almost daily cannabis use has tripled from 2002 (1.3 %) to 2019 (3.9 %) among U.S. adults (Substance Abuse and Mental Health Services Administration, 2020), with more than a third believing that smoking marijuana is safer than smoking cigarettes (Keyhani et al., 2018). Relatedly, e-cigarettes have gained popularity among adult smokers attempting to quit (Zhu et al., 2017). While cannabis use can treat pain, chemotherapy-induced nausea, and multiple sclerosis in adults (Abrams, 2018), it is still associated with heart, liver, lung, and vascular diseases (Gordon et al., 2013) as well as anxiety, cognitive dysfunction, depression, suicidality, and other mental health problems (Hasin et al., 2015; Keyes, 2018; Stoner, 2017). E-cigarette use is similarly associated with asthma, cardiovascular disease, lung injury,

and nicotine addiction (Conklin et al., 2019; Walley et al., 2019).

Exercise has established health benefits, including the prevention and improvement of chronic diseases such as anxiety, depression, and chronic inflammation, and could help mitigate the harms of marijuana and e-cigarette use (Geirsdottir et al., 2012; Mikkelsen et al., 2017). However, the relationship between cannabis and e-cigarette use and exercise is unclear. Several studies on adolescents and young adults reported no association between marijuana use and physical activity (Dunn & Wang, 2003; Gillman et al., 2015). Yet, some research suggested that athletes are less likely to use marijuana than non-athletes (Peretti-Watel & Lorente, 2004; Terry-McElrath et al., 2011). Similarly, researchers found both positive (Jacobs et al., 2021; Milicic et al., 2019) and negative (Miller et al., 2019; Pokhrel et al., 2019) relationships between e-cigarette use and exercise. However, these studies were either limited to adolescents and young adults or focused only on whether participation in a sport influenced an athlete's substance use. Little is known about this relationship in reverse (i.e., whether substance

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<https://doi.org/10.1016/j.pmedr.2024.102668>

Received 6 November 2023; Received in revised form 26 January 2024; Accepted 23 February 2024

Available online 28 February 2024

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use influences one's exercise habits), particularly among adults over the age of 30.

Two studies are the exception. Vidot and colleagues (2017) explored the association between marijuana use and recreational physical activity in adults aged 20–59 from the National Health and Nutrition Examination Surveys (2007–2014). They found that current and past marijuana users had lower odds of engaging in moderate physical activity than never users (Vidot et al., 2017), but this relation was weaker for vigorous physical activity. French and colleagues (2021) found that marijuana use was not associated with exercise among 24-to-42-year-olds from the 2008–2016 waves of the National Longitudinal Study of Adolescent to Adult Health. The only significant estimates suggested a positive relationship (French et al., 2021). These mixed results raise the question of whether marijuana use is only related to certain forms of exercise among adults.

To our knowledge, no studies examined the relationship between e-cigarette use and physical activity among adults, possibly due to the higher rates of e-cigarette use among adolescents and young adults than older age groups. Some studies in young people found that e-cigarette use was inversely associated with moderate to vigorous exercise (Pokhrel et al., 2019) and that e-cigarette users were less likely to engage in moderate-vigorous physical activity than never users (Miller et al., 2019). However, others concluded that youth e-cigarette users were more likely to play sports (Milicic et al., 2019) and meet the physical activity recommendation (Jacobs et al., 2021) than non-users.

In the current study, we aimed to build on existing studies by examining whether marijuana users engage in certain forms of exercise (strength training, walking, or general activities) more or less than non-users in adults aged 33–42 in 2016. Vidot et al. (2017) considered differences in only exercise intensity while French et al. (2021) did not consider differences in intensity or format. Distinctions in exercise format are especially important because combined resistance training and aerobic exercise provides more cardiovascular benefits than only one type of exercise (Schroeder et al., 2019; Suleen et al., 2012). These benefits, including increased body strength, cardio-respiratory fitness, fat loss, and weight loss, may help reduce rising obesity rates (Willis et al., 2012) as well as cardiovascular disease and cancer in American adults (Momma et al., 2022).

Next, using the same categories of exercise (strength training, walking, and general activities), we sought to investigate the relationship between e-cigarette use and physical activity among adults to fill this gap in the literature. Additionally, we contrasted exercise behavior among dual users of marijuana and e-cigarettes against non-users. While there is evidence that dual use of marijuana and e-cigarettes is associated with lower physical activity compared to single- or non-using adolescents (Jacobs et al., 2021), it is unknown whether this finding holds up among adults.

Lastly, we examined the relationship between marijuana, e-cigarette use and self-rated health (SRH). Better SRH is associated with increased physical activity (Marques et al., 2017; Richter et al., 2009) and is a powerful predictor of future health outcomes (Benyamini, 2011), and regular marijuana smoking with or without concurrent tobacco use is significantly related to lower SRH in adults (Tsai et al., 2017). However, little is known about the relationship between e-cigarette use and SRH in adults, as most of the literature is focused on young people. As more states legalize marijuana and e-cigarettes continue to be marketed as a safer alternative to cigarettes, adult consumption is likely to increase; it is imperative for researchers to establish whether and how marijuana and e-cigarette use relate to exercise in the adult population.

## 2. Methods

### 2.1. Participants

This study used data from Wave V of the National Longitudinal Study of Adolescent to Adult Health (Add Health), which was collected from

2016 to 2018. Add Health is a longitudinal study of over 20,000 adolescents who were in grades 7–12 during the 1994–95 school year and have since been followed with five waves of data collection to date. At the time of Wave V data collection starting in 2016, subjects were between the ages of 33 and 42, and detailed information about marijuana use, e-cigarette use, and exercise was collected through in-home interviews. While 12,300 adults were surveyed in Wave V, this study used the public-use data set that included only a subset ( $N = 4,196$ ) of the sample. This subset is representative of the larger sample. In determining the final analytic sample, 1,605 participants were excluded for missing data on marijuana use ( $n = 1,561$ ), e-cigarette use ( $n = 17$ ), or both ( $n = 27$ ). This left a total of 2,591 adults in the sample. All participants provided written informed consent per guidelines from the University of North Carolina School of Public Health Institutional Review Board.

### 2.2. Exercise variables

We examined the associations between past-month marijuana and e-cigarette use and recent exercise measured at Wave V of Add Health. Participants were asked to report the number of times in the past week that they performed each of the following categories of exercise:

1. Bicycle, skateboard, dance, hike, hunt, or yard work
2. Roller blade, roller skate, downhill ski, snowboard, racquet sports, or aerobics
3. Gymnastics, weight lifting, or strength training
4. Running, wrestling, swimming, cross-country skiing, cycle racing, martial arts, football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey
5. Golf, fishing, bowling, softball, or baseball
6. Walk for exercise

These categories were designed by the Add Health study researchers and are copied verbatim from the Wave V in-home questionnaire here. Participants' answers were recorded on a scale from 0 to 7, with each number indicating the number of times they did a certain category of exercise in the past week (0 = 0 times, 1 = 1 time, etc.). A score of 7 indicated 7 or more times in the last week. Because respondents could have performed more than one category of exercise on a particular day, the exercise categories are not mutually exclusive. In our analysis, we coded category 3 as strength training, category 6 as walking, and categories 1, 2, 4, and 5 as general physical activity. Our measure of general exercise primarily includes individual and team sports but also encompasses a few other activities (i.e., hunting, fishing, and yard work).

### 2.3. Marijuana and e-cigarette use variables

In Wave V of Add Health, adults were asked several questions about their marijuana and e-cigarette use. We used these data to construct one marijuana-use and one e-cigarette-use variable. First, participants were asked how many days they used marijuana during the past 30 days. Responses were limited to seven categories: 0 = never, 1 = one day, 2 = 2 or 3 days, 3 = 1 day a week, 4 = 2 days a week, 5 = 3 to 5 days a week, 6 = every day or almost every day. Then, subjects were asked how many days they used e-cigarettes during the past 30 days, with possible responses ranging from 0 to 30. Using these data, we sorted participants into four groups – non-users (if they responded 0 on both variables), exclusive marijuana users (if they responded 1–6 on the marijuana-use variable and 0 on the e-cigarette-use variable), exclusive e-cigarette users (if they responded 1–30 on the e-cigarette-use variable and 0 on the marijuana-use variable), or dual users (if they responded anything other than 0 on both variables). Throughout this paper, we refer to exclusive marijuana users as marijuana users and exclusive e-cigarette users as e-cigarette users for simplicity.

Building off previous literature (French et al., 2021; Vidot et al.,

2017), we further categorized marijuana users and e-cigarette users into light, moderate, and heavy users based on the number of days they used. People who use substances are not a homogeneous group (i.e., some use every day, some use once a month), so we wanted to make sure that we disentangled the effects of heavy substance use on exercise from those of lighter use. Because the marijuana-use variable was categorical and the e-cigarette-use variable was continuous in Wave V of Add Health, we used slightly different criteria to determine light, moderate, and heavy use across substances. For instance, we classified current marijuana users into light (1 day, 2 or 3 days), moderate (1 day a week, 2 days a week), and heavy (3 to 5 days a week, every day or almost every day) users based on the categorization system used by French et al. (2021). Relatedly, we categorized current e-cigarette users into light (<10 days in the past month), moderate (10–20 days in the past month), and heavy (>20 days in the past month) users, consistent with the classification system used by Vidot et al. (2017).

#### 2.4. Sociodemographic variables

We selected age, cigarette use, educational attainment, marital status, race, region, SRH, and sex assigned at birth as potential covariates for this study. These variables are significantly correlated with people's physical activity habits according to the literature (Bergman et al., 2008; Eime et al., 2018). Age was collected in years, educational attainment was based on whether participants had a college degree (yes, no), marital status was coded as married or unmarried, and sex assigned at birth was expressed as male or female. Cigarette use was based on the number of cigarettes participants smoked in the past 30 days. Race was categorized as white, Black/African American, Hispanic, Asian, biracial, or other (including Pacific Islander and American Indian or Alaska Native). Region was expressed as northeast, midwest, south, or west based on the options provided in the Add Health survey. SRH was classified into five categories: excellent, very good, good, fair, and poor.

#### 2.5. Statistical analyses

We used IBM SPSS Statistics 28 to perform our analyses. First, we conducted Pearson chi-square tests of independence to compare differences in the distribution of participant demographics based on their current marijuana and e-cigarette use. Next, we used separate one-way analyses of variance (ANOVAs) to explore whether participants' marijuana and e-cigarette use group predicted the number of times they performed strength training, walking, and general exercise. Post hoc tests included Dunnett's T3 tests to account for unequal variances between groups. We probed significant effects with one-way analyses of covariance (ANOVAs) controlling for cigarette use, educational attainment, marital status, race, SRH, and sex assigned at birth. We used another ANOVA and Dunnett's procedure to explore whether the substance-using groups and non-users rated their health differently. A two-tailed P-value of  $\leq 0.05$  was considered statistically significant in all analyses. As a robustness check, we also performed multivariate logistic regression, with Add Health-provided sampling weights for analyzing cross-sectional data in Wave V to examine whether subjects' marijuana and e-cigarette use habits predicted different forms of physical activity. We included the same outcome variables and covariates as the ANCOVA.

### 3. Results

As shown in Table 1, the sample included a relatively even sex split and an average age of 37.24. 29.33 % of participants used marijuana and 8.92 % used e-cigarettes in the past month, while 86.76 % exercised in the past week. Table 2 displays the same descriptive characteristics of the sample stratified by participants' marijuana and e-cigarette use group. All statistically significant differences in variable distributions between groups are marked with asterisks. E-cigarette users had the highest percentage of male (65.99 %) and White participants (72.11 %)

**Table 1**

Descriptive statistics for a sample of U.S. adults from Wave V of the Add Health survey (2016–2018),  $N = 2,591$ .

		<i>M (SD) or %</i>
Age in years		37.24 (1.90)
Sex assigned at birth	Female	53.79
	Male	46.21
Race	White	65.95
	Black/African American	16.65
	Hispanic	5.98
	Asian	1.72
	Biracial	7.39
Educational attainment	Other	2.03
	No college degree	60.56
	College degree	39.33
Number of cigarettes smoked in past 30 days		102.82 (207.75)
Marital status	Married	54.93
	Not married	44.84
Region	Midwest	21.46
	Northeast	20.02
	South	13.53
	West	37.14
Self-rated health	Excellent	16.22
	Very good	35.18
	Good	33.62
	Fair	12.43
	Poor	2.50

and those with no college degree (77.55 %). Marijuana users had the highest proportion of Black participants (23.00 %), and dual users smoked the most cigarettes ( $M = 218.80$ ,  $SD = 296.31$ ) in the past 30 days. Since approximately 37 % of the full sample ( $N = 4,196$ ) had missing data for marijuana use, we explored potential differences between those excluded for missing data and those included in the final analytic sample. Compared to those in the final sample, those with missing data were older, smoked fewer cigarettes, and were more likely to have a college degree, be married, and be female. Additionally, only 5.40 % of adults in the full sample used e-cigarettes in the past 30 days compared to 8.92 % of the final sample.

As shown in Table 3, results of the main analysis indicated that non-users, marijuana users, e-cigarette users, and dual users did not significantly differ in their frequency of strength training or general physical activity. However, there was a significant difference in the number of times that these groups walked for exercise [ $F(3, 2,519) = 3.154$ ,  $p = .024$ ], with marijuana users walking the greatest number of times a week ( $M = 2.51$ ,  $SD = 2.50$ ), followed by non-users ( $M = 2.26$ ,  $SD = 2.43$ ), e-cigarette users ( $M = 1.99$ ,  $SD = 2.31$ ), and dual users ( $M = 1.93$ ,  $SD = 2.19$ ). After controlling for cigarette use, educational attainment, marital status, race, SRH, and sex assigned at birth, this effect only approached significance [ $F(3, 2,489) = 2.400$ ,  $p = .066$ ] (see Table 4). These results did not significantly change after repeating this analysis via multivariable logistic regression. Weighted regression results are available in Appendix A. No significant between-group differences were observed between light, moderate, and heavy marijuana or e-cigarette users in the number of times they walked for exercise. Across all groups, the mean number of times participants performed any form of exercise was less than three times per week.

Since SRH was the most significant predictor of general physical activity [ $F(4, 2,467) = 33.887$ ,  $p < .001$ ], strength training [ $F(1, 2,488) = 107.584$ ,  $p < .001$ ], and walking [ $F(1, 2,489) = 17.012$ ,  $p < .001$ ] out of all the variables we tested, we explored how people who used marijuana, e-cigarettes, or both rated their overall health compared to those who did not. Importantly, non-users rated themselves as being in significantly better overall health ( $M = 2.41$ ,  $SD = 0.962$ ) than marijuana users ( $M = 2.66$ ,  $SD = 1.028$ ), e-cigarette users ( $M = 2.68$ ,  $SD = 0.958$ ), and dual users ( $M = 2.73$ ,  $SD = 0.923$ ),  $F(3, 2,586) = 13.797$ ,  $p < .001$ . Participants who used marijuana, e-cigarettes, or both did not

**Table 2**Descriptive statistics for a sample of U.S. adults from Wave V of the Add Health survey (2016–2018), stratified by marijuana and e-cigarette use groups ( $N = 2,591$ ).

		Group			
		Non-users	Marijuana users	E-cigarette users	Dual users
		<i>M</i> ( <i>SD</i> ) or %	<i>M</i> ( <i>SD</i> ) or %	<i>M</i> ( <i>SD</i> ) or %	<i>M</i> ( <i>SD</i> ) or %
N		1,684	676	147	84
Age in years		37.28 (1.87)	37.18 (1.93)	37.27 (2.00)	37.17 (2.03)
Sex assigned at birth**	Female	57.90	48.52	34.01	42.86
	Male	42.10	51.48	65.99	57.14
Race**	White	68.61	58.61	72.11	67.86
	Black/African American	14.95	23.00	10.20	13.10
	Hispanic	6.02	6.53	4.76	4.76
	Asian	1.79	1.34	2.04	2.38
	Biracial	6.79	8.01	10.20	8.33
	Other	1.85	2.52	0.68	3.57
Educational attainment**	No college degree	54.52	72.15	77.55	70.24
	College degree	45.48	27.85	22.45	29.76
Number of cigarettes smoked in past 30 days*		75.07 (178.34)	153.48 (241.31)	122.21 (227.22)	218.80 (296.31)
Marital status**	Married	63.08	38.69	48.98	39.29
	Not married	36.92	61.31	51.02	60.71
Region	Midwest	20.39	26.19	20.74	15.58
	Northeast	22.85	23.33	22.96	28.57
	South	15.28	13.65	10.37	15.58
	West	41.49	36.83	45.93	40.26
Self-rated health**	Excellent	17.76	14.07	10.20	9.52
	Very good	37.95	29.78	32.65	28.57
	Good	31.83	36.15	39.46	44.05
	Fair	10.51	16.30	14.29	15.48
	Poor	1.96	3.70	3.40	2.38

Note. \*\* indicates a statistically significant difference in variable distribution between specified user groups ( $p < .001$ ); \* indicates a statistically significant difference in variable distribution between specified user groups ( $p < .05$ ).

vary in SRH. Across all groups, participants rated themselves as being in good to very good health on average.

Furthermore, heavy marijuana users ( $M = 2.79$ ,  $SD = 0.996$ ) reported significantly worse overall health than light marijuana users ( $M = 2.54$ ,  $SD = 1.059$ ),  $F(2, 767) = 5.157$ ,  $p = .006$ . No significant differences were detected between light and moderate users and moderate and heavy users. When compared to non-users ( $M = 2.43$ ,  $SD = 0.966$ ), only heavy marijuana users displayed significantly worse SRH,  $F(3, 2,570) = 14.907$ ,  $p < .001$ , suggesting that light and moderate marijuana users do not consider themselves to be in worse health than non-users. Light, moderate, and heavy e-cigarette users did not self-report significantly different health scores than non-users.

#### 4. Discussion

To our knowledge, the current study is one of the first to examine exercise behavior (while distinguishing between exercise formats) among marijuana and e-cigarette users in a nationally representative sample of U.S. adults. Compared to two studies that assessed physical activity among only adult marijuana users (see Vidot et al., 2017; French et al., 2021), our findings corroborate those of French and his colleagues, who found that marijuana use was not significantly associated with exercise and sport. Our study expands on their findings by demonstrating that marijuana use is not significantly related to engagement in a particular type of physical activity. Though we find some evidence that marijuana users walk for exercise more than even non-users, this result represents a trend more than a significant association.

This trend may be due to some adults using cannabis to increase their motivation for and enjoyment of exercise (YorkWilliams et al., 2019) or the concentration of marijuana users in urban areas (Coughlin et al., 2019; Hasin et al., 2019). People who live in large American cities – which tend to be in states where medical and recreational marijuana are legal – also tend to use public transport and walk more (Watson et al., 2020). However, we cannot test whether urban living is involved in the relationship between marijuana use and walking for exercise because

the data on whether participants lived in urban or rural areas are not available. Regardless, this finding challenges the stereotype that adult marijuana users are less active than their non-using counterparts (Mortensen et al., 2019). While further research is needed, perhaps the association between marijuana use and exercise may not be a primary concern compared to the drug's relation to other aspects of health for adults.

Additionally, we found that e-cigarette users engage in the same frequency of strength training and general exercise as other groups but may walk for exercise less often than marijuana users and non-users. These findings exhibit the net result (no association) of those of prior studies in adolescents and young adults, which reveal significant positive (Jacobs et al., 2021; Milicic et al., 2019) or negative (Miller et al., 2019; Pokhrel et al., 2019) associations between e-cigarette use and exercise.

Since we cannot make any direct comparisons to studies about adults, we can only speculate upon the explanation for our findings. Perhaps e-cigarette use is only significantly related to participation in team sports, which are performed more often by adolescents and young adults than adults. One study found that e-cigarette users were more likely to participate in intramural, competitive, and team sports compared to non-users (Milicic et al., 2019). Vaping is considered a social activity for several teens (Groom et al., 2021), who may also practice sports to connect with their peers. There is likely not as much social reinforcement for vaping among adults, who primarily use e-cigarettes to quit using combustible cigarettes (Zhu et al., 2017). Similar to the results of Jacobs et al. (2021) in an adolescent sample, it appears that dual users of marijuana and e-cigarettes exercise less than single users, though the associations were either weak or non-significant. Additional research is needed in an adult sample to clarify the impact e-cigarette use has on exercise behavior.

As one would expect, marijuana and e-cigarette users reported lower SRH than non-users. However, this result is interesting to consider in the context of how substance use and exercise may be related. Perhaps some people who use substances exercise to offset the negative health effects of substance use, or exercise and substance use are both used as coping

**Table 3**

Number of times exercised in the past week for a sample of U.S. adults from Wave V of the Add Health survey (2016–2018), stratified by marijuana and e-cigarette use groups (N = 2,591).

	Group				F	P-value
	Non-users	Marijuana users	E-cigarette users	Dual users		
	M (SD)	M (SD)	M (SD)	M (SD)		
N	1,684	676	146	84		
Bicycle, skateboard, dance, hike, hunt, or yard work	1.95 (2.13)	2.11 (2.17)	1.70 (1.74)	1.99 (1.97)	1.74	0.16
Roller blade, roller skate, downhill ski, snowboard, play racquet sports, or aerobics	0.66 (1.51)	0.64 (1.47)	0.42 (1.15)	0.56 (1.26)	1.27	0.28
Gymnastics, weight lifting, or strength training	1.03 (1.77)	0.93 (1.65)	0.83 (1.74)	1.00 (1.64)	0.99	0.40
Running, wrestling, swimming, cross-country skiing, cycle racing, martial arts, football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey	0.68 (1.46)	0.63 (1.41)	0.50 (1.28)	0.54 (1.11)	0.88	0.45
Golf, fishing, bowling, softball, or baseball	0.25 (0.76)	0.29 (0.86)	0.28 (0.78)	0.37 (0.92)	0.89	0.45
Walk for exercise*	2.26 (2.43)	2.51 (2.50)	1.99 (2.31)	1.93 (2.19)	3.15	0.024

Note. \*\* indicates a statistically significant difference in variable distribution between specified user groups ( $p < .001$ ); \* indicates a statistically significant difference in variable distribution between specified user groups ( $p < .05$ ).

mechanisms for mental health conditions like depression or anxiety. Future studies should investigate the exact directional and temporal associations between substance use, exercise, and SRH. While substance users are often stereotyped as unhealthy in all areas, our results demonstrate that healthy behaviors do not always cluster together and that nuances exist in health habits.

Limitations of the current study include a lack of information about the intensity and duration of exercise, the specific quantity of marijuana and nicotine used, and the number of times subjects used marijuana and e-cigarettes within a day. Furthermore, Add Health did not explicitly distinguish between THC and CBD, or medical and recreational marijuana use, and we were unable to establish any causal relationships through the cross-sectional study design.

Despite limitations, the following strengths are noted. First, the current study is based on a large nationally representative sample of adults whose data were collected following marijuana legalization in several U.S. states. Wave V of Add Health includes adults (ages 33–42) who are more settled in their exercise and substance use habits. Second, our study is a timely contribution to the growing literature on marijuana and e-cigarette use and exercise. Our findings provide the first step for

**Table 4**

Differences in exercise behavior while controlling for covariates for a sample of U.S. adults from Wave V of the Add Health survey (2016–2018), stratified by marijuana and e-cigarette use groups (N = 2,591).

	Group				F	P-value
	Non-users	Marijuana users	E-cigarette users	Dual users		
	M (SD)	M (SD)	M (SD)	M (SD)		
N	1,684	676	146	84		
Bicycle, skateboard, dance, hike, hunt, or yard work	1.95 (2.13)	2.11 (2.17)	1.70 (1.74)	1.99 (1.97)	1.90	0.13
Roller blade, roller skate, downhill ski, snowboard, play racquet sports, or aerobics	0.66 (1.51)	0.64 (1.47)	0.42 (1.15)	0.56 (1.26)	0.89	0.45
Gymnastics, weight lifting, or strength training	1.03 (1.77)	0.93 (1.65)	0.83 (1.74)	1.00 (1.64)	0.68	0.56
Running, wrestling, swimming, cross-country skiing, cycle racing, martial arts, football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey	0.68 (1.46)	0.63 (1.41)	0.50 (1.28)	0.54 (1.11)	0.49	0.69
Golf, fishing, bowling, softball, or baseball	0.25 (0.76)	0.29 (0.86)	0.28 (0.78)	0.37 (0.92)	0.42	0.74
Walk for exercise	2.26 (2.43)	2.51 (2.50)	1.99 (2.31)	1.93 (2.19)	2.35	0.066

Note. Covariates: cigarette use, educational attainment, marital status, race, SRH, and sex assigned at birth. \*\* indicates a statistically significant difference in variable distribution between specified user groups ( $p < .001$ ); \* indicates a statistically significant difference in variable distribution between specified user groups ( $p < .05$ ).

future research to examine possible mechanisms of the associations found.

**5. Conclusion**

Despite documented health benefits of physical activity, adults in our sample exercised less than three times per week on average. This is much lower than the CDC’s recommendation of at least 30 min of moderate-intensity physical activity five days a week. Our results indicate that marijuana and e-cigarette use are not associated with low exercise rates among adults in the U.S. However, more research – particularly regarding the quantity and potency of marijuana and nicotine use – is needed to determine the impact of these substances on exercise behavior.

**CRedit authorship contribution statement**

**Sophie Boutouis:** Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing –

review & editing. **Frances Wymbs:** Formal analysis, Funding acquisition, Resources, Software, Supervision, Validation, Writing – review & editing. **Berkeley Franz:** Formal analysis, Resources, Software, Supervision, Validation, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data will be made available on request.

### Acknowledgements

This research uses data from Add Health, funded by grant P01 HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Add Health was designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill. This analysis using Add Health was supported as a part of the Ohio University Research Experience for Undergraduates Program, funded by a grant from the National Science Foundation (#1659455; PI: Frances Wymbs).

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2024.102668>.

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