1   Patterns and perceptions of cannabis use with physical activity

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Abstract

Background and Aims: Past research has shown that cannabis use is common among adults in the U.S. In addition, physical activity (PA), such as exercise, is often a component of many American's daily routines. Anecdotal information suggests that a subset of individuals use cannabis in conjunction with PA, but the evidence base is lacking. The purpose of this study was to assess the frequency, methods of ingestion, strain types, and timing (before, during or after) of cannabis use in combination with PA. We also sought to better understand the types of PA that cannabis is being used with and reasons why individuals may use cannabis with PA.

Methods and Results: A brief survey was developed and was administered online to community residents (N = 105) who reported use of cannabis with PA. Analysis of survey responses revealed that participants were using cannabis in combination with a wide range of physical activities. While cannabis use was reported before, during, and after PA, the majority of participants (92%) reported use of cannabis before PA. Most participants (77%) believed that the use of cannabis products with their PA had a positive effect on their performance. The strain of cannabis used with PA was dependent on timing of cannabis use before, during, or after PA. Although participants reported a range of reasons for using cannabis before, during, or after PA, pain management was the only reason reported across all time periods.

Conclusions: Findings from this study suggest that there is a sub-community of physically active individuals using cannabis with their PA, many who believe that cannabis use has a positive effect on their performance.

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Introduction

Cannabis products, also commonly referred to as marijuana, are derived from the flower, stems and leaves of the hemp plant. In 2016, almost 9% of the U.S. adult population reported cannabis use within the past month, making cannabis the most commonly used illicit drug in the U.S. (1). Beginning in 2012 States within the U.S. began to legalize the recreational use of cannabis products. Currently, cannabis products are recreationally available for legal consumption in Alaska, California, Colorado, Maine, Massachusetts, Nevada, Oregon, Vermont, Washington and Washington D.C.

Phytocannabinoids, the active components in cannabis, mimic the effects of the endogenous cannabinoids in the body (2). Delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD) are the two most abundant phytocannabinoids present in cannabis products, and have received the most attention from the scientific community. However, THC and CBD are just two of more than 100 known phytocannabinoids (3) and the effects of these compounds have yet to be fully elucidated. Products of the cannabis plant can further be described by their cultivar, or strain, and are often separated into two general categories: *Cannabis Indica* and *Cannabis Sativa* (4), with varying hybrids of the two strains. Among medical cannabis users, common reasons for the use of *Cannabis Indica* include pain management and as an aid in sedation and sleep, while *Cannabis Sativa* users often prefer this strain for its perceived induction of euphoria and energy enhancement (5). Although exploration of the medicinal and psychoactive effects of cannabis products is still in its infancy, interest related to cannabis use on physical activity (PA) is also emerging.

Within the U.S., just over half (51.7%) of adults over the age of 18 years met the federal PA guidelines of at least 150-minutes of moderate or 75-minutes of vigorous activity per week (6). Currently, although there is minimal research describing how and why the physically active general population is using cannabis with PA, there have been several studies investigating cannabis use and athletic populations. Among male and female Division 1 National Collegiate Athletic Association (NCAA) athletes surveyed about their personal use of cannabis, 36.8% reported use within the past year (7). Thirty-eight percent of the athletes reporting cannabis use within past year reported using on average once

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78   per month, with male athletes more likely to report use when compared to their female counterparts (7). A

79   more recent study found that athletes are more likely to use cannabis if they are male, Caucasian, or using

80   performance enhancing drugs (8). The increasing availability of cannabis products for recreational use,

81   combined with the growing number of U.S. adults who are physically active, and reports of athletes using

82   cannabis may have contributed to a growing interest in the use of cannabis in combination with PA. More

83   than 40 years ago, both moderate and heavy cannabis users were found to be less active the day after

84   heavy cannabis use, however, it was speculated that the findings may have been associated with social

85   reasons rather than pharmacological effects (9).

86   New evidence is emerging that the euphoric effects experienced during exercise, also termed as

87   "runner's high," may be the result of the actions of endogenous cannabinoid release during exercise rather

88   than endorphins (10). The G-protein coupled cannabinoid 1 receptors (CB1) in the brain have been

89   observed to be closely linked to opioid receptors, and the dopaminergic reward pathways suggesting

90   endogenous cannabinoid release with PA could be a major reason why regular exercise is perceived as

91   highly rewarding (11, 12). It is possible that using cannabis products high in CB1 agonists, such as THC

92   (13), could increase associated pleasure/reward already observed with regular exercise and increase

93   motivation to partake in PA. Conversely, delayed-onset muscle soreness (DOMS) is often associated with

94   muscle damage resulting from acute inflammation from strenuous exercise (14). Pain associated with

95   DOMS may even result in exercise avoidance (15). New evidence suggests that cannabinoids like THC

96   and CBD are associated with pain reduction (16) and may have anti-inflammatory effects through their

97   repressive effects on immune tissue (17). As a result, the use of cannabis may be a tempting option to

98   reduce exercise-induced pain and inflammation. Yet, there is little evidence in human populations on how

99   cannabis use combined with PA affects motivation to partake in exercise as well as how cannabis use

100   affects recovery from exercise.

101   The primary goal of this exploratory study is to describe cannabis use as it relates to PA. More

102   specifically, this study examines the frequency, method and timing (before, during or after) of cannabis

103   use in combination with PA. Secondary goals include characterizing cannabis use as it relates to modes of

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104   PA and strain use and the examination of characteristics (e.g., age, gender) associated with participants'

105   cannabis use in conjunction with PA. Finally, we aim to better understand reasons that participants use

106   cannabis with PA.

107   **Methods**

108   **Participants and Procedures**

109   From October to December 2017, 140 adults between the ages of 18 to 66 years across the U.S.

110   were surveyed about their cannabis use habits in combination with their PA. Recruitment of participants

111   was conducted online through social media (e.g., Facebook and Snapchat) and through snowballing and

112   flyers posted in the local area for convenience sampling. A link and/or QR code took participants to a

113   Qualtrics survey titled Cannabis Use and PA Questionnaire (CUPAQ), which they completed online.

114   Recruitment materials specifically sought participants who use cannabis and cannabis products in relation

115   to their exercise and PA habits. Participation was anonymous and took approximately 10 minutes. No

116   external incentive was given for survey completion. This study was approved by the Institutional Review

117   Board at the University of Northern Colorado.

118   **Survey Design and Administration**

119   Initial contact in Qualtrics provided participants with a brief overview of the purpose of the study,

120   emphasized that participation would remain anonymous, and noted the time required for participation (10

121   minutes). Participants were asked to complete an informed consent and confirm their age (18 or older)

122   and residence in the U.S. prior to continuing. The survey consisted of 39 questions which were divided

123   into three main sections. The first section consisted of 9 questions designed to gather general cannabis use

124   habits of participants (i.e., frequency and duration of use), as well as age, gender, minutes of PA

125   completed each week, and U.S. state of current residence. Section 2 included 18 questions focused on

126   participants' cannabis use habits as it pertained to their PA (before, during, or after PA). The frequency of

127   cannabis use associated with PA over the last year and most recent episode of use were also assessed.

128   Skip logic was programmed into Qualtrics so that participants who did not report cannabis use at one or

129   more of the PA time points (before, during, or after) did not receive those questions. When cannabis was

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130   used before, during, and/or after PA, participants were asked to select the most common method of

131   ingestion (e.g., smoking using a joint, inhaling via a vaporizer) and the strain (i.e., indica, sativa, or

132   indica/sativa hybrid) if known. Participants were also asked to indicate the specific activities (e.g., weight

133   lifting, kayaking) where cannabis was used before, during, and after PA. Lastly, an open-ended question

134   assessed reasons for using cannabis before, during, and after PA. The third and final section of the survey

135   consisted of 12 questions aimed at describing the amount and percentage of THC and CBD consumed.

136   Using skip logic, questions were further divided into three categories based on participant self-reported

137   primary form of cannabis use, including flower or bud, concentrates (i.e., oils, wax, shatter, dabs), and

138   edibles. In assessing the quantity of the flower or bud, a visual aid and terminology were adapted from the

139   Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU) (18).

140   **Statistical Analysis**

141   A total of 140 survey responses were obtained at the conclusion of the study. Three participants

142   failed to complete informed consent and 32 participants reported never using cannabis in combination

143   with their physical activities. These participants were removed from the dataset and a total of 105

144   participants were included in data analyses. All analyses were conducted using SPSS version 24 (IBM

145   Corp.; Armonk, NY) and data are reported as frequency, percent or mean ± standard deviation. We

146   present descriptive statistics to summarize the background characteristics of the sample and to examine

147   participants' use of cannabis before, during or after PA. To assess whether a range of demographic

148   characteristics (e.g., age, gender) were associated with participants' cannabis use during PA, we used a

149   series of chi square analyses. Significance was $p \leq 0.05$. Lastly, open-ended questions related to the

150   reasons for using cannabis before, during, or after PA were examined through a content-analysis which

151   allowed for the categorization of responses from each question into six or seven different themes.

152   Responses for each of the three questions were coded independently by two coders into each of the theme

153   categories. Agreement on these classifications was reached prior to listing a response under a specific

154   theme category (prior to agreement, interrater reliability [k] = .80 – 1.00). The frequency of responses

155   was calculated and reported for each theme.

156 **Results**

157 *Background Characteristics and Cannabis Use.*

158 Participants (53% male) ranged from 18-66 years of age (M = 31.4 ± 11.2 years) and lived in a

159 total of 21 states across the U.S. The majority of participants were from Colorado (n=59), California

160 (n=9), Louisiana (n=7) and Nebraska (n=5). Participants reported an average of 74.5 ± 111.5 months in

161 duration of regular cannabis use. Ongoing cannabis use frequency revealed that 1.9% used less than once

162 per month, 6.7% reported using between 1-3 times per month, 22.9% reported using between 1-6 times

163 per week, and 68.6% reported using cannabis products on a daily basis.

164 *Physical Activity and Cannabis Use*

165 Survey participants reported engaging in an average of 399.87 ± 543.82 minutes of PA

166 throughout a typical week. The average age of participants when they first reported using cannabis with

167 PA was 23 ± 8 years. When asked how frequently they used cannabis products in combination with PA,

168 63.8% of the participants reported using cannabis products in combination with PA within the past week.

169 When asked to report their frequency of cannabis use in combination with PA, 9.5% used cannabis in

170 combination with PA less than once a month, 12.4% used between 1-3 times per month, 41.0% reported

171 using cannabis 1-6 times per week with PA, and 37.2% reported using at least one time or more per day in

172 combination with their PA. Some participants who reported using cannabis with PA multiple times per

173 day used before and after exercise, or used before exercise on two separate exercise bouts within the same

174 day. The majority of participants (78.1%) reported using cannabis products in combination with PA at

175 least once per week.

176 Participants also reported the method and quantity of cannabis used most frequently with PA.

177 Methods/forms of cannabis consumption were grouped into four general categories: inhalation of

178 flower/bud, edible, concentrate (dabbing), and other. The majority (80.0%) of participants reported that

179 their primary method of cannabis use with PA was by inhalation of flower/bud. Methods of inhalation

180 from most to least common are as follows: hand pipe (n=23), vaporizer (n=22), bong (n=18), joint (n=11)

181 and blunt (n=6). Only 11.4% of participants reported primarily using concentrates with PA, 5.7% used

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182   edibles, and 2.9% other (topical/salves, capsules and fresh non-decarboxylated). Flower/bud forms were

183   most frequently (n=80) reported when cannabis was used in conjunction with PA. Using the visual aid

184   from the DFAQ-CU, participants who reported flower/bud as their primary form of use with PA

185   personally used an average of 0.44 ± 0.45 grams of flower/bud before PA, 0.54 ± 0.49 grams of

186   flower/bud during PA, and 0.78 ± 0.86 grams of flower/bud after PA.

187   *Timing of Cannabis Use with PA*

188   When asked when they had used cannabis in conjunction with PA, 92% (n=97) of participants

189   reported having used cannabis within one hour before beginning PA, 21% (n=22) reported having used

190   cannabis during their PA, and 73% (n=77) reported having used cannabis within one hour after PA. Fifty-

191   three percent (n=56) reported using most often before PA, 4.8% (n=5) reported using most often during

192   PA, and 41.9% (n=44) reported using most frequently within one hour after completing their PA. A total

193   of 23.8% of participants reported using cannabis only before PA, while 48.6% reported using before and

194   after PA, followed by 18.1% reporting using before, during and after. Only 6.7%, 1.9% and 1.0% reported

195   using only after, before and during, and only during respectively. The frequency of participant primary

196   method of cannabis use before, during and after PA is presented in Table 1. Over three-fourths of

197   participants who used cannabis either before, during, or after before PA reported their primary method of

198   use was through inhalation. Smaller numbers used edibles or concentrates.

199   Table 1. Primary Method of Consumption Used Before, During and After Physical Activity

Category	Method	Frequency Before n (% of total)	Frequency During n (% of total)	Frequency After n (% of total)
Inhalation (flower/bud)	Joint	12 (11.4%)	15 (29.4)	13 (13.8%)
	Blunt	7 (6.8%)	4 (7.8%)	7 (7.4%)
	Hand pipe	25 (24.3%)	11 (21.6%)	20 (21.3%)
	Bong	21 (20.4%)	1 (2.0%)	17 (18.1%)
	Vaporizer	20 (19.4%)	12 (23.5%)	14 (14.9%)
Edible	Edible	5 (4.9%)	3 (5.9%)	2 (2.1%)
Concentrate	Dabbing	11 (10.7%)	4 (7.8%)	14 (14.9)
Other	Other*	2 (1.9%)	1 (2.0%)	7 (7.5%)

200   Frequencies are reported in combination with the percentage of the total number of valid responses (Total
201   (n)). *Other forms of use included but were not limited to: topical/salves, capsules, and fresh non-
202   decarboxylated.

203   The cannabis strain used most by participants before, during, and after PA is depicted in Table 2.

204   Sativa and hybrid strains were most commonly used before PA, with hybrid and sativa strains most often

205   used during PA, and indica and hybrid strains most commonly used after PA.

206   Table 2. Cannabis Strain Participants Had Used Before, During and After PA

Strain	Before	During	After
	n (% of total)	n (% of total)	n (% of total)
Indica	20 (13.4%)	8 (9.6%)	57 (38.0%)
Sativa	68 (45.6%)	32 (38.6%)	32 (21.3%)
Hybrid	54 (36.2%)	37 (44.6%)	55 (36.7%)
Didn't Know	7 (4.7%)	6 (7.2%)	6 (4.0%)

207   Participants reported the strain(s) that they had used before, during and after PA.

208   *Perception of Cannabis Use on Athletic Performance*

209   When participants were asked to report whether cannabis use with PA had a positive, negative, or

210   no effect on their performance, 81 (77%) respondents reported they felt using cannabis in combination

211   with their PA had a positive effect on their performance. A smaller number (n=21; 20%) reported that

212   they felt cannabis use had no effect of their PA performance, and only 3 (3%) respondents felt cannabis

213   use with their PA had a negative effect on their performance.

214   *Reported Physical Activities with Cannabis Use*

215   Participants described using cannabis in association with both indoor and outdoor activities, as

216   well as team and individual PA. Participants reported using cannabis before (Figure 1a), during (Figure

217   1b) and after (Figure 1c) a variety of PA. When participants used cannabis within 1 hour before PA,

218   hiking (n=69), running (n=54), yoga (n=47), cycling (n=46), and resistance training (n=44) were the most

219   commonly reported. The most frequent activities reported where cannabis was used during PA were:

220   hiking (n=38), golf (n=19), yoga (n=16) and skiing/snowboarding (n=16). The most popular activities that

221   participants reported using cannabis within 1-hour after completion of the activity were: hiking (n=51),

222   running (n=49), resistance training (n=47) and cycling (n=39).

223   *Demographic Characteristics associated with Marijuana Use and Performance*

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224   Chi-Square analysis revealed a significant difference between younger ($\leq$ 27 years of age; n = 53)

225   and older ($\geq$ 28 years of age; n = 52) cannabis users with respect to their primary method of cannabis use

226   with PA (p = 0.02). Older users favored more traditional methods of consumption via inhalation (i.e.

227   joint, bong, pipe, vaporizer, and blunt), while younger users were more likely to use concentrates

228   (dabbing). Younger users started using cannabis with PA at an earlier age (19.3 ± 2.9 years) when

229   compared to older users (26.5 ± 10.5 years; p = 0.02). With respect to perceptions of cannabis use on

230   performance, older users were more likely to report feeling that cannabis use had a positive effect on their

231   PA performance. In contrast, younger users were more likely to report feeling that cannabis use had no

232   effect on performance (p = 0.03). There were no significant differences between younger and older users

233   with respect to the timing of cannabis use with PA (before, during, after; p = 0.44) or the frequency of

234   cannabis use with PA (p = 0.74).

235   *Participant Reasons for using Cannabis with PA*

236   Three separate open-ended questions asked participants to describe the reasons for using cannabis

237   before, during, or after PA. Coded responses can be found in Table 3. Only participants who reported

238   cannabis use during one or more of these times were provided with the respective open-ended questions.

239   The three most common reasons for using cannabis before PA were: pain relief (n=25), to improve focus

240   or get in the zone (n=25) and to calm the mind and/or body or to relax (n=25). The most popular reasons

241   for using cannabis during PA was to increase/restore energy, push harder, or use as a break (n=12).

242   Participants also described using cannabis during PA to improve their enjoyment of an activity and for

243   pain management/relief (n=11). The overwhelming majority of responses for reasons of cannabis use

244   after PA were related to relaxation (n=52) and to decrease pain or soreness (n=25), with minor reasons

245   including appetite stimulation, and aid in sleep and recovery (Table 3). The only category that was present

246   as a reason for cannabis use in all three times (before, during and after PA) was pain relief/management.

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251   Table 3: Categorized Reasons of Cannabis Use Before, During and After PA

Reasons for Using Cannabis Before PA	Frequency (n)
Pain management/relief	25
Improve focus, get in the flow, or "get in the zone"	25
Improve enjoyment of activity	19
Enhance performance, decrease fatigue, or to push harder	16
Improve motivation and state of mind	18
Calm mind and body; relaxation	25
Other	18
Reasons for Using Cannabis During PA	**Frequency (n)**
Improve enjoyment of activity	11
Improve focus, get back in or stay in the zone	7
Pain management/relief	11
Increase/restore energy, push harder, or to use during a break	12
Maintain the high	4
Other	11
Reasons for Using Cannabis After PA	**Frequency (n)**
Relaxation	52
Stimulate/increase appetite	7
Pain management/relief	25
Aid in sleep	6
Aid in recovery	9
Other	18

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253   **Discussion**

254   The present study aimed to describe how and why physically active individuals are using

255   cannabis in combination with PA. Not only are individuals using cannabis in combination with PA, but

256   individuals are using cannabis products before (within 1-hour of starting PA), during, and after PA

257   (within 1-hour of cessation of PA). Studies assessing cannabis use in elite athletes have found that

258   individuals who were male, Caucasian, and played hockey were most likely to report cannabis use (7, 8).

259   However, there is little data exploring the characteristics of cannabis use in recreationally physically

260   active individuals. The present study found that cannabis use with PA was reported equally among males

261   and females and across a wide range of activities in recreationally physically active individuals. With a

262   self-reported range of 25-3600 minutes of PA per week, 73 of the 105 participants met the national

263   weekly physically activity requirements. Hiking was reported as the most prominent activity to use

264   cannabis with before, during, and after PA. Further observation suggests that the timing of cannabis use is

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265   heavily dependent on the specific PA. Running, cycling, and resistance training were the 3rd, 4th, and 5th

266   most frequently reported with cannabis use prior to activity, and were the 2nd, 3rd, and 4th most frequently

267   reported activities to use cannabis after. However, reported frequency of cannabis use during running,

268   cycling, and resistance training dropped to 6th, 7th and 8th respectively. The most popular reported

269   activities to use cannabis during PA were: hiking, golf, skiing/snowboarding, and yoga. Together, these

270   results suggest that the timing of cannabis use with physical activity is heavily dependent on mode of PA.

271   The majority of participants were under the impression that cannabis use in combination with PA

272   had a positive effect on their PA performance, while only 3% felt that using cannabis had a negative

273   effect on PA performance. The perception of improved performance with cannabis use may be purely

274   subjective. The most recent studies which examined this question were conducted 40 years ago and

275   demonstrated that acute use of cannabis containing THC increased resting heart rate (19, 20), systolic and

276   diastolic blood pressure (20) as well as reduced time to exhaustion during a cycling bout (21). Yet, no

277   acute effects of THC administration were reported with respect to oxygen uptake or ventilation during

278   submaximal exercise (19). Unfortunately, the concentration of THC in the cannabis used in these studies

279   is no longer reflective of current cannabis products available on the market today, as THC content in

280   cannabis has been steadily increasing over the past several decades (22).

281   While evidence is lacking related to assessing the effects of acute consumption of cannabis on

282   exercise performance, a recent study explored the effects of chronic cannabis use on exercise

283   performance. In this study, participants were assessed for pulmonary, cardiovascular, anaerobic and

284   strength while at least 12-hours removed from last use of cannabis. When compared to a non-cannabis

285   using control group this cross-sectional study found that there were no differences with respect to

286   pulmonary, cardiovascular, anaerobic, or strength performance (23). However, findings from the present

287   study revealed that a large portion of participants believed that cannabis use had a positive effect on their

288   performance. More research is needed to fully elucidate if the acute use of cannabis is actually effects

289   performance.

290   Previous research has shown that adults aged 18-25 have the highest reported percentage of

291   cannabis use (1), with 20.8% reporting use at least once within the past month (1). While the current

292   study did not assess cannabis use rates among age groups of physically active adults, an age-based

293   analysis was done to assess if individuals 18-27 years of age had different perceptions and methods of use

294   compared to adults over 28 years of age. Chi-square analysis revealed that adults ages 18-27 were

295   significantly more likely to report using concentrates as their primary form of cannabis and began using

296   cannabis with PA at a significantly younger age (i.e., 7 years earlier). However, adults over the age of 28

297   were significantly more likely to report feeling that cannabis use had a positive effect on their

298   performance compared to adults aged 18-27. Emerging research shows that use of concentrates via

299   dabbing may be associated with greater negative consequences, tolerance, and withdrawal compared to

300   flower use (24). We did not assess negative consequences related to participants' cannabis use, but future

301   research should explore whether those using cannabis with their PA are more likely to have problems

302   related to their use and if they are more likely to use cannabis with PA for specific reasons (e.g., pain

303   management).

304   Results from this study revealed that 92% of survey participants reported cannabis use within 1-

305   hour of beginning PA, suggesting that more research to ascertain the effects of acute cannabis use on PA

306   performance may be necessary. Conversely, the perceived performance enhancing effect of cannabis on

307   PA performance could be related to the reduced perception of pain. When asked an open-ended question

308   as to why participants used cannabis before, during, and after PA, pain management/relief was the only

309   reason to be reported across all time points. Pain management was the most common reason for cannabis

310   use before PA, and the second most common reason for use during and after PA. This pain control theme

311   is supported by a recent study which found that pain was the most commonly reported reason for seeking

312   use among medicinal cannabis users (25, 26) with those seeking pain relief preferring *Cannabis Indica* (5,

313   27). Products derived from *Cannabis Indica* are typically lower in THC and container higher quantities of

314   CBD, reducing the perceived psychoactive effects while still maintaining high pain suppressive effects.

315   Mechanistically cannabinoids modify synaptic transduction in the central nervous system and the

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316   periphery. THC and CBD are agonists of the two primary cannabinoid receptors, CB1 and CB2 (2),   with

317   CB1 being highly expressed in the central nervous system (28) and CB2 more abundant in the periphery

318   (29). These cannabinoids act on CB1 and CB2 receptors expressed on the pre-and post-synaptic

319   membrane blocking calcium influx, and blocking synaptic vesicle release (30). Activation of these

320   receptors blocks synaptic signal transduction and has even been implicated in long-term depotentiation

321   (31). This mechanism provides a suitable explanation as to why cannabis is used for exercise-associated

322   pain reduction. Interestingly, individuals using cannabis for pain mediation have been found to be at

323   lower risk of development of cannabis use disorders (27).

324   In conjunction with pain management, the most common reasons reported for cannabis use prior

325   to PA were related to improved focus and to calm or relax the mind and body. This was unexpected, as

326   *Cannabis Sativa* was the most frequently reported strain used prior to PA, which is typically associated

327   with feelings of euphoria and energy enhancement (5). After PA, using cannabis for relaxation was

328   reported more frequently than any other response. Given the reported perceived effects of *Cannabis*

329   *Indica* related to sedation and pain management (5), it was expected that this strain may be used

330   predominately post-exercise. This was supported in this study with only 13% and 10% of participants

331   reporting the use of *Cannabis Indica* before and during exercise, respectively. *Cannabis Indica*

332   predominant strains were the most frequently used strain following PA at 38%. This practice could be

333   influenced by perceptions of the effects of *Cannabis Indica* that are popular in the cannabis community.

334   The method and form of cannabis appears to differ based on the time when cannabis is used in

335   relation to PA. Most participants reported consuming cannabis through traditional inhalation methods

336   regardless of PA time point. Yet, the distribution of individual inhalation methods at each of those time

337   points did vary. Before PA, cannabis consumed with a hand pipe was the primary method of use by nearly

338   a quarter of participants. Comparatively, 30% reported using a joint and 23% described using a vaporizer

339   during PA. Primary flower/bud inhalation methods then shifted back to predominant hand pipe and bong

340   use following completion of PA.

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341   Although this study provides new information on why physically active individuals are using

342   cannabis products with their PA, it does have a number of limitations. The study was cross-sectional and

343   conducted as an online survey. There are limitations associated with self-report data, even though online

344   and in-person administration of surveys has been shown to yield similar results (32). Reported weekly

345   minutes of PA varied dramatically, with a range of 25 to 3600 minutes of physical activity per week. In

346   an effort to allow participants to report any type of physical activity, participants were not asked if they

347   were physically active for recreational reasons, or if their PA was a part of a structured exercise regimen.

348   Although this approach allows for more broad interpretation of physical activity, it should be considered a

349   limitation and future work should further examine this question. In addition, the present study did not

350   explore if participants experienced any negative side effects due to their cannabis use, such as those

351   associated with Cannabis Use Disorder. Future studies exploring the use of cannabis with exercise may

352   want to discern whether individuals are consuming *ad libitum* and happen to be physically active vs. those

353   who are intentionally using cannabis in conjunction with structured exercise.

354   In summary, this study provides novel insight into cannabis use among individuals that reported

355   using cannabis in combination with their physical activity. This study revealed that the most common

356   time to use cannabis in combination with PA was within 1-hour of starting PA, with the majority of

357   individuals reporting use through traditional inhalation methods. The majority of participants reported

358   feeling that the use of cannabis with PA had a positive effect on PA performance. Reasons for cannabis

359   use with PA were heavily dependent on timing of cannabis use in relation to that activity with pain

360   management as the only common reason reported at before, during, and after time points. Finally, results

361   from this study indicate that timing, method of use and strain of cannabis use were commonly considered

362   when cannabis was used in conjunction with PA.

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15

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Figure 1. Frequency of Cannabis Use Before (1a.), During (1b.), and After (1c.) Physical Activities