Exploratory Factor Analysis of Medical Students’ Perceptions of Medical Cannabis Scale

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Abstract

Background
There are few published research articles investigating medical students’ perceptions of medical cannabis (MC), including their attitudes toward its efficacy and appropriateness in medicine, concerns for potential adverse effects, and their willingness to prescribe it to patients (in future practice). This research investigated the factor structure of a tool to assess medical students’ perceptions of MC for the purpose of curriculum enhancement.

Methods
Using a voluntary electronic survey, quantitative data were collected between January and March 2022 from 526 medical students enrolled in a large medical school in Florida, United States. A 32-item questionnaire developed by the researchers was used to investigate medical students’ perceptions of MC. The survey was anonymous and took about 10 minutes to complete. Bivariate correlation analyses were conducted prior to performing a principal component analysis with varimax rotation.

Results
Using principal component analysis with varimax rotation, three factors were identified with eigenvalues greater than 1.0 and a cumulative variance of 59.694%. These factors are perceived knowledge of MC, concern for possible adverse effects of MC (e.g., the potential for misuse/dependence), and attitudes toward MC (e.g., cannabis having an acceptable role in medicine, willingness (as a future physician) to help patients access MC, obtaining training about MC in school and residency training, the physician’s role as a prescriber, and efficacy and benefits of MC for certain health conditions).

Conclusions
The development of this kind of brief measure may be valuable for defining the future educational needs of medical students and other health professionals as well as a tool for future research.

Categories: Pain Management, Therapeutics, Integrative/Complementary Medicine
Keywords: medical education research, measurement, factor analysis, cannabinoid, medical marijuana, cannabis

Introduction
Perceptions of medical cannabis (MC) among physicians in training are of particular interest as favorable attitudes toward alternative therapies such as MC among patients are gaining popularity and acceptance [1-9]. Cannabis has been shown to relieve pain and assist in managing certain chronic diseases [10-16] yet may present potential side effects, including dependence [17].

In early 2022, in the United States (USA), 39 states and Washington, DC, legalized MC [18]. Currently, MC is still federally classified as a Schedule I substance, that is, drugs that are not acknowledged for medical use and possess the potential for abuse. In April 2022, the United States House of Representatives passed legislation that attempts to legalize cannabis at the federal level [19]. In this context, early-career physicians will most likely come across patients asking for information on MC’s usefulness and safety as it becomes more socially acceptable [20,21], and legalization continues to expand. In light of these recent events, MC may likely become a significant issue for the healthcare profession and medical trainees in particular who might be expected to inform patients of its efficacy, recommend it, and develop treatment plans. However, it is unclear if medical students have sufficient knowledge about MC or what their perceptions are about its use in medical practice including efficacy and possible adverse effects.

While clinical research on the benefits and adverse effects of MC is still, relatively speaking, in its nascent stages, there is evidence indicating that MC results in some improvement in pain relief, physical functioning, and sleep quality among patients with chronic pain and can help reduce opioid use [22-24]. It
has also been suggested that MC can alleviate symptoms related to chemotherapy-induced nausea and vomiting, chronic pain, and multiple sclerosis-related spasticities, among other conditions [25].

In 2021, Weisman and Rodríguez published a systematic review of medical students’ and health professionals’ attitudes toward MC [26]. They found that physicians’ and medical students’ endorsement for legalizing MC has increased from 1991 to 2019 [26]. In addition, 64.4% of the 9,265 medical students from 26 studies believed in MC’s therapeutic utility. Students also reported being concerned about MC’s potential for dependence/addiction and possessed a strong desire for more education about MC while in school [7,26].

Other research studies report that most medical students believe that MC can play a role in the management of several health conditions but resonate with concerns about the risks of MC and may be reticent to recommend it to future patients [27]. Other researchers have reported that prior cannabis use was related to the belief that MC was an effective treatment [8].

As MC increases its social acceptability [20] and laws begin to change in favor of legalization, newly trained physicians will be faced with an increased number of patients looking for treatment options and information on the safety of medical cannabis [21]. To date, however, there are few if any, instruments available that can measure students’ perceptions of MC, including concerns and willingness to use MC in their post-residency practice.

The aim of this study was thus to develop a brief instrument to measure medical students’ perceptions of medical cannabis. Perceived knowledge of MC, concern for potential adverse effects, and attitudes toward legalization and physician prescribing issues were investigated. The development of this kind of tool may be helpful in furnishing the educational needs of medical students and other health professionals. Moreover, the tool may be useful for promoting future research.

Materials And Methods
Sample and questionnaire administration
This study was approved by the Nova Southeastern University Institutional Review Board (protocol number 2022-28). Using an anonymous, electronic survey, quantitative data were collected between January and March 2022 from medical students enrolled in a Florida college of osteopathic medicine via student email listservs. The email contained a letter delineating the purpose of the study and the voluntary nature of the study. The survey was sent at predetermined intervals to encourage participation in completing the survey. The survey took about 10 minutes to complete.

Assessment instrument
The aim of the development of the 32-item questionnaire (created by the researchers) was to evaluate medical students’ attitudes toward MC, concerns for its possible adverse effects, and perceived knowledge about MC. The items included were Likert-type items using a 6-point response set (1=strongly agree, 2=agree, 3=somewhat agree, 4=somewhat disagree, 5=disagree, 6=strongly disagree), many of which were adapted from various research reports [3,27,28-52]. All items were checked for face validity through the agreement of three health professions educators (from medicine, pharmacy, and social work) and three medical students in various years of study. The items assessed for this study were part of a longer instrument that investigated medical students’ attitudes, perceptions, opinions, and knowledge of MC, including legalization and prescribing aspects. In addition, participant demographic data were collected.

Analysis
Out of the 1,447 medical students (class years 1-4) enrolled in the school, 637 students returned the questionnaire cases with less than two-thirds of completed items dropped from the analysis (n=111), leaving 526 completed questionnaires for the final analysis.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 27 (IBM Corp., Armonk, NY, USA) [53]. The researchers visually inspected the observed distributions and conducted tests for skewness and kurtosis (i.e., assessment for normal distributions). Multicollinearity testing was performed (i.e., tolerance and variance inflation factor (VIF), whereby tolerance statistics less than 0.2 and VIF statistics greater than 5.0 indicate multicollinearity); variables were found to be within acceptable VIF limits [54].

Data were also examined to determine if they approximated normal distributions by investigating skewness and kurtosis to evaluate data distributions [55,56]; the data did not deviate from normality to any significant degree.

Bivariate correlation analyses were conducted prior to performing the factor analysis. To reduce the risk of inefficient factor solutions, items that were not statistically significantly correlated with other items were omitted from further analysis [57].
Due to its size (N=526) and lack of multicollinearity, the sample was considered adequate. Nonetheless, to confirm its adequacy, it was assessed using the Kaiser-Meyer-Olkin (KMO) statistic for both individual and multiple variables. It is known that scores for these two analyses may range from 0 to 1, with higher scores more desirable in factor analysis. The KMO statistic for multiple variables was computed at 0.913; scores equal to or greater than 0.9 are considered to be excellent [54]. In addition, statistics for individual scores were computed, with all items ranging from 0.527 to 0.879. Scores above 0.5 are considered acceptable [54]. KMO statistics in this analysis imply that the sample size for the principal component analysis exceeded the minimal requirements.

While various methods of extraction available to factor-analyze data can be used, principal component analysis with varimax rotation was chosen. It is a statistical technique used as an attempt to illuminate the relationship among factors by adjusting the coordinates of data that evolve from the principal component analysis. The adjustment (i.e., rotation) maximizes the variance shared among items. The varimax rotation streamlines the loadings of items by removing the middle ground and identifying the factor upon which data load, resulting in a small number of important salient variables, thus aiding in the interpretation of the results [55]. When examining participants measured on each of the variables, varimax rotation looks for a base that most economically represents each individual. In essence, each person can be adequately described by a linear combination of only a few functions [55].

Principal component analysis

Twenty-two items were analyzed using principal component analysis with varimax rotation in an attempt to reduce the number of correlated items into fewer factors. Eigenvalues, one of the statistics generated in this procedure, were used to identify the variation in the original items that are explained by a particular factor [56]. Eigenvalues less than 1.0 are not considered significant [56].

It is important to note that four items were removed as they did not contribute to a simple factor structure, failing to meet the minimum criterion of having a primary factor loading of 0.5 or above. These items were as follows: 1) "medical cannabis is taught as part of my medical school curriculum," 2) "I am concerned there is limited evidence of therapeutic benefits from medical cannabis," 3) "it is acceptable to prescribe medical cannabis by virtual office visits (telehealth)," and 4) "additional research regarding medical cannabis use should be encouraged." In addition, the item "additional research regarding medical cannabis use should be encouraged" had a floor effect (i.e., there was a lower limit on the survey item, and a large percentage of the participants scored near this lower limit) with 99.2% (N=483) of the students who answered the item reporting that they "agree" with the statement (using combined responses reported under strongly agree, agree, and somewhat agree), resulting in positively skewed data.

Results

Characteristics of the sample

The age range of the participants was 18–47 years (mean=26 years, SD=3.431). Table 1 shows the sample characteristics.
TABLE 1: Sample Characteristics (N=526)

| Characteristic           | n   | %    |
|--------------------------|-----|------|
| Sex                      |     |      |
| Female                   | 239 | 45.4 |
| Male                     | 229 | 43.5 |
| Preferred not to answer  | 58  | 11   |
| Race                     |     |      |
| White                    | 330 | 62.7 |
| Black                    | 12  | 2.3  |
| Asian or Pacific Islander| 96  | 18.3 |
| Preferred not to answer  | 88  | 16.7 |
| Ethnicity                |     |      |
| Hispanic                 | 79  | 15   |
| Non-Hispanic             | 330 | 62.7 |
| Year in medical school   |     |      |
| Year 1 (preclinical)     | 169 | 32.1 |
| Year 2 (preclinical)     | 251 | 47.7 |
| Year 3 (clinical)        | 73  | 13.9 |
| Year 4 (clinical)        | 33  | 6.3  |

Attitudes toward MC

Table 2 reports the frequencies and percentages for the original 22 items. The majority of the participants reported that they agree (combined strongly agree/agree/somewhat agree) that "cannabis has an acceptable role in medicine" (n=513; 97.6%), "there are significant physical health benefits to using MC" (n=454; 86.3%), and "MC helps patients who suffer from chronic, debilitating medical conditions" (n=420; 79.9%). Most participants also felt that "physicians should be able to legally prescribe cannabis as medical therapy" (n=476; 96%), "physicians should recommend medical cannabis as medical therapy" (n=476; 96%), and "cannabis should be reclassified so that it is no longer a Schedule I drug" (n=432; 88.7%).

| Items                                                                 | Strongly agree | Agree | Somewhat agree | Somewhat disagree | Disagree | Strongly disagree |
|-----------------------------------------------------------------------|----------------|-------|----------------|-------------------|----------|------------------|
|                                                                       | Count          | Row valid N | % | Count          | Row valid N | % | Count          | Row valid N | % | Count          | Row valid N | % |
| I am familiar with the possible therapeutic effects of medical cannabis.| 94             | 23.5% | 195 | 48.8% | 81 | 20.3% | 22 | 5.5% | 5 | 1.3% | 3 | 0.8% |
| Medical cannabis helps patients who suffer from chronic,               | 215            | 40.9% | 205 | 39%  | 93 | 17.7% | 5  | 1%   | 6  | 1.1% | 2  | 0.4% |
| debilitating medical conditions.                                       |                |         |     |       |    |       |    |      |    |      |    |     |
| Using cannabis poses serious physical health risks.                    | 12             | 2.3%  | 46  | 8.7% | 99 | 18.8% | 157 | 29.8% | 150 | 28.5% | 62 | 11.8% |
| Using cannabis poses serious mental health risks.                      | 27             | 5.1%  | 59  | 11.2%| 154 | 29.3% | 143 | 27.2% | 101 | 19.2% | 42 | 8% |
| Cannabis has an acceptable role in medicine.                          | 159            | 30.2% | 186 | 35.4%| 149 | 28.3% | 21  | 4%   | 9  | 1.7% | 2  | 0.4% |
| There are significant physical health benefits to using medical        | 127            | 24.1% | 172 | 32.7%| 155 | 29.5% | 56  | 10.6% | 13  | 2.5% | 3  | 0.6% |
I have substantial knowledge about medical cannabis. 39 7.4% 105 20% 153 29.1% 103 19.6% 90 17.1% 35 6.7%
I am extremely confident regarding my current knowledge of medical cannabis. 33 6.3% 79 15% 136 25.9% 106 20.2% 107 20.3% 65 12.4%
I have good knowledge of the side effects of medicinal cannabis. 56 10.6% 129 24.5% 138 26.2% 103 19.6% 72 13.7% 28 5.3%
Physicians should be able to legally prescribe cannabis as medical therapy. 174 35.1% 187 37.7% 115 23.2% 13 2.6% 4 0.8% 3 0.6%
Physicians should recommend medical cannabis as medical therapy. 109 22% 148 29.8% 136 26.2% 103 19.6% 72 13.7% 28 5.3%
As a healthcare provider (in the future), I would be willing to help patients access medical cannabis. 137 27.6% 178 35.9% 135 27.2% 31 6.3% 9 1.8% 6 1.2%
Training about medical cannabis should be incorporated into medical/health/social well-being-related academic (preclinical) curricula. 181 36.5% 185 37.3% 107 21.6% 17 3.4% 3 0.6% 3 0.6%
Training about medical cannabis should be incorporated into residency/field practice (clinical) requirements. 164 33.1% 177 35.7% 126 25.4% 16 3.2% 9 1.8% 4 0.8%
Medical cannabis use can be addictive. 53 10.9% 143 29.4% 165 33.9% 80 16.4% 32 6.6% 14 2.9%
I am concerned with medical cannabis’ potential for abuse/misuse. 67 13.8% 139 28.5% 119 24.4% 85 17.5% 50 10.3% 27 5.5%
I am concerned about the potential side effects of medical cannabis use. 52 10.7% 127 26.1% 132 27.1% 79 16.2% 68 14% 29 6%
Cannabis should be reclassified so that it is no longer a Schedule I drug. 265 54.4% 99 20.3% 68 14% 37 7.6% 13 2.7% 5 1%
Medical cannabis is taught as part of my medical school curriculum. 21 4.2% 29 5.8% 62 12.5% 115 23.2% 172 34.7% 97 19.6%
I am concerned that there is limited evidence of the therapeutic benefits of medical cannabis. 28 5.3% 81 15.4% 147 27.9% 106 20.2% 102 19.4% 62 11.8%
It is acceptable to prescribe medical cannabis by virtual office visits (telehealth). 43 8.6% 81 16.6% 126 25.9% 126 25.9% 83 17% 28 5.7%
Additional research regarding medical cannabis use should be encouraged. 312 64.1% 133 27.3% 38 7.8% 3 0.6% 1 0.2% 0 0%

TABLE 2: Frequencies and Percentages for Survey Items

Concern for possible adverse effects
While less than one-half of the participants reported that they agreed that "using cannabis poses serious mental health risks" (n=240; 45.6%) and even fewer believed that "using cannabis poses serious physical health risks" (n=157; 29.8%), a large proportion believed that MC use can be addictive (n=361; 74.2%) and were "concerned for MC’s potential for abuse/misuse“ (n=325; 66.7%) and potential side effects (n=311; 63.6%).

Perceived knowledge
Only about one-half of the participants (n=297; 56.5%) agreed that they had substantial knowledge about MC. Fewer participants (n=248; 47.2%) felt "extremely confident regarding their current knowledge of MC,” yet 61% (n=325) believed that they "have good knowledge of the side effects of MC.” Only 22.5% (n=112) of participants reported that MC was taught as part of their medical school curriculum.

Factor analysis
Using principal component analysis with varimax rotation, 18 of 22 items were reduced to a three-factor solution. Table 3 depicts the rotated solution with factor loadings.
TABLE 3: Rotated Component Matrix

Note: All items were adapted from a variety of previous studies [3,27,28-52].

The items not included in Table 3 for failure to contribute to a simple factor structure are as follows: "medical cannabis is taught as part of my medical school curriculum," "I am concerned that there is limited evidence of the therapeutic benefits of medical cannabis," "It is acceptable to prescribe medical cannabis by virtual office visits (telehealth)," and "additional research regarding medical cannabis use should be encouraged." All factors had an eigenvalue greater than 1.0, and the cumulative variance of 59.694% was calculated. A scree plot was used to confirm the solution (i.e., determine the number of factors to keep in the exploratory factor analysis) (Figure 1).
The three factors included are as follows: 1) attitudes toward MC, 2) concern for possible adverse effects of MC, and 3) perceived knowledge of MC. Factor 1 (perceived knowledge of MC) accounted for approximately 41.5% of the total variance, with nine items. The reliability estimate (Cronbach’s α) for the first factor was calculated at 0.91. The second factor, with five items, accounted for 9.5% of the variance and a reliability estimate of 0.89. Factor 3 accounted for 8.7% of the variance, with four items. The reliability estimate was calculated at 0.89 for the third factor. Table 4 reports the information regarding each factor’s variance and eigenvalue.

**TABLE 4: Eigenvalues and Variance of the Factors**

| Factor | Eigenvalue | Percent of variance | Cumulative percent of the variance |
|--------|------------|---------------------|------------------------------------|
| 1      | 9.127      | 41.486              | 41.486                             |
| 2      | 2.090      | 9.498               | 50.985                             |
| 3      | 1.916      | 8.709               | 59.694                             |

**Discussion**

Using principal component analysis with varimax rotation as an exploratory method, the factor structure of an instrument to determine medical students’ perceptions of MC was investigated. Three factors were identified. The first factor comprises nine items that address attitudes toward MC, including willingness (as a future physician) to help patients access MC, obtaining training about MC in school and residency training, the physician’s role as a prescriber, cannabis having an acceptable role in medicine, efficacy of MC for chronic conditions, belief in physical health benefits of using MC, and reclassifying cannabis so that it is no longer a Schedule I drug (i.e., substances with no currently accepted medicinal use and a high potential for abuse). Concern for the potential adverse effects of MC, the second factor, consists of five items. These items address the medical student’s concern with MC’s potential for abuse/misuse, potential side effects, whether it poses serious physical and mental health risks, and its potential for addiction. Lastly, the third factor, which contains four items, addresses perceived knowledge of MC, such as confidence regarding current knowledge of MC and having knowledge about MC in general and its potential side effects.

In the area of attitudes toward MC (factor 1), two items specifically address the desire for training in MC (during undergraduate and graduate training), four items address the physician’s role and legality of prescribing MC (including medical students’ willingness to prescribe it in the future), and three items address MC’s acceptability in medical practice (including its physical health benefits and assistance for patients who suffer from chronic, debilitating medical conditions). Overall, the participants had positive attitudes toward MC; the mean score for this factor was 2.10 (SD=0.797, range=5), where lower scores indicate more positive attitudes toward MC.

Concern for the potential adverse effects of MC (factor 2) addresses the medical student’s concern with MC’s potential for abuse/misuse and addiction (two items) and its negative effects (three items). The mean for this...
toward MC (including legal aspects and the role of the physician), perceive their own knowledge of MC, and the items in the brief 18-item instrument target specific areas in which medical students maintain attitudes and perceptions of knowledge about MC.

**Conclusions**

Since this sample is reflective of Florida osteopathic medical students, the findings in this study are applicable to similarly trained physicians in Florida and other states where MC education is part of the medical school curriculum. However, the limitations of this study are acknowledged, including the sample size and the potential for selection bias due to the anonymous nature of the survey. Further research is needed to understand how nonacademic experiences with MC influence medical students' perceptions and attitudes toward its use in clinical practice.

**Limitations**

While the sample reflects Florida osteopathic medical students, generalizability to other populations may be limited. Additionally, the self-reported nature of the survey data might introduce bias, as participants may have different levels of self-awareness and motivation to report their attitudes and perceptions. Despite these limitations, the study provides valuable insights into medical students' attitudes and knowledge about MC, which can inform future educational and policy efforts.

**Conclusions**

The items in the brief 18-item instrument target specific areas in which medical students maintain attitudes toward MC (including legal aspects and the role of the physician), perceive their own knowledge of MC, and the items in the brief 18-item instrument target specific areas in which medical students maintain attitudes and perceptions of knowledge about MC.
express their concerns about its possible adverse effects, such as the potential for misuse/dependence and addiction. In US states where MC is not yet legal, the development of curricula that integrate MC training is encouraged as many students enter residencies in states other than those in which they went to medical school. While the measure requires further testing and development in terms of reliability and validity, it may inform future academic research about MC and provide pertinent information for medical educators to improve curricula to ensure MC readiness in their graduates.

**Additional Information**

**Disclosures**

**Human subjects:** Consent was obtained or waived by all participants in this study. The Nova Southeastern University Institutional Review Board issued approval 2022-28. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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