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Exploring THC labelling preferences to communicate the strength of cannabis products: Insights from U.S. consumers

Danielle Dawson [a,b], Wayne Hall [b], Isabella Goodwin [a], Beatriz H. Carlini [c], Dan I. Lubman [d], David Hammond [e], Tom P Freeman [f], Valentina Lorenzetti [a,g,*]

[a] Neuroscience of Addiction and Mental Health Program, Healthy Brain and Mind Research Centre, School of Behavioural and Health Sciences, Faculty of Health Sciences, Australian Catholic University, Fitzroy, Victoria, Australia
[b] National Centre for Youth Substance Use Research, School of Psychology, The University of Queensland, St Lucia, Queensland, Australia
[c] University of Washington School of Medine, Psychiatry and Behavioural Sciences Department, Addictions, Drug & Alcohol Institute, Seattle, WA, USA
[d] Turning Point, Eastern Health and Monash Addiction Research Centre, Eastern Health Clinical School, Monash University, Victoria, Australia
[e] School of Public Health Sciences, University of Waterloo, Waterloo, Canada
[f] Addiction and Mental Health Group (AIM), Department of Psychology, University of Bath, Bath, UK
[g] Clinical Psychopharmacology Unit, Research Department of Clinical, Educational and Health Psychology, University College London, London, UK

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ABSTRACT

Background: As cannabis policies have become more liberalized internationally, cannabis products have become increasingly accessible, diversified and potent as indicated by the amount of delta-9-tetrahydrocannabinol (THC) they contain. The THC content of cannabis products is often inconsistently reported, limiting opportunities to inform consumers about health risks and safer consumption practices. We explored consumers' preferences on the type of THC information (i.e., standard units, concentration, total content) that should be displayed on cannabis products in legal markets. Methods: A convenience sample of 575 adults from various U.S. states who reported cannabis use within the past 12 months was recruited via Amazon Mechanical Turk. Respondents completed a survey assessing cannabis use and related attitudes, which included a subsection focused on potential metrics that could be used to report THC content. Descriptive and inferential statistical analyses were conducted. Results: Majority of respondents considered it important for cannabis products to include information on Standard THC Units (e.g., 5 milligrams of THC), THC concentration (%), or the total content of THC on cannabis product labels. When comparing Standard THC Units, THC concentration or both options, Standard THC Units were the preferred metric, $p<.001$. Consumer preferences for these three metrics did not signficantly differ across U.S. state cannabis policy environments, sex, and frequency of cannabis use when compared using multinomial logistic regression. Conclusions: These exploratory findings preliminarily support the potential value of standardized THC dose labelling, particularly in the form of a standardized metric such as the Standard THC Unit, as a tool to better inform consumer decision-making and promote safer patterns of use. The findings require replication in more representative samples using additional THC metrics, including but not limited to, THC milligrams as a response option.

As cannabis policies have become more liberal internationally, legal cannabis products have become increasingly accessible, diverse and cost-effective (Kilmer & Pacula, 2017). The concentration of Δ9-tetrahydrocannabinol (THC), the primary psychoactive compound found in cannabis, has risen over time, increasing by 0.29 % each year from 1970 to 2017 internationally (Freeman et al., 2021). Meanwhile, there have been reports of accidental overconsumption (Hammond, 2021; Lineham et al., 2023) and unintentional cannabis intoxication in youth (Wang et al., 2017). Given that the addictive and psychotogenic effects of cannabis increase with higher THC concentrations (Petrilli et al., 2022), accurate information on the amount of THC in cannabis products is critical for informed consumer decision making and encouraging safer consumption practices.

In many jurisdictions where the sale and consumption of cannabis products is legal, such as Canada and some states in the U.S., the amount of THC contained in the products must be reported. However, the way in

* Corresponding author.
E-mail address: valentina.lorenzetti@acu.edu.au (V. Lorenzetti).

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which THC levels are described is often varied for different types of product (e.g., flower versus edibles), and this information is often unreliable and/or erroneous (e.g., THC amount being under-labelled or over-labelled) (Vandrey et al., 2015). Information on cannabis products can include the type of cannabis, such as 'sativa' or 'indica' cannabis strains, which is problematic in that they do not reflect distinct chemovars, which would instead provide a more precise and accurate representation of cannabis composition (Smith et al., 2022; Piomelli & The, 2016). In several countries including the United States, labels on cannabis products can report the proportion or percentage (%) of THC within the packaged product, while other labels may report the total number of milligrams of THC within a certain serving size or across the total product weight. As such, it is unlikely that the current approach to THC reporting provides consumers with consistent information on how much total THC the product contains, limiting decisions regarding THC consumption and the associated health risks (Freeman & Lorenzetti, 2021). Information on consumers' preferences regarding how to report the amount of THC in legal cannabis markets is required to inform the development of appropriate labelling.

Evidence suggests that cannabis consumers support the inclusion of warning labels about the risks of cannabis consumption which underscores the need for clear and informative packaging to promote safer consumption (Malouff et al., 2016). However, research examining consumers' views on THC metrics is lacking. As key stakeholders in the cannabis market, understanding consumers' perspectives on how to report the amount of THC in cannabis products is critical for effective labelling.

This study explored the perceived importance of different THC metric options in a U.S. sample of cannabis consumers; and the associations between state-level cannabis policies, age and sex on respondents' preferred THC metrics, as understanding how cannabis policies and demographic variables impact upon consumers' perspectives may help guide the development process. The THC metrics explored were adapted from a review of perspectives from multidisciplinary cannabis experts' (e.g., from cannabis research, clinical practice, public health) on THC labelling led by a steering committee (BC, DH, TF, VL, WH). They included: THC content; concentration (%) of THC; and the recently developed Standard THC Unit (i.e., 5mg of Δ9-THC) endorsed by the US National Institute of Health (Freeman & Lorenzetti, 2020).

Method

Procedure

This project was nested within a larger study on current cannabis consumers with a broader scope. A sample of 575 respondents aged 18 or older, who were cannabis consumers, were included in the study and were recruited between 24th February and 18th December 2022 (see Supplement A for participant inclusion criteria and data cleaning). Respondents were recruited via Amazon Mechanical Turk (AMT), an online platform for crowdsourcing participants, which in our study directed individuals to Qualtrics XM, where the participation information and consent form was presented. Informed consent was given by all participants before taking part in the study, with US$7/hour reimbursement. The study was approved by the Australian Catholic University Human Research Ethics committee (HREC:2021–4E).

Measures

Demographics

Participants reported their biological sex at birth, with the sample consisting of 64.3 % males and 35.7 % females. The mean age of the sample was 33.3 years ($SD = 9.6$, *Range* = 20.0–64.0 years). Age was recategorised into intervals with 28.9 % of the sample between 18–25 years, 46.3 % between 26–35 years, 10.0 % between 36–45 years, and 14.8 % being 46 and above.

Perceived importance of THC metrics

The perceived importance of reporting THC through different metrics was assessed by the following questions:

1. How important do you think it is to report THC content in all medical and non-medical cannabis products?

2. How important do you think it is to report THC content in all cannabis products using THC units, akin to standard drinks in alcoholic beverages?

3. How important do you think it is to report THC concentration (e.g., % THC) products, akin to % alcohol in alcoholic beverages?

Possible responses included: "*not important*", "*slightly important*", "*moderately important*", "*very important*", "*essential*", "*not sure/don't know*". The responses of *"essential"* and *"very important"* were amalgamated to harmonise with existing literature on the Delphi Consensus study investigating THC units (OSF, 2025).

Preferred THC reporting metric

Respondents' preference for a THC reporting metric was assessed by the item: "Do you think that it is more important to report THC units (akin to standard drinks in alcoholic drinks), concentration of THC (akin to % of alcohol in alcoholic drinks) or both?". Possible responses included: *"the number of standard THC units (5* mg *THC)*", "*concentration or % THC*", "*both*" or *"not sure/don't know"*.

Frequency of use

Frequency of cannabis use was assessed by the item: "How often do you use cannabis?" with the possible responses of "*daily or almost daily (7 to 5 days a week)", "a few times a week (4 to 2 days a week)",* and *"weekly or less (1 to 0 days a week)"*.

Cannabis regulatory framework

Respondent's state of U.S. residency was recoded to reflect the legal status of cannabis in the year 2022 when the survey was conducted (i.e., *"recreational legalisation", "medical legalisation", "medical CBD only legalisation"*).

Statistical analyses

Descriptive analyses were used to assess the perceived importance of each THC metric. Pearson's χ^2 Goodness of Fit test was used to compare the preferred option of THC metrics. Additionally, multinomial logistic regression was conducted to investigate whether age, sex, frequency of use or cannabis policy predicted the preference for a particular THC metric. The reference category for the outcome variable was THC units, selected due to its larger cell size compared to THC concentration or both options. For the following predictor variables, the reference groups were chosen based on the largest sizes within each category: "*a few times a week*" for frequency of use, "*ages 26–35*" for age, and "*recreational*" for state cannabis policy. For sex, "*female*" was the reference group. A conservative α level of $p = .001$ was applied to reduce the likelihood of false positives across multiple comparisons. All analyses were conducted using Stata 18 SE and replicated in R Studio Version 2024.12.1 + 563.

Results

Demographic descriptives

The sample included 575 respondents (see Table 1). On average, respondents took 40 minutes to complete the broader survey (*SD:* 126 min).

Support for reporting THC content

36.2 % (95% CI: 32.2%-40.1%) of respondents rated it as "*moderately important*" or "*very important*" (26.3 % [CI: 22.7 %–29.9 %]) to report the

Table 1
Overview of sample descriptives.

Variable		$N = 575$	
Age		***n***	**%**
	18–25	166	28.9
	26–35	266	46.3
	36–45	58	10.1
	46+	85	14.8
Sex			
	Male	370	64.3
	Female	205	35.7
State, Legal Cannabis Policy			
	Recreational	334	58.1
	Medical-only	63	11.0
	Medical CBD only	178	31.0
Frequency of cannabis use			
	Daily or almost daily	85	14.8
	Few times a week	331	57.6
	Weekly or less	159	27.7

Note: Cannabis legality status was classified as follows across U.S. states. Recreational: Alaska, Arizona, California, Colorado, Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nevada, New Jersey, New Mexico, New York, Ohio, Oregon, Rhode Island, Vermont, Virginia, Washington. Medical-only: Alabama, Arkansas, Florida, Hawaii, Iowa, Louisiana, Mississippi, Nebraska, New Hampshire, North Dakota, Oklahoma, Pennsylvania, South Dakota, Utah, West Virginia.
Medical CBD only: Georgia, Idaho, Indiana, Kansas, Kentucky, North Carolina, South Carolina, Tennessee, Texas, Wisconsin, Wyoming.

amount of THC in all medical and non-medical cannabis products (see Fig. 1). Additionally, 33.7 % (CI: 29.9 %–37.6 %) rated reporting THC content as "*slightly important*" and only 3.8 % (CI: 2.3 %–5.4 %) indicated that it was "*not important*".

Support for reporting % THC

The perceived importance of reporting *THC concentration* in cannabis products, akin to % alcohol in alcoholic beverages, was rated as: "*moderately important*" by 37.0 % of respondents (CI: 33.1 %–41.0 %) and "*very important*" by 30.4 % (CI: 26.7 %–34.2 %); followed by "*slightly important*" and "*not important*" in 29.2 % (CI: 25.5 %–32.9 %) and 3.3 % (CI: 1.8 %–4.8 %) of the sample, respectively.

Support for reporting standard THC units (i.e., 5 mg)

A total of 38.1 % (CI: 34.1 %–42.1 %) respondents viewed the reporting of the *Standard THC Unit*—similar to standard drink labelling in alcoholic beverages in distinct countries (e.g., UK, Australia) — in all medical and nonmedical cannabis products as "*moderately important*", "*very important*" (29.7 % (CI: 26.0 %–33.5 %), followed by "*slightly important*" by 29.2 % (CI: 25.5 %–32.9 %) and 3.0 % as "*not important*" (CI: 1.6 %–4.3 %).

Preferred metric to report the level of THC

The Standard THC Unit (5mg THC) was significantly more likely to be selected as the most important THC metric, compared to concentration (% THC) or both options when using a Pearson's Goodness of Fit test (χ^2 [2, 575] = 252.78, p <.001). Nearly two-thirds of respondents (63.1 %, CI: 59.2 %–67.1 %) rated "*The number of standard THC units (5mg THC)"* as the most important metric for reporting THC compared with 26.6 % (CI: 23.0 %–30.2 %) who reported "*concentration of % THC*" while 10.3 % of participants (CI: 7.8 %–12.7 %) preferred "*both*".

A multinomial logistic regression examined whether age, sex, frequency of cannabis use, and state-level cannabis policy predicted respondents' preferred THC reporting metric (i.e., Standard THC Units, THC concentration or *both* Standard THC Units and THC concentration). The model was statistically significant (χ^2[16, N = 575] = 40.26, p <.001; see Supplemental Materials B). The only significant effectwas younger participants aged 18–25 compared to those aged 26–35, preferred reporting Standard THC Units *alone* (reference group) compared to *both* Standard THC Unit and THC concentration.

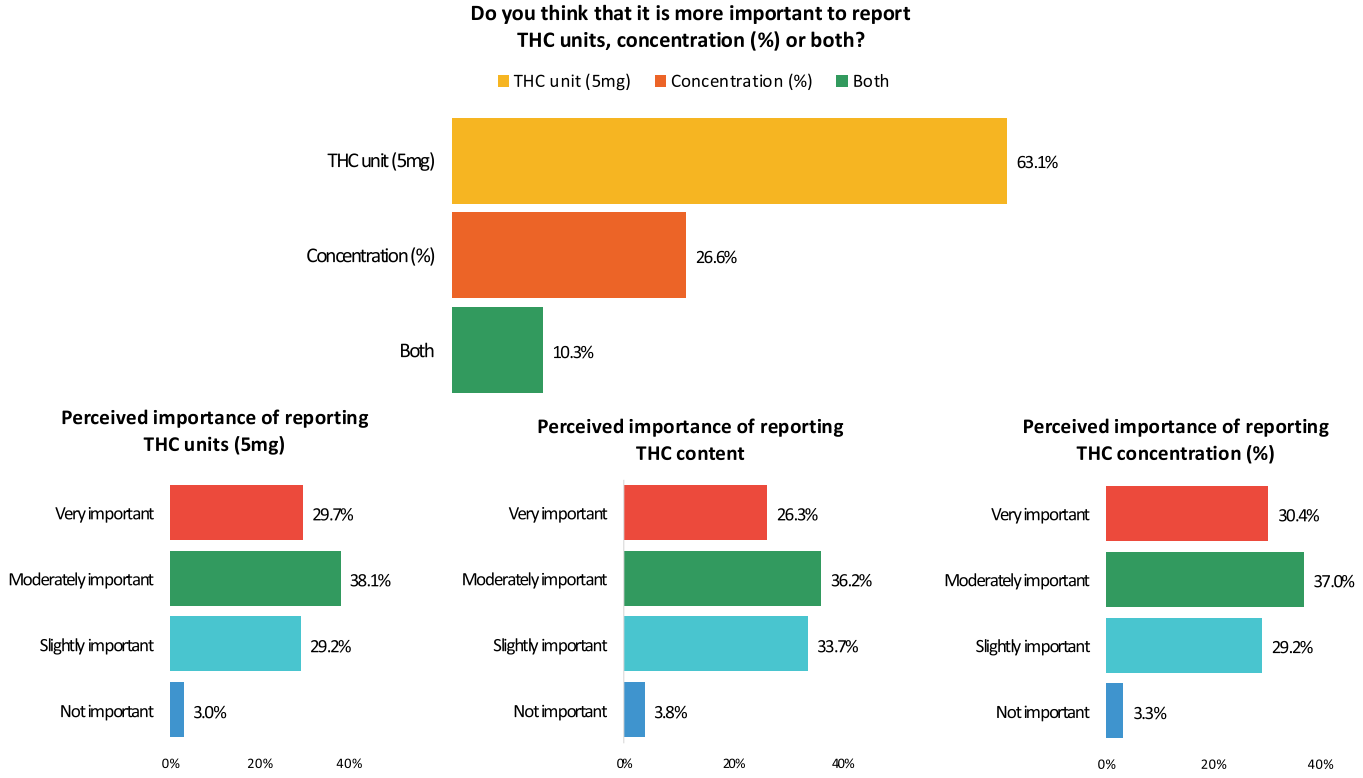

Fig. 1. Visualisation of THC preferences.

Discussion

In this exploratory study, preliminary evidence indicates that the dominant majority of respondents who used cannabis considered it important on some level to include information on Standard THC Units, THC concentration (%), or THC content on cannabis product labels. Standard THC Units were the preferred labelling metric in this sample, compared to THC concentration or labelling displaying both measures.

Respondents' preferred metric to report THC on cannabis products did not significantly differ across U.S. state cannabis policy environments, respondent sex, or frequency of cannabis use. The limited variability across consumer groups may indicate a desire for standardized THC labelling, particularly in the form of a dose-based metric such as the Standard THC Unit. These initial findings may highlight the importance of including standardized THC dosing on all cannabis product labels, to inform consumers about THC content and potentially promote informed decision-making and safer usage habits (Leos-Toro et al., 2020).

Several limitations should be considered when interpreting the results of this exploratory study. First, the AMT sample may not generalise to individuals in the U.S. and other world regions (Walters et al., 2018) as we are unable to make population-level inferences based on this sample (Mellis & Bickel, 2021). Second, representation was uneven from U.S. states with varying cannabis policy contexts. Respondents from recreationally legal states were over-represented (58.1 %), while those from states permitting only medical CBD use were under-represented (11.1 %). To determine the influence of legal status, a more balanced representation of states may be required. Third, the age distribution of the sample may limit generalizability, as older adults were underrepresented. Fourth, we did not ask whether participants were specifically using cannabis for recreational or medicinal purposes or both, and the role of these variables on the perceived importance of THC metrics remains unexamined. Further and importantly, a major limitation was that the description of the THC metrics was incomplete and lacked milligrams of THC and other THC metrics that may be relevant for the heterogeneity in cannabis products and modes of administration. The lack of THC milligrams as a response option might have introduced bias in the results and preference for the standard THC unit due to the lack of alternative metrics. Future studies should build upon, confirm and expand on the preliminary evidence reported herein, via incorporating THC milligrams and a more comprehensive characterisation of THC metrics. Overall, replication across diverse product types and international contexts are needed to confirm the findings, yet these preliminary findings from survey platforms such as AMT can address critical and timely questions for drug policy which are not possible in nationally-representative population surveys due to their restricted scope.

Conclusion

This study offers preliminary insight into consumer preferences for how THC should be reported on cannabis product labels. In a diverse U.S. sample, the Standard THC Unit emerged as the most preferred metric, with preferences largely consistent across age, sex, frequency of use, and state-level cannabis policy. As cannabis products continue to diversify and cannabis use becomes increasingly decriminalised or legalised globally, replication studies are needed to further explore consumer labelling preferences. Such evidence will be essential to inform standardized labelling approaches that promote safer and more informed cannabis use.

CRediT authorship contribution statement

Danielle Dawson: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis. **Wayne Hall:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Isabella Goodwin:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Conceptualization. **Beatriz H. Carlini:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Dan I. Lubman:** Writing – review & editing, Writing – original draft, Supervision. **David Hammond:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Tom P Freeman:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Valentina Lorenzetti:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

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.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2025.105076.

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