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Prices of flower and resin in cannabis social clubs: Analyses of register data from 220,000 collections

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Abstract

Introduction: Cannabis social clubs (CSC) are community-based non-profit organisations that aim to minimise cannabis-related harm for their members. This contribution seeks to: (i) compare the cost of cannabis flower and resin in CSCs to the national average retail price on the illegal market; and (ii) identify possible quantity discounts for cannabis flower and resin distributed to members of CSCs.

Methods: Routine data from four CSCs located in Barcelona, Spain, contained information on $n = 220{,}465$ collections of cannabis resin and flower (0.01–39 g per collection). The costs for 1 g of cannabis flower and resin per collection were determined. The mean national prices on illicit cannabis were obtained from Spanish police reports.

Results: On average, members paid 6.19€ for 1 g flower (median: 6€; interquartile range: 6–7€) and 8.54€ for 1 g resin (median: 7€; interquartile range: 6–9€), with less variations for flower than for resin. Compared to the national average, prices appeared to be higher for cannabis products distributed in CSCs, but comparisons were limited by a lack of data on the variation of national prices. For resin, doubling the quantity was associated with a 20.7% (95% confidence interval 20.4–21.2%; $p < 0.001$) fee discount.

Discussion and conclusions: Cannabis in CSCs may be more costly than the estimated national average for the illicit market. No meaningful price discount could be observed for flower but for resin. Pricing policies pursued by CSCs may help to disincentivise consumption of larger amounts but may also bar socioeconomically disadvantaged users from accessing safer alternatives than the illegal market.

KEYWORDS
Barcelona, cannabis, cannabis social club, flower, price, quantity discount, resin, Spain

1 | INTRODUCTION

The regulation of legal cannabis markets is increasingly debated among both researchers and policymakers. In North America, mostly for-profit and private retail models have been established, while non-profit retail models exist in Uruguay and select European countries [1]. Cannabis social clubs (CSC) represent an important form for uncommercial access to cannabis for recreational (and medical) purposes. The cannabis distributed to club members is either cultivated by the association itself or acquired from producers [2]. Technically, club members do not purchase

their cannabis but collect it in limited amounts against a certain fee. This procurement fee is levied in addition to the membership fee that allows members to access a protected space for consumption and socialising purposes.

Unlike for-profit models for cannabis supply, CSC prescribe to harm reduction aims, which are partially achieved by self-regulatory conditions, such as granting the adults-only access, limiting daily and monthly amounts per member, providing safe environments for consumption and quality control of products [3]. Some gaps with respect to achieving harm reduction in CSC have been identified, including lack of routine laboratory tests [4] and regulation of retail prices [3]. Pricing policies are considered effective measures to protect public health (e.g., for cannabis see [5] and for alcohol see [6]). In the literature, the price of cannabis products in CSC is rarely addressed. We are only aware of one study that reported the price per gram in Spanish CSC to vary between 4.50 and 15€ per gram (type of product not specified), based on an unknown number of interviews [2].

The establishment of legal (for-profit) cannabis markets in North America had two important consequences for cannabis prices. First, the introduction of legal markets is associated with a drop in prices for cannabis products on both legal and illegal markets (see e.g., [7, 8]). This is not surprising as the industry can produce cannabis in larger amounts and economy of scale effects bring down the price per unit. High competition of both legal and illegal suppliers and reduced risk for prosecution are further drivers for falling prices. Second, there are high discount rates involved when purchasing cannabis. Early data from Washington showed that, on average, a 6% discount was given if people bought double the amount [8]. Data from Canada confirmed this finding and extended that discount quantities were also observed on the illegal market [9].

Given that lower prices of cannabis products may constitute a potential incentive for increased purchases, especially for high-risk users [10], it is of interest how cannabis prices are regulated in CSC. Analysing a unique cross-sectional data set from CSC in Barcelona, Spain, this study was guided by the following research questions:

1. How do cannabis prices in CSC in Barcelona compare to national estimates (from the illicit market)?
2. Can quantity discounts be observed in CSC?

2 | METHODS

2.1 | Data sources

Representative data from members of CSC are not readily available but we were able to obtain data from several clubs located in Barcelona and its metropolitan area. In this region, administrative data from more than 40 clubs is compiled by the Catalan Federation of Cannabis Associations since 2017. From this sample, we included four clubs that had the required data available for at least 3 years between 2017 and 2020. Thus, we excluded clubs with no data available and those with data from fewer than 3 years. Having more than 1 year of data from the same club was considered to increase the robustness of the analyses.

The data provided were free of charge and did not contain any information that would allow a third party to identify either the clubs or their members. Therefore, no ethical clearance was obtained.

In the data, each collection of cannabis by club members is detailed with information on date of collection, weight of cannabis products collected (0.01–39 g per collection), procurement fee charged and type of cannabis product (flower vs. resin). The procurement fees do not include any taxes.

Data on collections of products other than cannabis flower or resin (pre-rolled joints, oils, edibles, cannabidiol products, tobacco, rolling paper, vaping devices, etc.) were removed from the data set. The removed collections make up 22% of the total number of collections and 6% of the total revenue in the four clubs. Lastly, collections without valid price data in two clubs (<0.01% of all collections) were removed from the analyses.

In addition to the data from the CSC, we obtained data from the European Monitoring Centre of Drugs and Drug Addiction which compiles annual statistics on various drug-related indicators, including price [11]. In Spain, the price data are from police surveys (published also in Spanish: [12]). We have contacted the Spanish Interior Ministry and the responsible police unit but were unable to obtain any additional information.

2.2 | Analyses

The analyses were not pre-registered and the results should be considered exploratory. To analyse the procurement fees and weight data, we performed descriptive and regression analyses that are described in the following.

The average fee for 1 g of cannabis was determined through two methods. First, the arithmetic mean was calculated, indicating the mean fees paid across all interactions. Second, this mean was weighted for the weight collected in each transaction, to account for possible quantity discounts. If larger weights are collected at lower prices, then this should result in the weighted mean to be lower than the unweighted mean. Rather than calculating 95% confidence intervals around the mean, we

TABLE 1 Sample description.

Club	Number of collections by product		Number of collections by year			
	Flower	Resin	2017	2018	2019	2020
A	17,376	–	–	6617	5621	5138
B	39,644	13,432	–	20,588	32,076	412
C	69,352	13,571	24,257	21,320	21,579	15,767
D	54,853	12,235	19,763	17,730	18,694	10,901

present the interquartile range which is more informative for large sample sizes of possibly non-normally distributed variables.

To test for possible quantity discounts, we performed regression models analogously to the procedure described by Smart and colleagues [8]. As formulated in Equation (1), the model regressed the natural log of the fee paid (f of product j) against the natural log of the weight (w of product j), separately for cannabis flower and resin (j). In this model, the coefficient β_1 describes the % changes in the fee that is associated with a 1% increase in the weight of the product under consideration.

$$\log\left(f_j\right) = \beta_0 + \beta_1 \log\left(w_j\right) + \varepsilon. \quad (1)$$

To test whether the quantity discounts varied between product types, one model with an interaction effect was further conducted. For the product-specific models, we also considered the inclusion of random intercepts and random slopes for each club, to account for possible clustering effects.

All analyses were conducted with R version 4.1.2 [13]. All fees and prices remain unadjusted for inflation, which ranged between −0.3% and 2.0% in the study period [14].

3 | RESULTS

3.1 | Sample description

On a total of 220,465 occasions, cannabis flower or resin were collected by members of four CSCs. In the smallest club (Club A), only flower were collected and in the other three clubs, the share of resin in all cannabis collections ranged between 16% (Club C) and 25% (Club B; see Table 1). Clubs A and B provided data for 3 years (2018–2020), while data from an additional year was available from Clubs C and D (2017–2020).

As compared to previous years, there was a considerably lower number of transactions in 2020 which may reflect the impact of restrictions related to the COVID-19 pandemic. This decline could not be observed in Club A, which only distributed cannabis flower. On average, larger amounts of cannabis resin and flower were collected between June and October as compared to other months.

3.2 | Comparison of procurement fees for cannabis in CSC to national averages

The mean fee paid for cannabis flower and for resin is summarised in Table 2. Across all 4 years of available data from the CSC, 6.19€ was paid for 1 g of flower (weighted mean: 6.10€; median: 6€; interquartile range: 6–7€) and 8.54€ was paid for 1 g of resin (weighted mean: 7.18€; median: 7€; interquartile range: 6–9€).

For cannabis flower, the mean fee/price per gram was similar in both CSC and according to the illicit market estimates for Spain, although the national average tended to be a little bit lower. Accounting for differences in fees for different weights, we found only very little differences (see weighted mean price column). Moreover, there was very little variation across clubs with regards to mean fee per gram flower (A: 6.46€, B: 6.07€, C: 6.20€, D: 6.19€) and *weighted* mean fee per gram flower (A: 6.29€, B: 6.01€, C: 6.03€, D: 6.19€).

For cannabis resin, the gap between CSC and national statistics was more pronounced. When calculating the mean fees while weighting for the amount collected, the gap between national average and CSC was reduced by some degree (see weighted mean price column). As compared to cannabis flower, there was more variation across clubs with regards to mean fee per gram resin (B: 6.88€, C: 10.08€, D: 8.65€) and *weighted* mean fee per gram resin (B: 6.07€, C: 7.83€, D: 8.01€).

Across all collections, 99% of all fee values ranged between 3.00€ and 9.50€ per 1 g for cannabis flower and between 4.00€ and 35.00€ for resin. The broader variations of cannabis resin in years with data available from all clubs (2018–2019) are also illustrated in Figure 1. In most months, the mean fee for cannabis resin was close to the upper value of the interquartile range and

TABLE 2 Mean procurement fees/retail prices for 1 g of cannabis flower or resin according to different sources in €.

Year	Flower				Resin			
	Cannabis social clubs			Illicit market	Cannabis social clubs			Illicit market
	Number of collections	Mean fee (IQR)	Weighted mean fee	Estimated mean price	Number of collections	Mean fee (IQR)	Weighted mean fee	Estimated mean price
2017	37,986	5.87 (5.00–6.40)	5.74	5.16	6034	10.7 (7.00–10.00)	8.09	6.04
2018	53,921	6.21 (6.00–7.00)	6.13	5.22	12,334	8.77 (6.00–9.00)	7.09	5.59
2019	62,060	6.24 (6.00–7.00)	6.14	5.06	15,910	7.48 (5.00–9.00)	6.66	5.68
2020	27,258	6.51 (6.00–7.15)	6.32	5.09	4960	8.70 (7.00–10.00)	8.15	5.57

Note: Mean fees/prices of cannabis products per 1 g. Data from the year 2017 only based on collections from Club C and D.
Abbreviations: EMCDDA, European Monitoring Centre of Drugs and Drug Addiction – data source of national average; IQR, interquartile range.

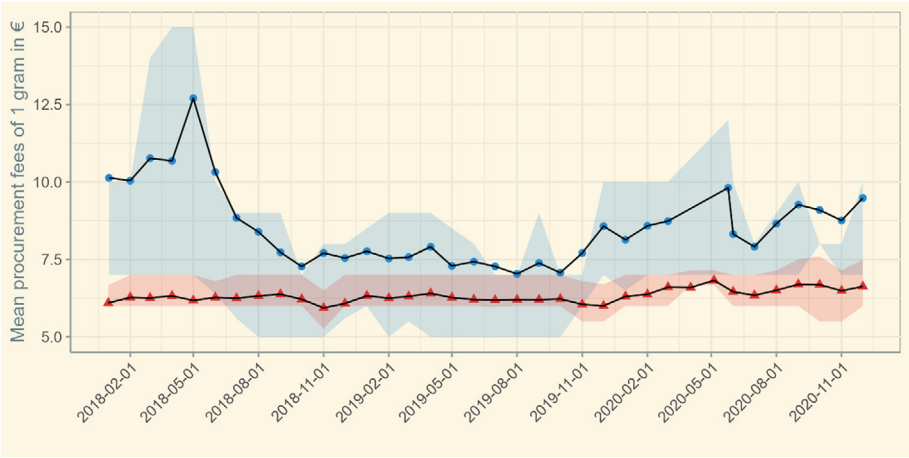

FIGURE 1 Average monthly fees paid by members for cannabis flower (red triangles – lower line) and resin (blue circles – upper line) in four cannabis social clubs between January 2018 and December 2020. Points indicate arithmetic mean and shaded areas indicate interquartile range (lower boundary: 25%, upper boundary: 75%).

sometimes also beyond this range. This pattern depicts not only the broad fee variation of resin but also the skewness of the fee distribution, which implies that a sizeable number (in some months 75% or more) of collections were done at lower fees than the monthly mean. In other words, the relatively high mean for cannabis resin was determined by few collections for high fees.

Club-specific trends are portrayed in Figure S1. They show that the difference in fees was most pronounced in Clubs C and D – those clubs with the largest number of collections. The main source of fee variation observed for resin stems from Club C, while the fees for resin were more stable in the other two Clubs B and D.

3.3 | Quantity discounts

As shown in Figures 2 and 3, the weight of cannabis products correlates with the fee per gram, but this correlation is greater for resin than it is for flower (interaction term: $p < 0.001$). For flower, a doubling of the weight collected (e.g., from 1 to 2 g) was linked to a mean discount of 1.7% per gram (95% confidence interval 1.6–1.9%; $p < 0.001$; see Model 1 in Table S1). It should be considered that the effect of weight only became significant because of the high number of observations and this variable explained a very small percentage of variance ($R^2 = 0.6\%$, see also Figure 2) in the fee variations of flower. Considering the nested nature of the data by including random intercepts and random slopes, the association between amount collected and fees paid was rendered insignificant (see Model 3 in Table S1). Figure S2, also shows that the slightly negative association was only observed in one out of the four clubs.

For resin, doubling the amounts was associated with a mean fee discount of 20.7% (95% confidence interval 20.4–21.2%; $p < 0.001$; see Model 3 in Table S2) and the weight variable explained a larger amount of observed variance in the outcome ($R^2 = 21.8\%$) than for cannabis flower. This association was slightly reduced to −18.8%

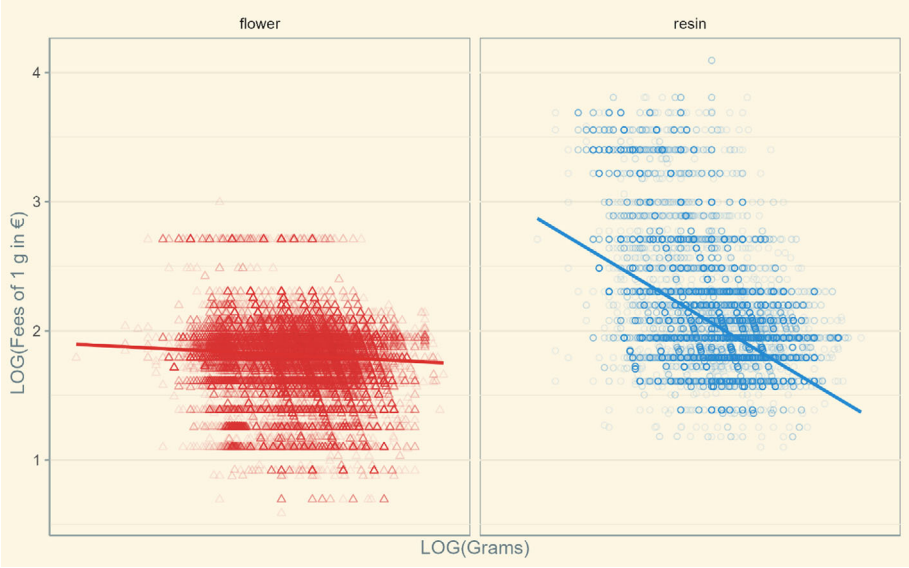

FIGURE 2 Scatter plot of the natural logarithm of weight (x-axis) and fee per gram (y-axis) for 1 g of flower (red triangles – left) and resin (blue circles – right).

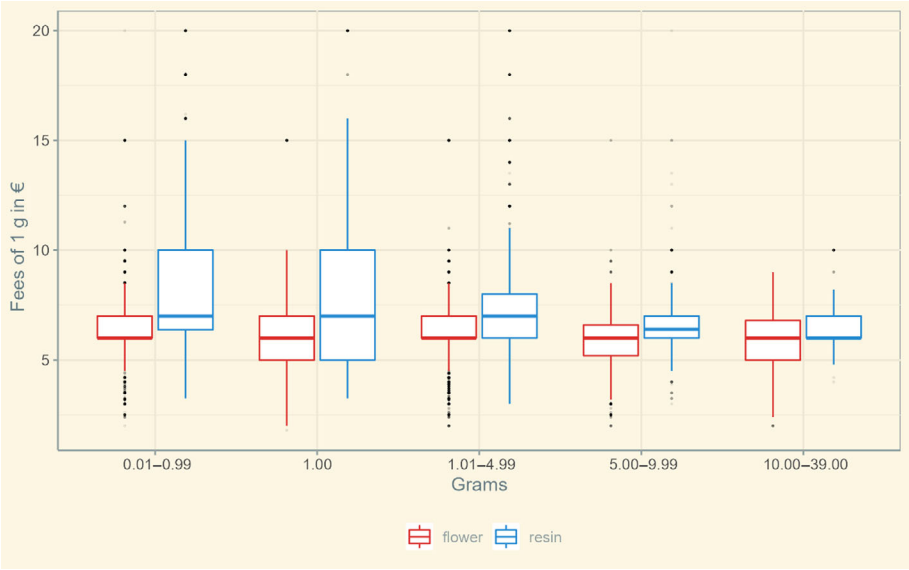

FIGURE 3 Boxplots of fees per gram in € for cannabis flower (red – left) and resin (blue – right). Borders of boxes represent the interquartile range, middle line indicates median, whiskers represent 1.5 times the interquartile range, and points indicate outliers outside of the whiskers (darker for multiple outliers).

(−35.0 to −2.6%) when random intercepts and random slopes were included in the model (see Model 3 in Table S2). As shown in Figure S2, a negative association could be observed in all three clubs.

To illustrate the quantity discounts, Figure 3 shows the mean fees per gram for select weight categories. With increasing quantities, the fees per gram decreased almost linearly for cannabis flower (mean, unweighted fees: 0–1 g = 6.26€/g; 1 g = 6.04€/g; 1–5 g: 5.21€/g; 5–10 g = 5.89 €/g; 10–39 g: 5.68€/g) and more steeply for resin (mean, unweighted fees: 0–1 g = 9.01€/g; 1 g = 7.66€/g; 1–5 g: 6.99€/g; 5–10 g = 6.63€/g; 10–39 g: 6.64€/g). Figure S3, illustrates the quantity discounts for each club separately.

4 | DISCUSSION

4.1 | Summary of main findings

Analysing about 220,000 collections of cannabis flower (82.2% of all collections) and resin from four CSC in Barcelona (Spain), we observed that cannabis resin was more

costly in clubs than on the illicit market, while the cost differences were smaller for cannabis flower. Moreover, we did not observe any meaningful fee discount for flower but for resin.

4.2 | Limitations

We do not have any means to determine the representativeness of the analysed data set and our findings should thus be interpreted with caution. The included clubs are organised in the Catalan Federation of CSC, which stresses the importance of harm reduction and social community. However, there are also clubs with profit-oriented business models which may differ from the clubs included in this study. Specifically, CSC distributing cannabis to tourists and other "one-time-members" rather than to a stable community of long-term members may have different pricing models, for example, with pronounced price discounts. As a complete characterisation of CSC in Barcelona or let alone Spain is not available, it cannot be assessed to which degree our data reflects reality for members of CSC in the respective jurisdictions.

Moreover, the comparisons with the national illicit cannabis price data need to consider that the assessment methods, as well as uncertainty intervals for these estimates are not available. Lastly, some of the observed variations but also the gap between national averages and club data may be due to variations in product quality, that is, levels of cannabinoids (e.g., tetrahydrocannabinol [THC], cannabidiol), the type of cultivation (e.g., outdoor vs. indoor) and the use of pesticides or other contaminants. Notably, the THC level of resin has increased from 18% in 2017 to 29% in 2020 according to the data compiled by the European Monitoring Centre of Drugs and Drug Addiction [11], suggesting that the price per THC unit has decreased considerably for this product.

4.3 | Implications

This study is the first to our knowledge to analyse cannabis prices with objective register data from CSC. Our findings suggest a couple of patterns relevant for public health and regulation of cannabis markets: First, in CSC, 1 g of cannabis flower is cheaper than 1 g of resin. This is in contrast to national as well as European estimates: According to data compiled by the European Monitoring Centre of Drugs and Drug Addiction, 1 g of resin (11.65€, average from $n = 17$ countries) is priced at very similar rates as cannabis flower (11.04€, average from 18 countries; own calculations based on [11]), however, there are some countries that report similar price gaps between the two products (e.g., Netherlands or Italy).

Second, cannabis in CSC may be pricier than the national average. The exact reasons for this price gap remain unclear. Possibly, this reflects higher costs of living in Barcelona than in other parts of the country. Moreover, an institutionalised club has more expenses (e.g., for rent, salaries, etc.) than a person who sells cannabis illegally. In addition, we expect that this price gap could also be the result of market factors and product quality, as discussed below.

To understand the market factors, it is important to understand the sources for each product. Cannabis flower are either produced by the clubs themselves or acquired from nearby producers, which means that no or very little charges for transport, especially cross-border smuggling must be paid. Conversely, cannabis resin from non-domestic sources (e.g., Morocco) may cost more because prices reflect charges for import, which may vary with each shipment and explain the observed variations. It is unknown whether these charges exceed the cost savings related to lower wages and economy of scale effects of cannabis from non-domestic sources, thus it cannot be assessed with certainty whether domestically produced or imported resin is more expensive. However, domestically produced resin is likely more expensive than imported resin because it is produced with costly extraction methods resulting in higher quality in the final product. CSC may prioritise domestically produced resin to avoid being associated with illegal drug smuggling and thus reduce the risk of being involved in law enforcement activities. This could (partially) explain the higher costs of resin than flower as observed in our study. Also, variations in batch sizes and differences in extraction methods may have a larger impact on the final price of domestically produced resin than for flower, explaining larger variations in procurement fees for cannabis resin.

Another important driver for the observed price gap may be related to the quality, that is, levels of cannabinoids (e.g., THC, cannabidiol), the type of cultivation (e.g., outdoor vs. indoor) and the use of pesticides or other contaminants. As resin is a form of concentrate made from flower, THC concentration is usually higher in resin as compared to flower (see e.g., analyses from samples collected in Dutch Coffeeshops: [15, 16]). Nevertheless, organically grown or pesticide-free tested flower available in CSC can easily be a lot more expensive than imported mass-produced cannabis resin. Possibly, cannabis users are willing to pay more for locally produced cannabis resin, that is free of contaminants and has high THC levels. Thus, both supply and demand factors are likely to explain the observed findings.

As we do not have any information on the THC levels in the cannabis products distributed in CSC, we cannot validate the proposed explanations. However, European data suggest that one standard dose (10 mg) of THC costs on average 1€ in flower but only 0.61€ in resin (own calculations based on [11]), supporting our considerations.

While no meaningful quantity discounts were observed for cannabis flower, doubling the amount of cannabis resin was linked to a 21% fee reduction. Quantity discounts for cannabis have been observed on both legal (e.g. [8, 9]) as well as illegal markets (e.g. [17]), ranging between 6% [8], 11% [9] and 17% [17]. The quantity discount observed for resin in this study was above those estimates. While we do not have information in the data to explain why the quantity discount practice differed so greatly between cannabis flower and resin, there are some possible explanations other than this being a deliberate pricing policy decision of the cannabis social club management. As discussed above, the variations in resin prices may be driven by market factors, that is, supply (e.g., non-domestic vs. domestic production) and demand (product quality). It is possible that the quantity discount reflects the fact that larger amounts of resin are collected by members if the prices are relatively low. In contrast to flower prices, resin prices vary largely, which could make members wait for a better deal rather than buying whatever is available. Thus, the quantity discount may simply reflect the members' tendency to purchase larger amounts when resin is offered at a relatively low price. Controlling for the specific batch for resin may be done in future studies to validate this hypothesis.

Another possible explanation for the observed price discount would be related to the policy of each cannabis social club. It is not part of the non-profit harm-reducing approach of CSC to grant quantity discounts to usual members. However, staff and medical users may be entitled to those discounts – depending on the policy of the respective club. If these groups are more likely to collect larger amounts of resin than normal members, this could also explain the observed findings. Again, this may also be followed up in further studies.

4.4 | Summary

Based on register data collected over 4 years, we found no evidence that cannabis flower or resin distributed in CSC is cheaper than the estimated national average in the illicit market. In contrast, cannabis may be more costly in these non-profit settings. Moreover, most cannabis collected was in form of flower, for which we did not observe any quantity discounts. For resin, quantity discounts have been observed, which are not in line with a non-profit harm reduction approach.

Overall, pricing policies observed in CSC may be more reflective of harm reduction principles than pricing policies observed on commercial legal or illegal markets. Higher prices and no quantity discounts may help to disincentivise consumption of larger amounts among members. However, they might also drive users who cannot afford higher prices to purchase their cannabis on the illegal market – a pattern also observed on legal markets in North America [18].

AUTHOR CONTRIBUTIONS

Jakob Manthey: Conceptualisation (lead); investigation (equal); methodology (lead); software (lead); validation (equal); formal analysis (lead); resources (equal); data curation (equal); writing – original draft (lead); writing – review and editing (lead); visualisation (lead). **Anna Obradors-Pineda**: Investigation (equal); validation (equal); resources (equal); data curation (equal); writing – review and editing (supporting).

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CONFLICT OF INTEREST STATEMENT

AOP collaborates with the Catalan Federation of CSC as an external assessor and is the founder and owner of a company providing software to register the activities of cannabis social club members. Unrelated to the present work, Jakob Manthey has worked as consultant for and received honoraria from various public health agencies and was involved in designing a study protocol for an experimental pilot study for licenced cannabis sales, funded by the federal state of Berlin (Germany).

DATA AVAILABILITY STATEMENT

The data analysed in this submission is not owned by the authors and can thus not be made publicly available.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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