

Does the total consumption model apply to cannabis use?

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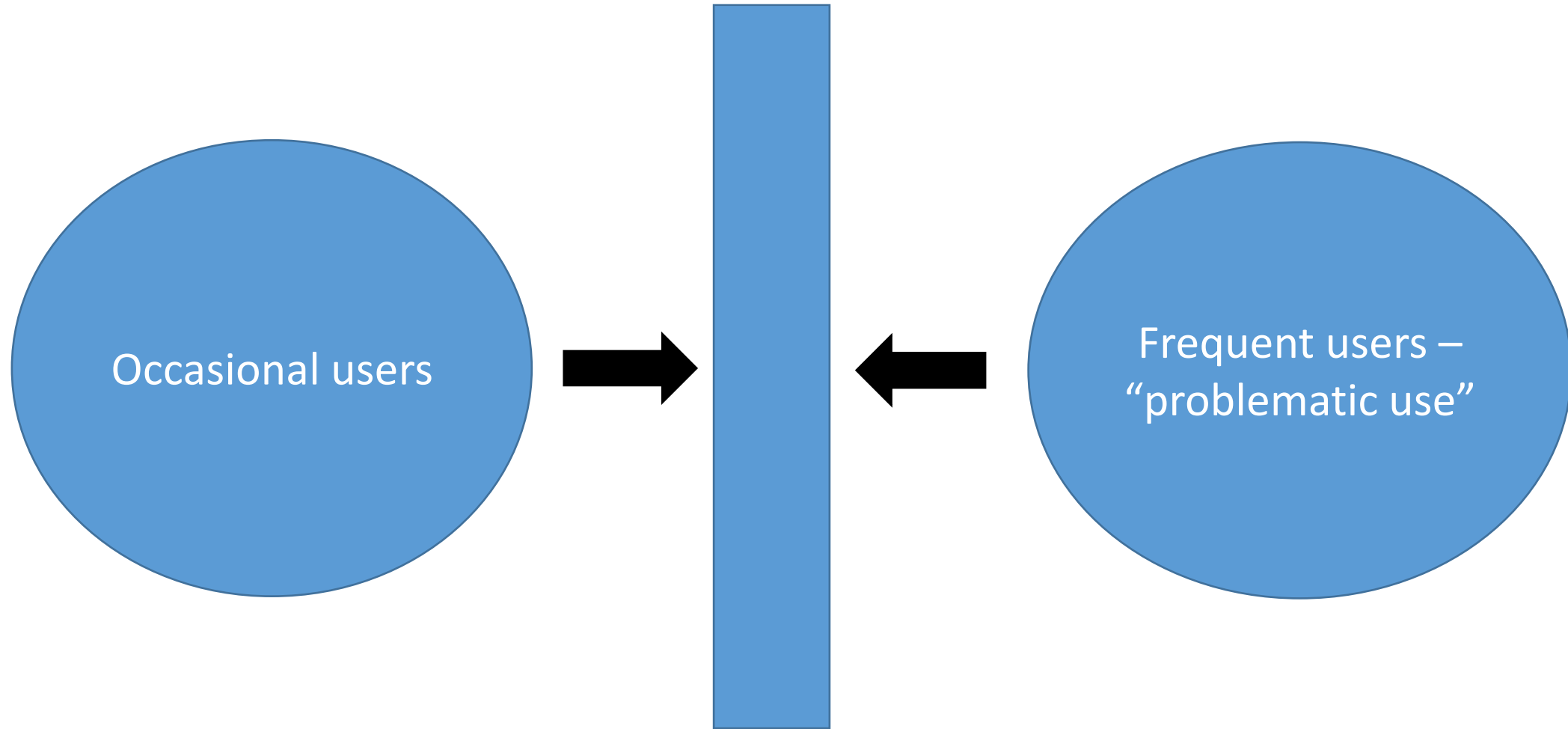
Background

- Cannabis policy liberalisation has led to increased use globally
- Unclear whether rises reflect general increases or changes in specific subgroups
- Study focus: Swedish adolescents—a restrictive policy context with shifting norms
- **A lot is at stake?:**

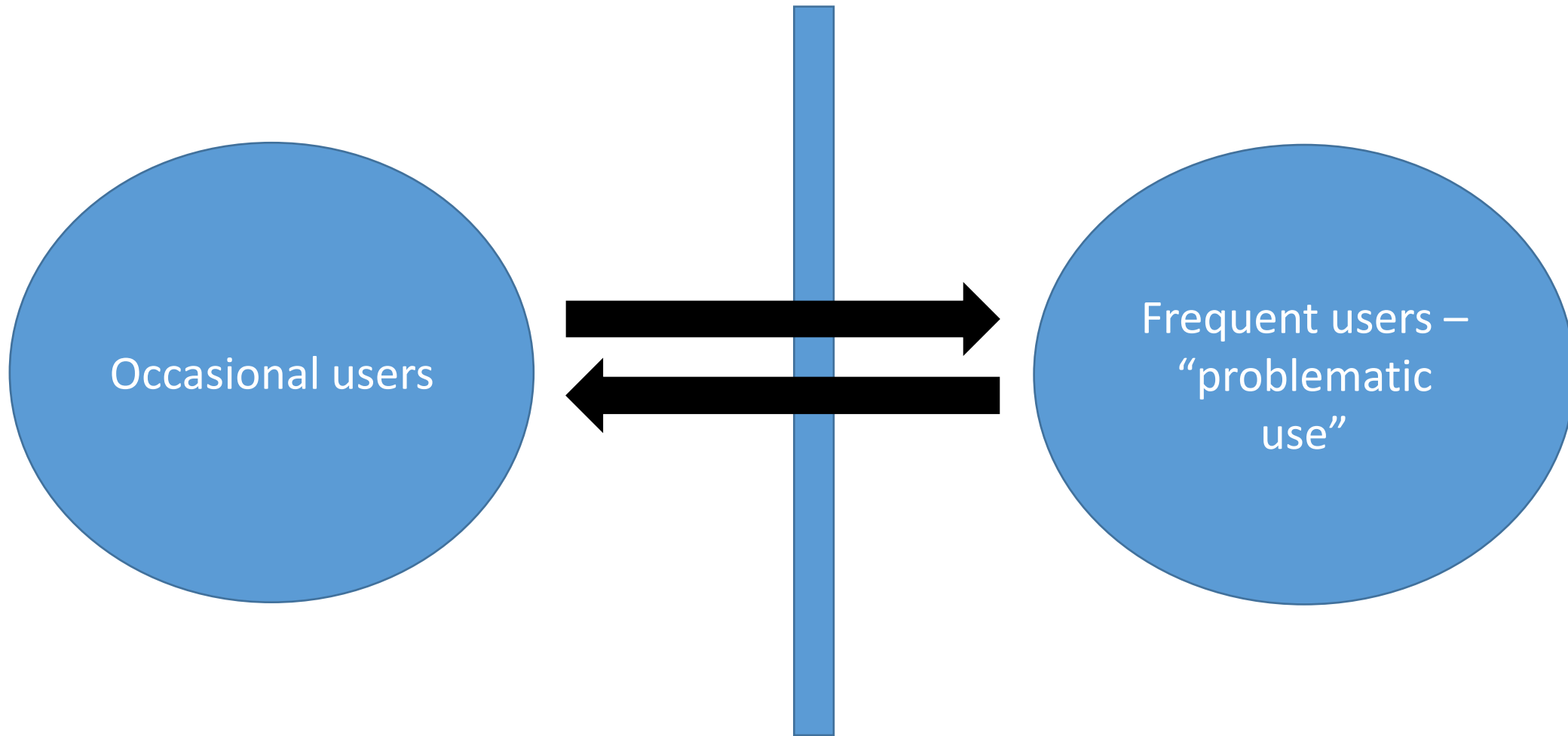
A key question for how we think about drug use – particularly cannabis

Are occasional and frequent drug users separate or interconnected?

Two separate groups?



Or linked together into one group?



Static or dynamic? Why does it matter for drug policy?

Two perspectives on drug use – different implications for prevention

If static: leave occasional users with few problems alone

- **Focus primarily on those with clear drug-related problems** – social policy/treatment rather than population-level drug policy
- The prevalence of occasional/recreational use is of little direct concern

If dynamic: universal prevention targeting the base becomes relevant

- The fewer people who initiate or occasionally use drugs, the fewer will develop frequent or problematic use
- **Becomes a public health issue:** prevention, reduced availability, and fewer young people initiating use
- Occasional/recreational users matter because a larger population of users may ultimately contribute to more frequent and problematic use

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Abstract

Aims: To test whether the total consumption model and its extension, the theory of collectivity, apply to adolescent cannabis use. We estimated: (1) whether the distribution of cannabis use frequency was stable over time; (2) whether changes in average cannabis use were mirrored across consumption quantiles; and (3) whether higher average use corresponds with a higher prevalence of high-frequency users.

Design: Repeated cross-sectional study based on annual surveys. We analyzed trends in cannabis use frequency across consumption percentiles using Lorenz curves and Gini coefficients to assess distributional stability. We used ordinary least squares (OLS) regression to estimate the elasticities between overall mean frequency of use and mean frequency of use for five quantiles ranging from P25 to P95. The association between average use and the prevalence of high-frequency users was examined graphically and parametrically.

Setting: Sweden.

Participants: Ninth-grade students (aged 15–16) surveyed annually between 1990 and 2023 (excluding 2013), with a total of 180 059 respondents, and 2nd-year high school students (aged 17–18) surveyed annually between 2004 and 2023 (excluding 2013 and 2020), totaling 80 925 respondents. Our analyses were limited to individuals who reported cannabis use, resulting in analytical samples of 10 139 9th-grade students and 11 160 2nd-year high school students.

Measurement: Frequency of cannabis use was measured by a question on how many occasions the respondent has used hashish or marijuana. The seven response alternatives ranged from 0 to 50 times or more.

Findings: Mean frequency of cannabis use fluctuated statistically significantly across survey years among 9th-grade students (F -test = 7.647, $P < 0.001$) and marginally among 2nd-year students (F -test = 1.550, $P = 0.068$). Notwithstanding this variation in mean use, the distribution of frequency of cannabis use remained stable: Lorenz curves were consistent across years, and Gini coefficients showed no significant changes. Mean frequency in all five quantiles (25th–95th) were positively and statistically significantly associated with overall mean frequency, suggesting synchronized changes across user groups; e.g. the elasticity for P50 was estimated at 0.914 ($P < 0.001$) in 9th grade. Increases in mean frequency use were associated with a higher prevalence of high-frequency users. Thus, an increase in average frequency of cannabis use by 1 percentage point was associated with a 1.794 (standard error = 0.065, $P < 0.001$) percentage point increase in high-frequency users in 9th grade.

- **Study 1:** Published in *Addiction* in February 2026
- **Study 2:** Test whether the findings hold in another study using a different dataset
- **Study 3:** Focus on the proportion of users/non-users – do these proportions change in parallel with increases or decreases in frequency of use?
- **Study 4** (starting this autumn): Test whether the total consumption model holds across European countries using ESPAD data

Theoretical Framework

- Rose & Day (1990): Population-level shifts reflect changes across the distribution: a close link between the population mean of health-related behaviours and the prevalence of associated problem
- Total Consumption Model (TCM): Developed in the alcohol field
- Collective shifts in use – not two separate distribution but one single distribution
- Driven by *social networks* (influenced by peers and *external factors* (e.g. policy, availability, norms))
- Application to cannabis is unexplored

Previous findings on alcohol

- **The Total Consumption Model (TCM):** Changes in mean consumption are accompanied by changes in the same direction in the prevalence of heavy drinkers
(e.g. an increase in mean consumption from 5 to 6 litres (+20%) is associated with an approximately 40% increase in the prevalence of heavy drinking)
- **Skog's theory of the collectivity of drinking (CoD or CoC) extended this perspective:** consumption levels across the population are interconnected – from light to heavy drinkers: changes in mean consumption leads to changes in the same direction across different drinking groups
- **The shape of the consumption distribution is remarkably similar** across different populations and over time, despite differences in overall consumption levels

Does this collective pattern also apply to cannabis use?

There are no comparable *consumption* data over time (or across areas/countries)

Focus on school students

- Initially based on CAN's national school surveys, now also using data from the Stockholm School Survey
- Grade 9 students: 1990–2023
- Second-year upper secondary school students: 2004–2023
- Approximately 5,000 and 4,300 respondents per year, respectively

Study 1 – nationally representative CAN school surveys

- Measure: “How many times have you used hashish or marijuana?”
- Response categories: 0 to 50+ occasions
- Thus, the analysis focuses on frequency rather than quantity
- The frequency distribution was used to estimate different percentiles, e.g. the 25th, 50th (median), 75th and 95th percentiles

Method

- 1. Lorenz curves & Gini coefficients to assess stability**
- 2. Percentile analysis (25th–99th) and OLS regressions to evaluate collectivity**
- 3. Graphical analysis and OLS to assess link between average use and heavy use prevalence**

They are all three connected – different ways to test the TCM och Collectivity of drinking (change) (CoC)

1. Stability of consumption* distribution

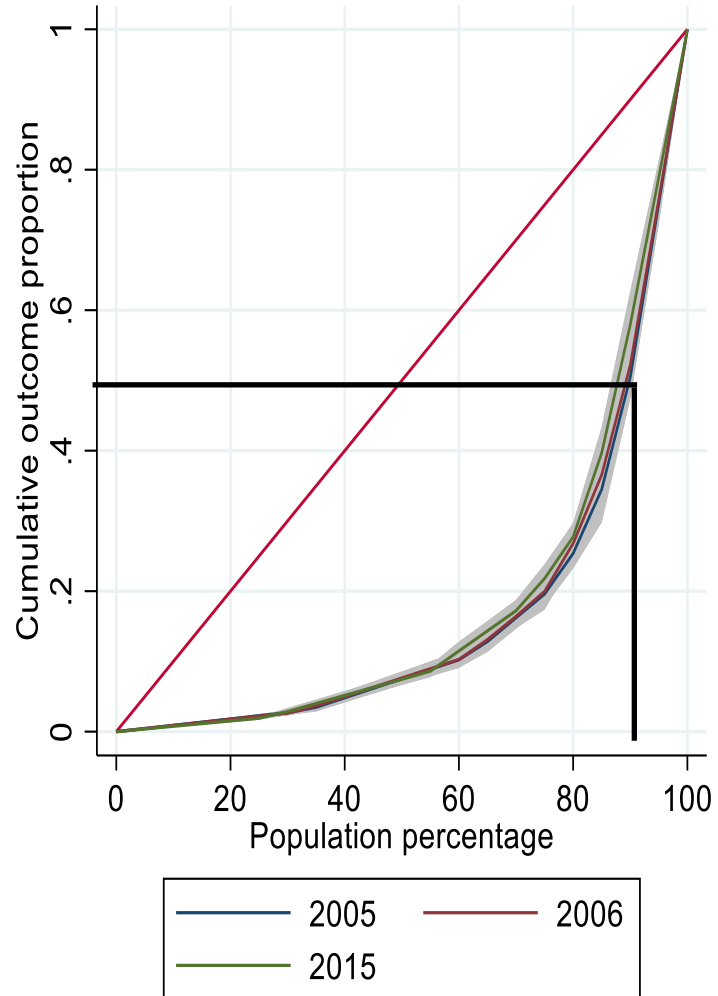
(*thus: frequency of use)

- Lorenz curves
- Gini coefficients (measure of dispersion)

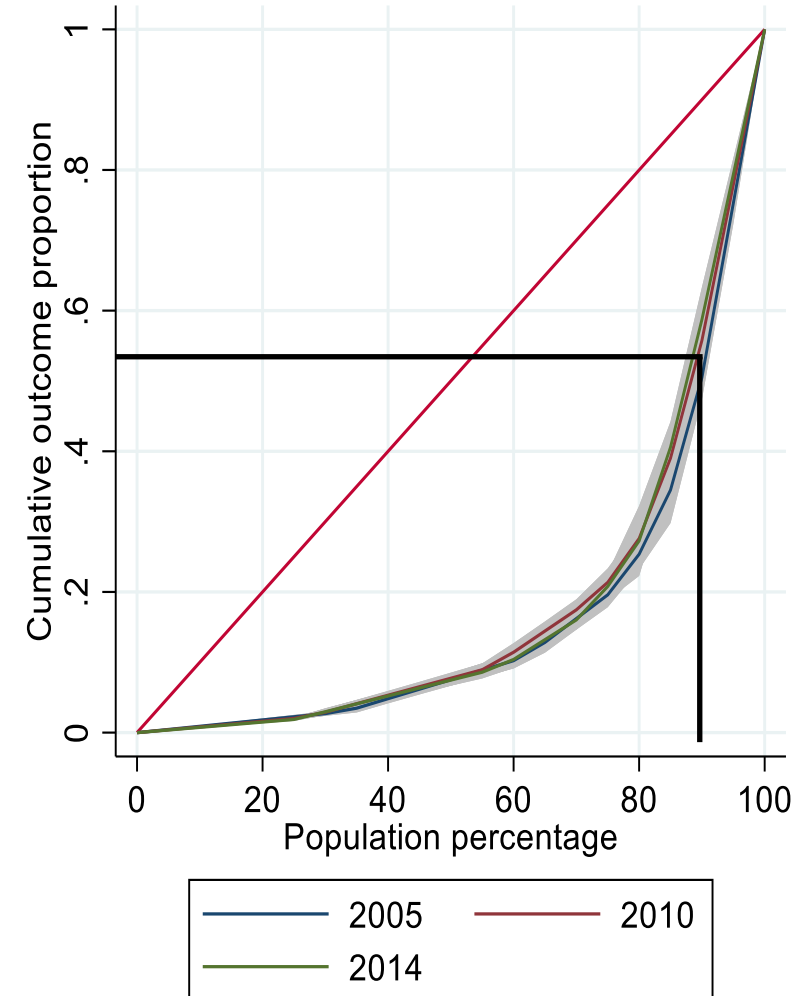
Lorenz curves for cannabis use (frequency)

Three years: lowest Gini, highest Gini and a year in-between

9th grade junior high school



2nd grade high school



Descriptive statistics for frequency of use

Gini-koefficient: higher values indicate greater dispersion (“inequality”)

9th grade junior high school

Frequency of cannabis use								Gini	
Year	N	% users	Mean	SE	SD	Median	IQR	EST	SE
1990	196	3.305	8.324	1.039	14.545	3	6.5	0.694	0.046
1991	183	3.127	6.615	0.913	12.354	3	6.5	0.677	0.055
1992	211	3.625	7.002	0.854	12.406	3	6.5	0.675	0.047
1993	246	4.190	7.065	0.826	12.961	3	2.0	0.682	0.046
1994	247	4.248	5.696	0.657	10.324	3	6.5	0.646	0.047
1995	298	5.381	5.601	0.605	10.437	3	2.0	0.636	0.045
1996	405	6.812	6.091	0.527	10.614	3	2.0	0.651	0.034
1997	402	7.126	7.106	0.617	12.362	3	6.5	0.659	0.034
1998	376	6.981	7.684	0.691	13.408	3	6.5	0.664	0.036
1999	402	7.809	6.591	0.598	11.994	3	6.5	0.663	0.037
2000	391	7.426	8.005	0.702	13.872	3	6.5	0.676	0.034
2001	431	7.955	8.586	0.669	13.881	3	6.5	0.659	0.029
2002	383	7.083	9.051	0.780	15.271	3	6.5	0.672	0.033
2003	324	6.211	9.568	0.861	15.494	3	6.5	0.676	0.033
2004	347	6.458	9.893	0.867	16.154	3	6.5	0.681	0.032
2005	313	5.821	8.698	0.833	14.737	3	6.5	0.681	0.036
2006	238	4.884	8.828	0.980	15.112	3	6.5	0.681	0.042
2007	246	4.679	9.203	0.946	14.841	3	6.5	0.668	0.038
2008	259	5.352	8.981	0.954	15.346	3	6.5	0.682	0.040
2009	355	6.869	10.363	0.886	16.702	3	6.5	0.681	0.031
2010	352	7.329	9.464	0.816	15.308	3	6.5	0.666	0.032
2011	320	6.966	11.503	0.924	16.521	3	14.5	0.649	0.027
2012	272	6.053	12.250	0.634	18.105	3	14.5	0.601	0.026
2014	324	6.679	12.718	1.018	18.316	3	14.5	0.655	0.026
2015	273	5.592	12.350	1.061	17.523	3	12.5	0.637	0.029
2016	236	4.987	15.108	1.276	19.604	3	14.5	0.629	0.024
2017	341	5.651	13.587	1.008	18.611	3	14.5	0.640	0.023
2018	322	6.158	12.870	1.002	17.976	3	14.5	0.648	0.025
2019	319	6.175	11.440	0.966	17.252	3	6.5	0.659	0.029
2020	245	6.017	12.851	1.166	18.254	3	14.5	0.653	0.029
2021	269	5.175	10.152	0.974	15.969	3	6.5	0.667	0.034
2022	288	5.555	13.743	1.110	18.833	3	13.5	0.642	0.025
2023	303	5.902	11.682	0.997	17.357	3	6.5	0.662	0.029
F-test			7.647					0.011	
p			<0.001					>0.999	

2nd grade high school

Frequency of cannabis use								Gini	
Year	N	% users	Mean	SE	SD	Median	IQR	EST	SE
2004	597	13.362	10.446	0.637	15.570	3	6.5	0.652	0.021
2005	630	13.889	11.106	0.674	16.912	3	6.5	0.667	0.021
2006	528	14.103	11.362	0.733	16.835	3	14.5	0.660	0.022
2007	616	14.382	10.343	0.634	15.738	3	6.5	0.653	0.022
2008	571	14.430	9.334	0.617	14.753	3	6.5	0.663	0.024
2009	635	15.718	10.995	0.668	16.825	3	6.5	0.664	0.021
2010	675	17.312	12.428	0.680	17.656	3	14.5	0.646	0.018
2011	576	16.157	12.138	0.707	16.978	3	14.5	0.639	0.019
2012	547	16.471	12.152	0.743	17.388	3	14.5	0.606	0.016
2014	602	15.880	13.323	0.757	18.569	3	14.5	0.587	0.013
2015	586	14.210	13.078	0.755	18.276	3	14.5	0.645	0.018
2016	660	16.633	12.540	0.696	17.874	3	14.5	0.643	0.019
2017	734	15.604	11.689	0.633	17.152	3	6.5	0.649	0.018
2018	697	14.503	12.049	0.649	17.142	3	14.5	0.653	0.018
2019	683	14.777	12.463	0.678	17.714	3	14.5	0.641	0.018
2021	556	12.888	11.911	0.754	17.767	3	14.5	0.645	0.018
2022	624	12.981	12.697	0.727	18.149	3	14.5	0.661	0.022
2023	643	12.713	11.159	0.657	16.657	3	6.5	0.655	0.018
F-test			1.550					0.021	
p			0.068					>0.999	

1. Yes, stability in distribution over time

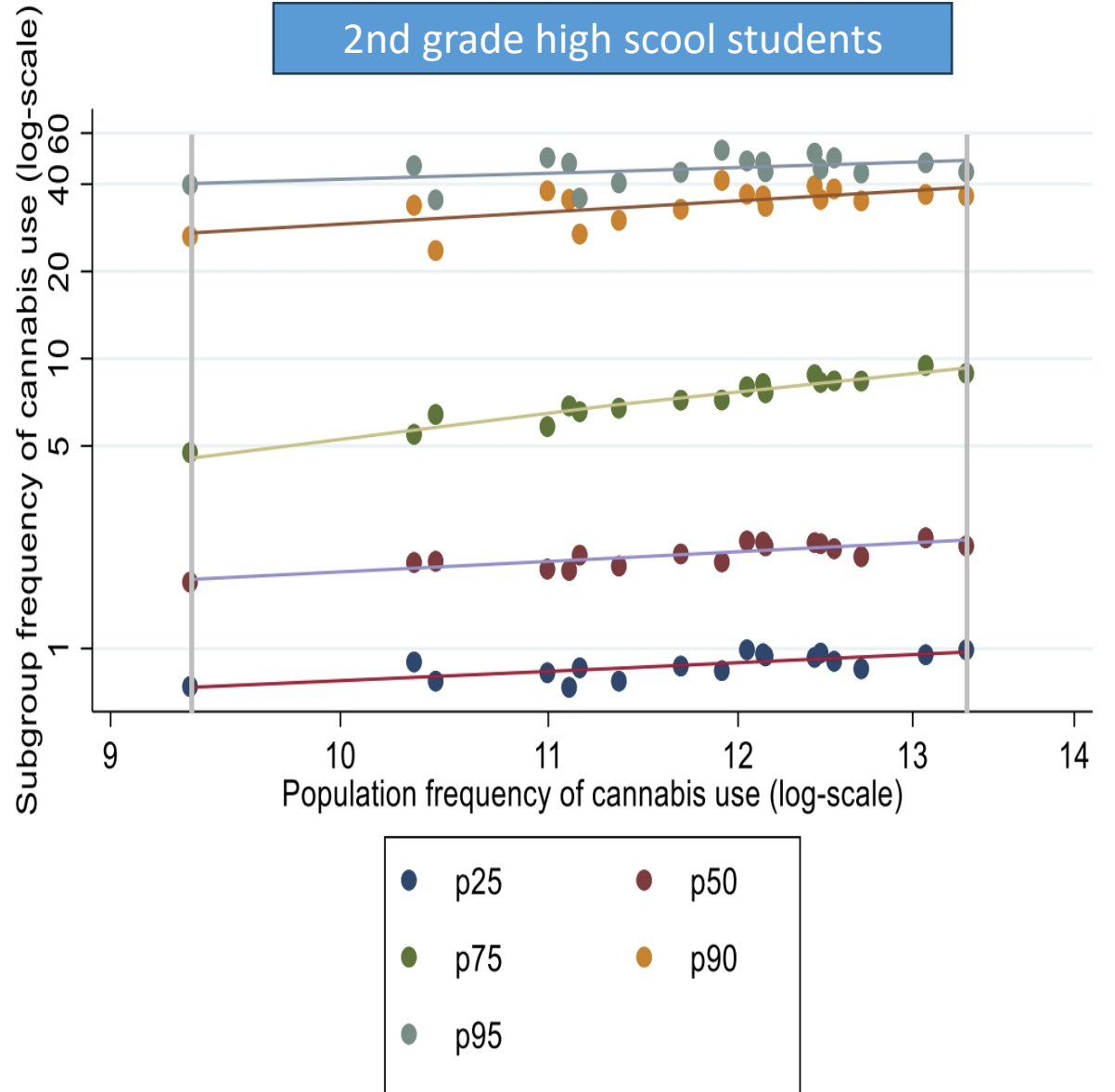
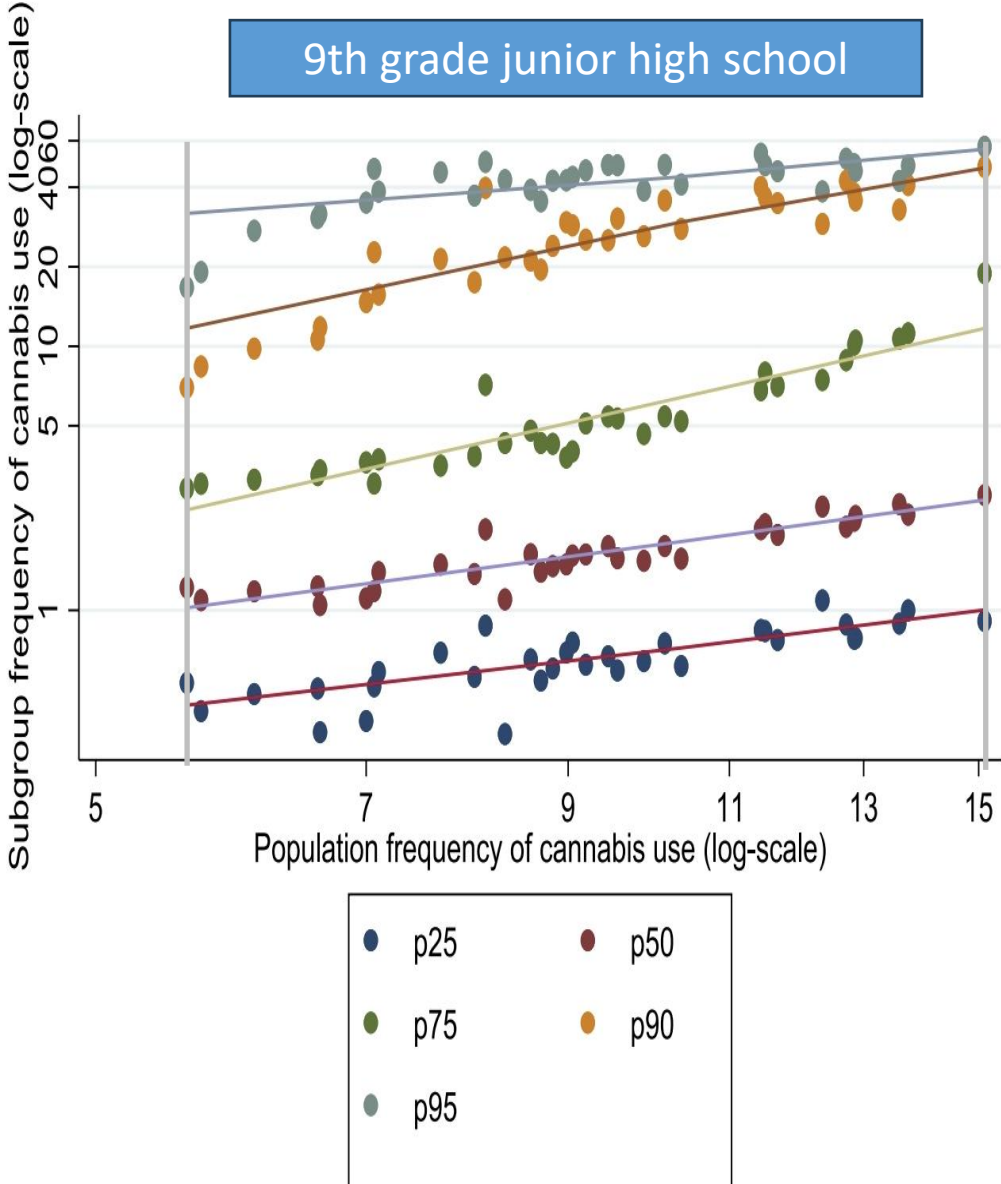
- Lorenz curves are stable over time
- Gini coefficients: No significant distributional changes between different years (equally unequal all years)
- No signs of increased/decreased polarisation
- Supports TCM assumption of stable distribution

2. Collectivity in all consumption groups?

- Frequency of use at different percentiles, by year: percentiles 25, 50 (median), 75, 90, 95

Mean frequency of cannabis use in five consumption groups (percentiler) plotted against overall mean frequency of usen. Yearly data 1990–2023 (2004–2023)

Straight lines show fitted values from OLS regressions.

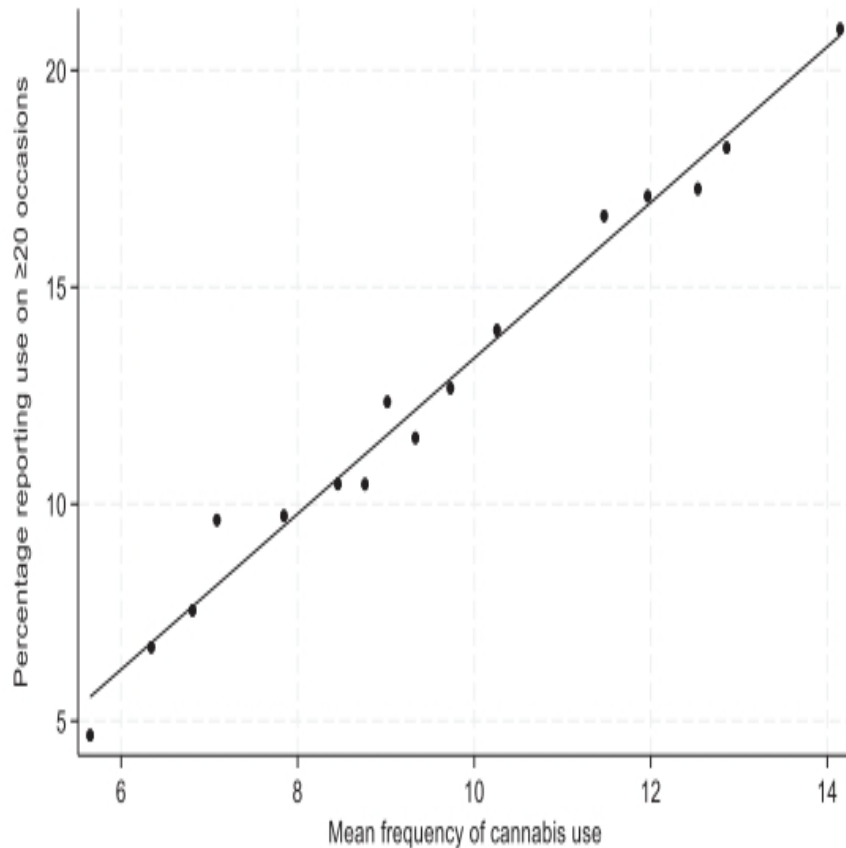


2. Yes: collectivity

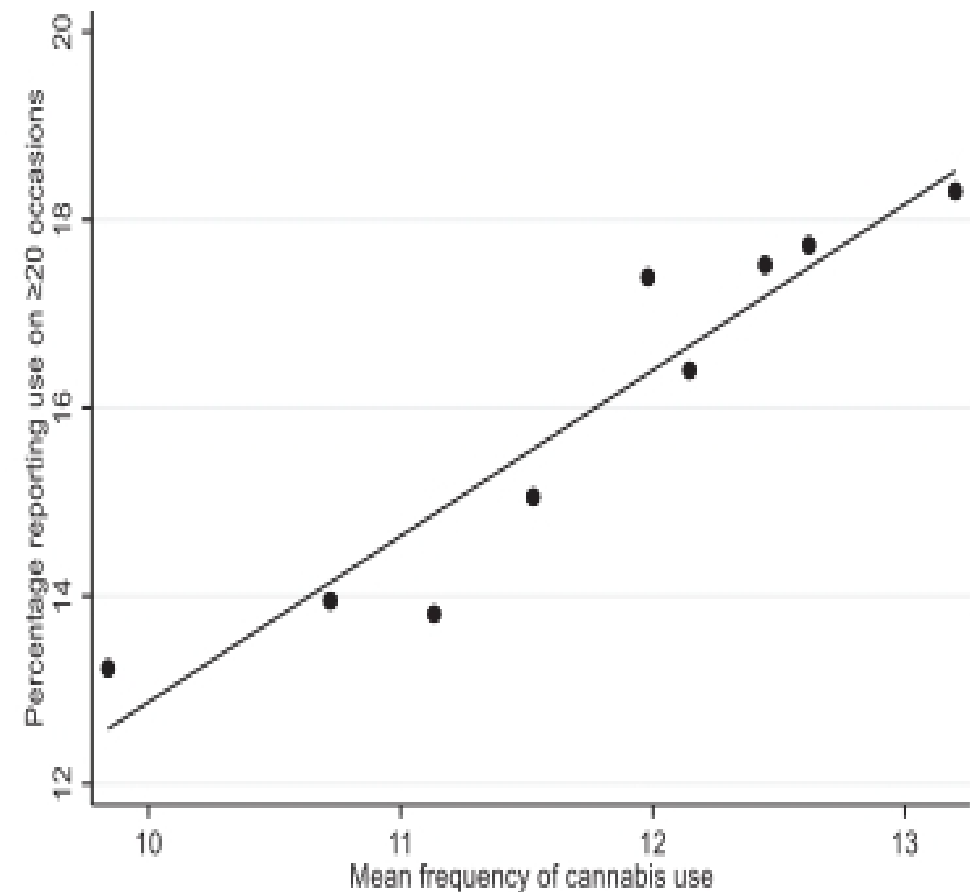
- Consumption groups move in sync with mean use
- OLS results: Significant elasticity for all groups (percentiles)
- Supports collectivity hypothesis

3. Link between average use and heavy use (≥ 20 occasions). (annual values averaged over 2 year).

9th grade junior high school



2nd grade high school



3. Yes, Strong link between average use and heavy use prevalence

- **Strong link between average use and heavy use prevalence**
- **As average use increases, so does proportion of high-frequency users**
- **Supports TCM prediction**

To conclude

The basic assumptions of the TCM and CoC also appear to apply to adolescent cannabis use in Sweden:

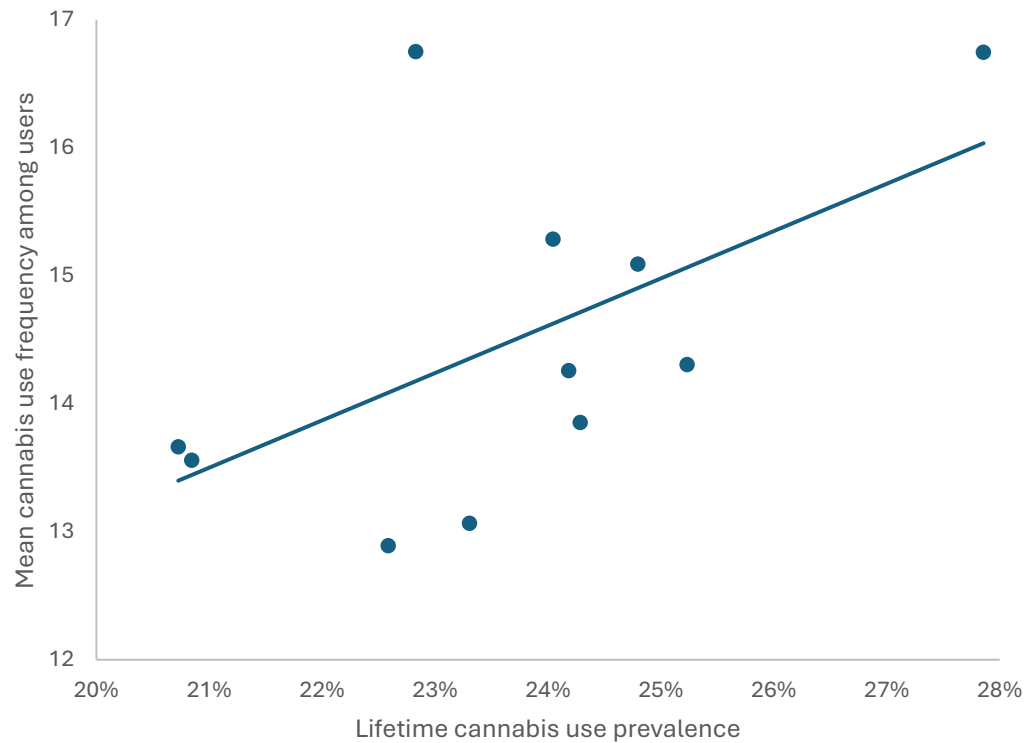
- The frequency distribution is relatively stable over time
- Different user groups change in parallel with mean frequency of use
- Higher mean frequency is associated with a higher prevalence of frequent users
- **Due to the skewed distribution:**
+1% in mean frequency → +1.8% in the prevalence of frequent users (≥20 occasions)
In both grade 9 and 2nd grade high school students

Study 2 and 3

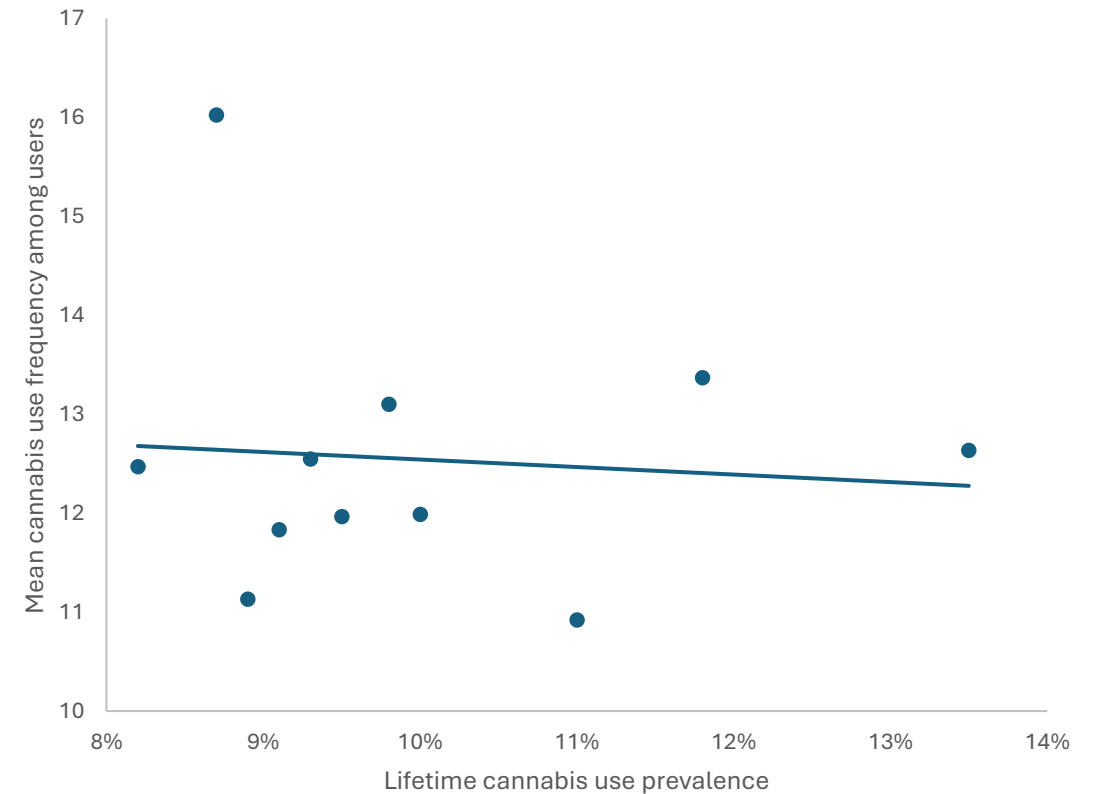
- **Study 2:** Replication of Study 1 using Stockholm data
 - Do the findings hold in Stockholm?
 - Does the TCM also apply across Stockholm districts with different socioeconomic conditions?
- **Study 3:** Extending the analysis to non-users
 - Do changes in frequency among users also correspond to changes in the prevalence of cannabis use?

Association between cannabis use prevalence and mean frequency among users, 2004–2024

2nd grade high school: positive association



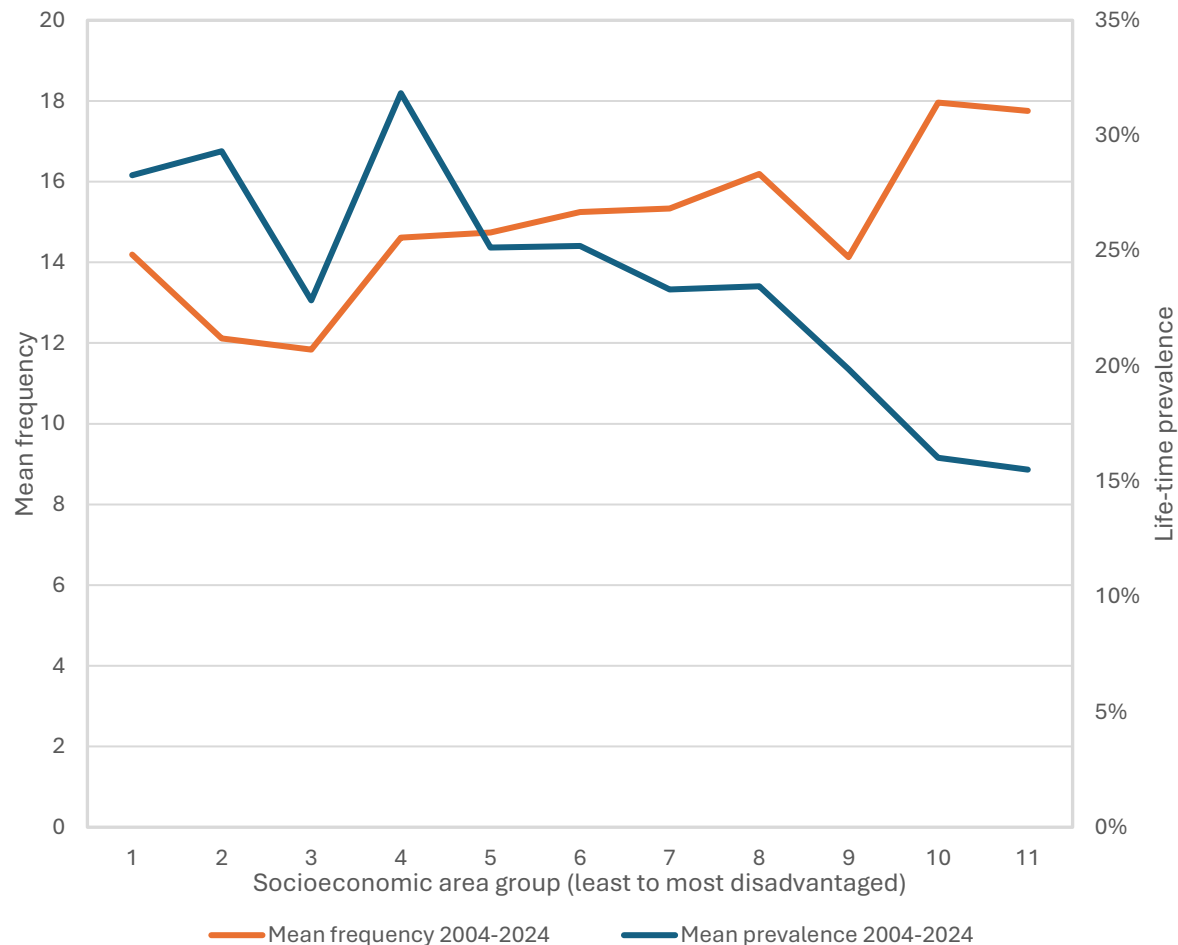
9th grade junior high school: no association



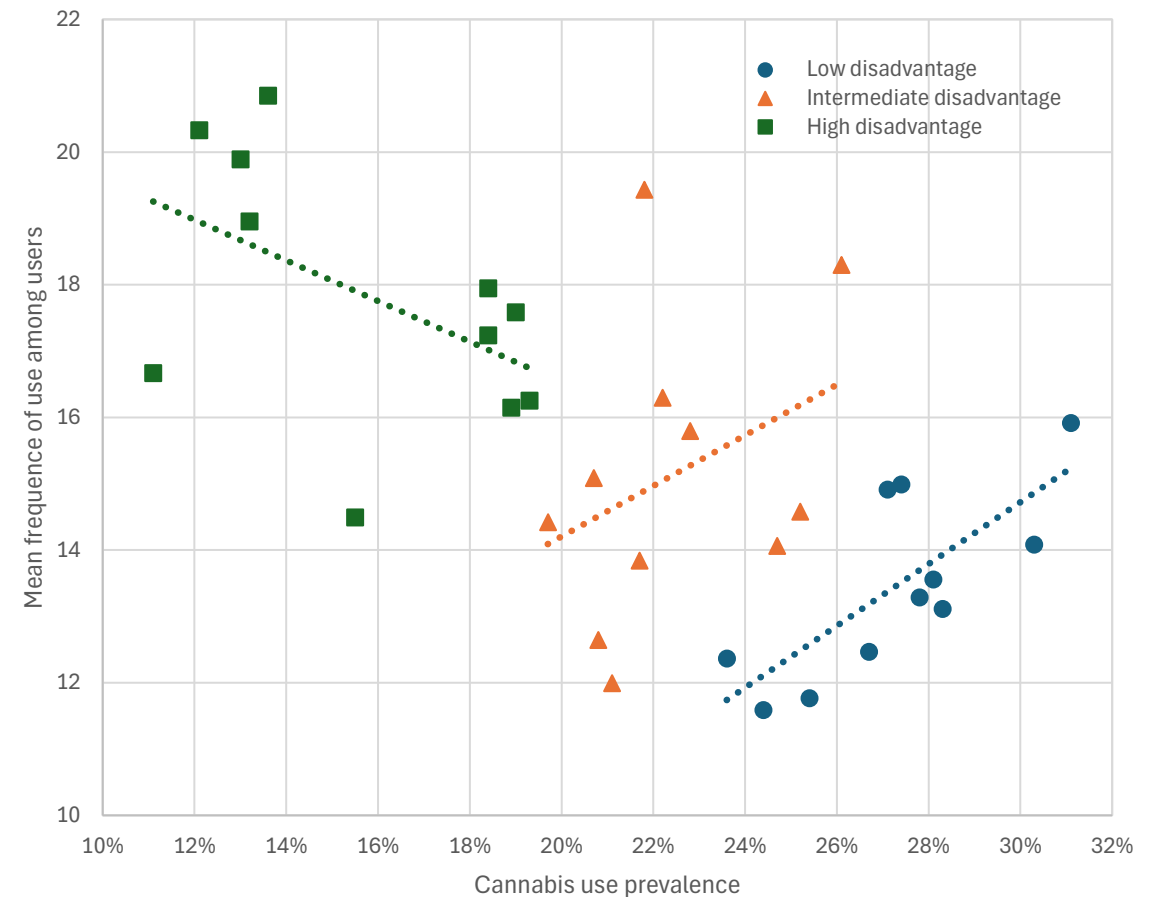
Study 3: Does the prevalence–frequency association also hold across Stockholm districts? Stockholm districts differ substantially in socioeconomic conditions

- Overall, higher prevalence is associated with higher mean frequency among users
- However, the most disadvantaged districts show a different pattern: lower prevalence but higher frequency among user

2nd year high school students: prevalence and mean frequency of use across 11 districts, 2004–2024 combined



Second-year high school students: prevalence and mean frequency by socioeconomic disadvantage, 2004–2024 combined



Limitations

- Self-report data subject to bias
- No data on quantity of use
- Context-specific to Sweden; may not generalize

Thank you for listening!

More results to come...

And a special thank you for making it possible for me to join you remotely.

I would have loved to be with you in the Faroe Islands!

Any questions? I am just an e-mail away: hakan.leifman@ki.se