

Cost-effectiveness Research Report:

A Healthy Israel Free of Smoking and Tobacco and Nicotine products

by Smoke-Free Israel

המיזם למיגור העישון
SMOKE FREE ISRAEL بلا تدخين

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¹ The research was conducted in the framework of Effective Altruism associations effectiveness assessment. Shira is Smoke Free Israel's CEO, Mickey is the data scientist of Smoke Free Israel, and Lior is Effective Altruism's representative.

Executive summary

- Tobacco usage is harmful, causing damage to life, and to the economy.
- Intending to reduce tobacco usage, Smoke Free Israel conducted two interventions in the Israeli tobacco market to increase the taxation of Roll Your Own Tobacco and IQOS (heated tobacco product) and match it to the cigarette tax burden. The cost of both interventions is roughly 146,000\$.
- We estimated the interventions' effectiveness using four yearly surveys ordered by Smoke Free Israel. We further validate our results using governmental data on tobacco imports, taxation data provided by the Israeli Tax Authority, and comparisons to similar countries.
- The interventions were found to reduce the tobacco users rate by 15.57%, thus making **each 115\$ donation to save the life of one man**, and another 30 others from serious smoking-related illness.
- The interventions' effectiveness is estimated to be **7.18 QALYS per dollar**, which means 7.18 additional years in perfect health per dollar donation.
- To ensure the effectiveness of those, and future interventions, taxation on all tobacco and nicotine products needs to be aligned to maintain a unified price threshold.
- Smoke Free Israel's future intentions are to match the tax burden on Hookah (Nargila) and the new tobacco product - E-cigarettes, to the cigarettes' tax burden. The estimated cost of the future interventions is 220,000\$, and they are required to maintain the reduction in tobacco usage in Israel with the same success rate (or more).
- Estimated QALY for future interventions is 4.30 per dollar donation.

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Introduction

The Tobacco Problem & The Intervention

Tobacco usage has already been recognized as an epidemic by the World Health Organization (WHO hence force). According to them, the Tobacco epidemic is one of the biggest public health threats the world has ever faced, killing more than 8 million people a year, including around 1.2 million deaths from exposure to second-hand smoke. Specifically, tobacco use is a major risk factor for cardiovascular and respiratory diseases, over 20 different types or subtypes of cancer, and many other debilitating health conditions. Not only first and second-hand smokers are affected by it, but the whole population. The economic costs of tobacco use are substantial and include significant healthcare costs for treating the diseases caused by tobacco use as well as the lost human capital that results from tobacco-attributable morbidity and mortality (WHO, 2022).

According to the Ministry of Health of Israel (2023) one out of every 5 Israelis smoke, meaning 1.87 million people. Smoking in Israel causes 8,000 deaths per year (Ministry of Health of Israel, 2017). Not only that, for every person who dies because of smoking, at least 30 people live with a serious smoking-related illness (WHO, 2011), meaning 240,000 Israelis with a serious smoking-related illness (2% of the country's population). QALY-wise, Jia & Lubetkin (2017) estimate that the potential gains if a person quit smoking would be at least 5.4 QALYs.

In this paper, we analyze the effectiveness of regulator interventions in the Israeli tobacco market that took place as a result of Smoke Free Israel's (SMI henceforth) interventions. With the intention to reduce the smoking rates in the country, the reviewed interventions increased the taxation of Roll your own tobacco (RYO) and heated tobacco product (IQOS). To achieve meaningful change, the organization works through the legislative and judicial authorities. The following figure displays the interventions and their effect on the products taxation a timeline:

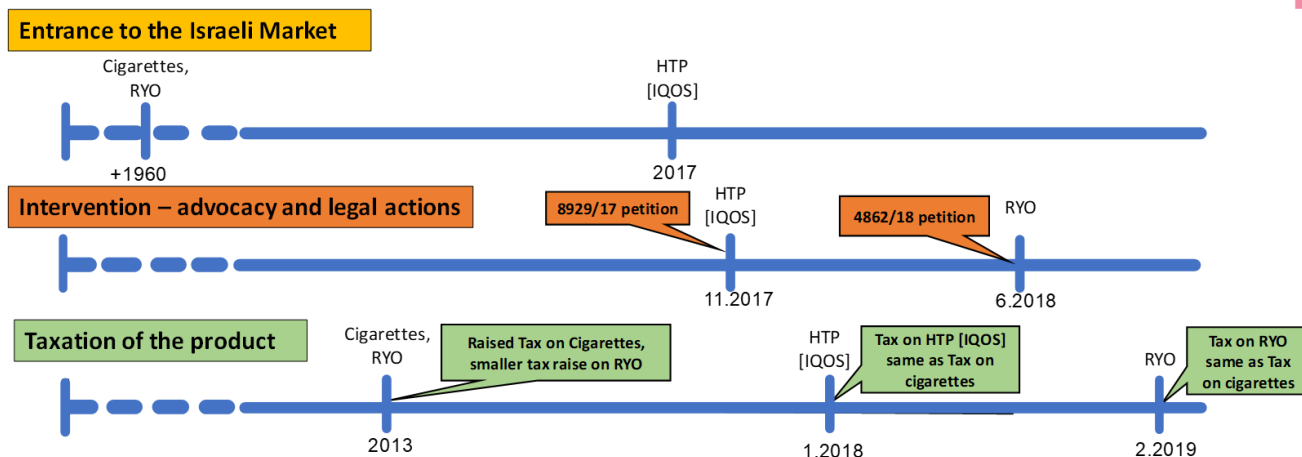


Fig 1: The Smoking Market in Israel: Products Entrance and Taxation. In 2013 cigarette and Roll Your Own Tobacco (RYO) tax was updated upwards, but unequally, making the RYO tax burden relatively lower. Following the RYO intervention it was compared in 2019. IQOS is a new heated tobacco product that entered the Israeli market in 2017. It was taxed as cigarettes in 2018 following another intervention, only a year after its market entry. The petitions: IQOS petition: HCJ 8929/17 Association for Progressive Democracy and others V. Minister of Finance RYO petition: HCJ 4862/18 The National Initiative to Eradicate Smoking - Smoke Free Israel and others V. Minister of Finance

The above figure displays the end product of the intervention, which was composed of data collection, several legal petitions, and lobbying and governmental relations, on which the organization works continually. The following table specifies the effect of the tested interventions on each product:

Regulated product	Date of application	Regulation Effect (As increase in tax burden)*	Legal reference
IQOS (Heated tobacco product)	January 2018	From 14.5% to 80% of price	Order on the customs tariff and exemptions and purchase tax on goods (amendment no.), 2018
Roll Your Own (RYO) tobacco	21 February 2019	From 59% to 80% of price	Customs Tariff Order and Exemptions and Purchase Tax on Goods (Amendment no. 4) 2019

Table 1: The Interventions. * As of today, after the regulation, both IQOS and RYO are taxed similarly to cigarettes - 270% of the wholesale price plus fixed tax per 1000 units/kilo, but no less than the fixed price per 1000 units/kilo. Beforehand, IQOS 14.5% as the tax burden is the 17% VAT that applies to all Israeli products. RYO 59% tax burden represents VAT and fixed tax by weight that was applied.

Literature review

Acknowledging Tobacco usage to be a pandemic, the WHO launched in 2003 the FCTC (Framework Convention on Tobacco Control) - a legally binding treaty that requires countries to implement evidence-based measures to reduce tobacco use and exposure to tobacco smoke. The FCTC includes a ratified policy package of interventions to reduce the demand for tobacco. The package was named MPOWER for its 6 evidence-based components: **M**onitor tobacco use and prevention policies, **P**rotect people from tobacco smoke, **O**ffer help to quit tobacco use, **W**arn about the dangers of tobacco, **E**nforce bans on tobacco advertising, promotion and sponsorship, and **R**aise taxes on tobacco.

Among the six evidence-based components for country-level implementation of effective interventions, increasing taxes on tobacco products was found to be the most effective to reduce the demand for tobacco. This result arises from Chaloupka et al. (2012), as well as Mannocci et al.'s (2019) umbrella review, which reviewed 13 systematic reviews and meta-analyses of health policy and health promotion on the effectiveness of tobacco policies and interventions.

According to 36 studies from 15 countries, a 10% price increase would reduce demand by: 8.3% for cigars (95% CI 2.9 to 13.8), 6.4% for 'roll your own' tobacco (95% CI 4.3 to 8.4), 5.7% for bidis (95% CI 4.3 to 7.1) and 2.1% for smokeless tobacco (95% CI -0.6 to 4.8) (Jawad et al., 2018). Though few studies there that examined cross-price elasticity suggested a positive substitution effect between cigarette and non-cigarette tobacco products.

Down-trading created by tax gaps between tobacco products undermines taxation effectiveness (Gallus et al., 2013). Morris & Tynan (2012) as well as Tynan & Morris (2014) display evidence for down-trading in the US tobacco market, occurring after RYO was taxed while pipe tobacco wasn't. Ross et al. (2017) argue that tobacco companies use tax gaps to minimize the full effects of tobacco tax increases. Hence, taxation needs to be comparable across all tobacco products to achieve maximum effectiveness by preventing 'down trading' to untaxed tobacco products.

To summarize, SFI promotes tax increase interventions, interventions approved by the WHO treaty on tobacco, and that were found to be the most promising in reducing smoking rates.

Methodology

Our goal is measured by two indicators: Reduction of tobacco usage in the population, and prevention of new users. The major difficulty of such measures is that they are population-wide – hence control groups are harder to find. For that, we use 3 setups: before-after, between countries, and between product compressions. When decreased usage is measured in all three, meaning less tobacco usage in absolute numbers, relative to similar products, and relative to the same product in other countries – the result is said to be significant. Aside from that design, we also use surveys to directly ask people if the specific intervention affected their smoking habits.

We use for this research several datasets to increase the reliability of our results. As for smoking habits, both surveys' data and national reports (on taxes and imports) are used. After estimating the effectiveness of the above interventions in units of tobacco users per intervention, we convert it to monetary units using the literature on Quality-Adjusted Life Years (QALY). QALY is a measure of the value of health outcomes in terms of length of life and quality of life, one QALY equates to one year in perfect health, 0 to death (Weinstein et. al, 2009). The interventions QALY is measured as follows:

$$\text{Population} \times \text{decrease smoking rate} \times \text{QALY per smoker} = \text{QALY gained}$$

According to Jia & Lubetkin (2017): “The potential gains if a person quit smoking would be 5.4 QALYs, and the gains would increase with a longer time since quitting as well as quitting at a younger age”. To increase accuracy in the ‘QALY per smoker’ we use Xu et. al.'s (2021) tables that specifies how QALY gained from quitting smoking differentiates depending on one's remaining life years, and smoking product.

For combusted tobacco products, Xu et al. (2021) used exclusive cigarette smokers to estimate the effect. This estimation suits the Roll Your Own Tobacco (RYO) which similarly to cigarettes is consumed by smoking the tobacco, and its use is estimated to have the same (or worse) health implication (Israel Medical Association, 2018; Cancer Council, n.d.; see *Appendix F* for detailed comparison):

QALY gained per smoker - Combusted Tobacco (Xu, et al., 2021))

Age group	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Current vs. Never users	8	7.7	7.4	7.1	6.7	6.3	5.7	5.2	4.6	4	3.4	2.9	2.5
Current VS. Former users	5.1	4.9	4.6	4.3	4	3.7	3.3	2.9	2.5	2.1	1.8	1.4	1.2

* In both tables, former users were those who have quit using tobacco for 2 or more years

Xu et al. (2021) estimations are lower than Jia & Lubetkin (2017) due to differences in the QALY assessments. We use Xu et al.'s (2021) estimations, according to the ages in which subjects reported quitting smoking (see Appendix E), which resulted with a weighted QALY per smoker of 4.75.

That is:

$$Population \times decrease\ smoking\ rate \times 4.75 = QALY\ gained$$

For future interventions QALY gained will be multiplied by the chance of their success, which is 90% (see section 'Room For More Funding').

Surveys' Data

Smoke Free Israel (SFI) orders surveys on various tobacco consumption topics in the Jewish population in Israel each year. The surveys are normally used within the organization to estimate their interventions, thus they include many questions, some of which are not relevant to this paper (such as e-cigarettes specific topics, or media effects), and were not reviewed. Nevertheless, the surveys' reliability is high given that they are outsourced and handled by an exterior company (each survey's company is detailed below). Moreover, the data and methodology from the 2018, and 2019 surveys were published in a peer-reviewed journal (Kislev & Kislev, 2020). The surveys' descriptive information is summarized below:

	2018	2019	2020	2021
Sample size	1,710	2,300	2,837	2,656
Participants' Ages (min, max)	12-74	12-84	12-70	12-80
Total number of question*	35+	35+	35+	35+
Demographics related	11	11	11	11
Directly research related	8	10	9	9
Platform	Online survey panel, "Midgam Project Panel"		Online survey panel, "IPanel"	
Dates	April 30–May 3, 2018**	April 19–May 7, 2019	March 26 - April 10, 2020 (partial lockdown)	March 31 - April 13, 2021

Table 2: surveys' description

* Only relevant questions were supplied, excluding ones relating to other products s.a. E-cigarettes.

** Small supplement was conducted on May 22, 2018.

All surveys are for ages 12 and above (the oldest participant was at the age of 84, in 2019's survey) Demographics questions were: Gender, age, atrial status, religious identity, town, years of education, occupation, income, country of birth (+immigration year), and formal education (e.g., undergraduate). Surveys were conducted on the Jewish population in Israel.

Surveys' summary statistics and demographics is detailed in Appendix A.

Results - Roll Your Own Tobacco (RYO)

Roll Your Own (RYO) is a cigarette made from loose tobacco (usually a shag cut) and rolling paper that the user rolls on its own - hence its name. RYO is a fairly common way to consume tobacco in Israel, as can be seen in the table below, about 15% of our survey participants who are in the legal age of purchasing tobacco products (18+) use it on a regular basis.

What tobacco products have you used last month? [Adults (18+)]

Mark what products have you used last month?	2018	2019	2020	2021
<i>Other products*</i>	293 (21%)	610 (30%)	1171 (48%)	1014 (44%)
<i>RYO</i>	205 (15%)	274 (13%)	378 (15%)	251 (11%)
<i>None</i>	901 (64%)	1177 (57%)	911 (37%)	1023 (45%)
Total	1,399	2,061	2,460	2,288

This was a multiple-choice question, meaning that some of the RYO users marked other products as well. Yet, the 'Other products' category here counts only those who used other products and did not use RYO.

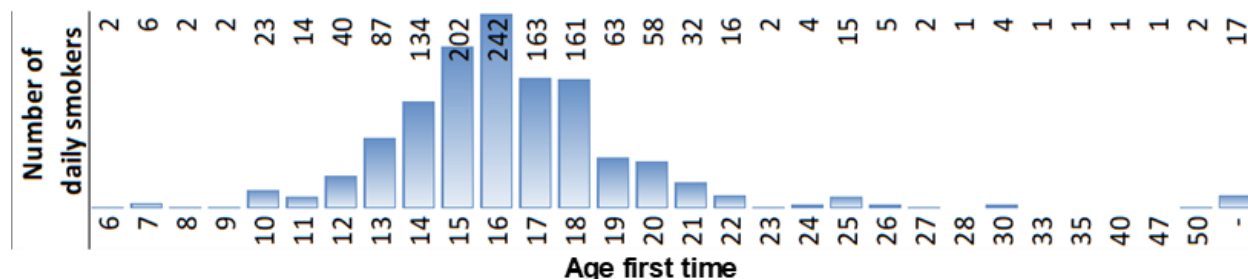
RYO Prevention

In 2013, the tax on cigarettes and Roll Your Own Tobacco increased but the tax on RYO was increased less, which created a price gap in its favor, hence causing lots of users to shift to it, and also lowered the price threshold for new users. To enumerate, in 2018, one year before the intervention, the tax burden out of its price was 59%, relative to 80% of packed cigarettes. In the 2018 survey, we asked RYO users why they started using it – the results were explicit:

Why did you start using RYO (2018)	Total
price	120 (56.6%)
smoke less	34 (16%)
always smoked it	19 (9%)
everybody shifted	10 (4.7%)
mix with other substances	9 (4.2%)
love making a cigarette	9 (4.2%)
pure tobacco	5 (2.4%)
health harm reduction	5 (2.4%)
other	1 (0.5%)
Total	212

Lower price threshold on tobacco products causes new users, who might never use tobacco to start doing so. As a new tobacco user, the age at which one starts highly affects his smoking habits in the future. In the following question, we asked all the participants who identified themselves as daily tobacco users – At what age have you started smoking?

At what age have you first smoked? [Daily smokers, 2019-2021 surveys]



It can be seen that younger ages are the most common ages to start smoking, for those who later become daily smokers. With what product does the young enter the tobacco market today?

What was your first product (age 12-19)?	2018*		2019		2020		2021	
	Spl.	Cal. %	Spl.	Cal. %	Spl.	Cal. %	Spl.	Cal. %
Packed cigarettes	67 (15.6%)	13.6%	130 (22.8%)	13.5%	148 (18.9%)	17.2%	119 (15.8%)	15.7%
Hookah	36 (8.4%)	6.1%	64 (11.2%)	7.7%	57 (7.3%)	4.9%	59 (7.8%)	6.8%
RYO	18 (4.2%)	2.9%	25 (4.4%)	2.4%	25 (3.2%)	1.6%	22 (2.9%)	1.9%
e-cigarettes	9 (2.1%)	1.5%	32 (5.6%)	3.5%	24 (3%)	3.2%	44 (5.9%)	4.9%
IQOS	0 (0%)	0.0%	0 (0%)	0.0%	0 (0%)	0.0%	3 (0.4%)	0.2%
Others	1 (0.2%)	0.1%	5 (0.9%)	0.5%	2 (0.3%)	0.2%	4 (0.5%)	0.5%
Never tried	298 (69.5%)	75.7%	314 (55.1%)	72.4%	529 (67.4%)	72.8%	501 (66.6%)	70.0%
RYO / All other products	14%	12%	10%	9%	10%	6%	9%	6%
Total	429		570		785		752	

Table 3 * Cal.% column refers to the calculated result after stratification (Smith, 1991). Means the percentage after adjusting subject weights according to differences between the sample and the population demographics.

In the above table it can be seen that RYO was the third most common entrance product. Moreover, since the RYO tax increase in Feb 2019 its share as an entrance

product decreased steadily in the following years. Fewer new RYO users in those ages means fewer new tobacco users, which means fewer future smokers.² We assume that the tax increase had such a strong effect because the young population is less wealthy, thus the price threshold is a key factor for them (Levy et al., 2016). This decrease is significant, though a big part of it might be attributed to new users who started with e-cigarettes, which are the cheaper alternative now as they are yet to be fully taxed.

By continuing with regulative initiatives, the price threshold of all tobacco products will increase, creating a high threshold for smoke-starts. As shown in the ages figure above, any prevention of smoke-start at young ages will save them from being future daily users. At this point, the exact prevention rates due to the RYO tax can only be assumed between 0 to 1% (2.9%-1.9%). In the next section we will dive into the exact rates of reduction in tobacco usage.

² We will note that users who did not start with RYO might enter the market with some other product (rather than not smoking at all). Yet we couldn't directly address this hypothesis, since addressing the market as a whole will be biased due to the pandemic quarantines, and direct questions in the form of 'why didn't you start smoking?' aren't reliable enough.

RYO Reduction in Tobacco Usage

We use several methods to estimate the RYO taxation effect on smokers. First, we asked them directly about that in the 2019 survey, 3 months after the RYO taxation was compared to that of cigarettes, and a year later in another survey:

How has the RYO taxation affected your use?

did the RYO taxation affect your use?	2019			2020		
	Responders	Cal. %	95% CI	Responders	Cal. %	95% CI
No, I did not smoke before	1816 (79.1%)	80.8%	[79.2%, 82.4%]	2253 (80%)	85.4%	[84.1%, 86.7%]
No, I smoked the same	285 (12.4%)	11.2%	[9.9%, 12.5%]	319 (11.3%)	7.3%	[6.3%, 8.3%]
Yes, the black market	18 (0.8%)	0.8%	[0.4%, 1.2%]	43 (1.5%)	1.6%	[1.1%, 2.1%]
Yes, shift to packed cigarettes	57 (2.5%)	1.8%	[1.3%, 2.3%]	85 (3%)	2%	[1.5%, 2.5%]
Yes, shift to e-cig	19 (0.8%)	0.9%	[0.5%, 1.3%]	26 (0.9%)	0.7%	[0.4%, 1%]
Yes, shift to JUUL	38 (1.7%)	1.8%	[1.3%, 2.3%]	24 (0.9%)	0.6%	[0.3%, 0.9%]
Yes, shift to IQOS	3 (0.1%)	0.1%	[0%, 0.2%]	1 (0%)	0%	[0%, 0%]
Yes, I stopped smoking	55 (2.4%)	2.3%	[1.7%, 2.9%]	64 (2.3%)	2.3%	[1.7%, 2.9%]
Yes, other	4 (0.2%)	0.3%	[0.1%, 0.5%]	3 (0.1%)	0.1%	[0%, 0.2%]
Total	2,295			2,818		

Table 4: RYO taxation effect on use. Cal.% column refers to the calculated result after stratification (Smith, 1991). For the 2019 survey, X-squared = 10989, df = 8, p-value < 0.001. For 2020 survey, X-squared = 13765, df = 8, p-value < 0.001. Missing data in 2019's survey were filled according to similar questions asked in that survey.

In both surveys, 2.3% out of the entire population stated that the taxation caused them to stop smoking completely (or 15.75% fewer smokers³). To back up this result we use the annual Minister of Health's report on smoking in Israel for 2021 which was published recently (Ministry of Health of Israel, 2023).⁴ The report details yearly RYO imports (in Kilograms).

³ The active smokers population in 2020 was 1-85.4%=14.6%. Then 2.3%/14.6%=15.75% is the rate of the population who stopped smoking, out of the smokers population.

⁴ Other reasons to stop smoking are mainly health reasons (See Appendix A). Also, COVID-19 lockdowns at the time of the intervention might have affected national smoking rates (Appendix D). Moreover, often there is more than one reason to quit, thus in the survey we asked directly about the effect of the intervention, so that other reasons affecting the national smoking rates do not interfere with the results (other reasons to quit were asked earlier in the survey, and are detailed in Appendix A).

Yearly Imports of RYO to Israel (Kilograms)

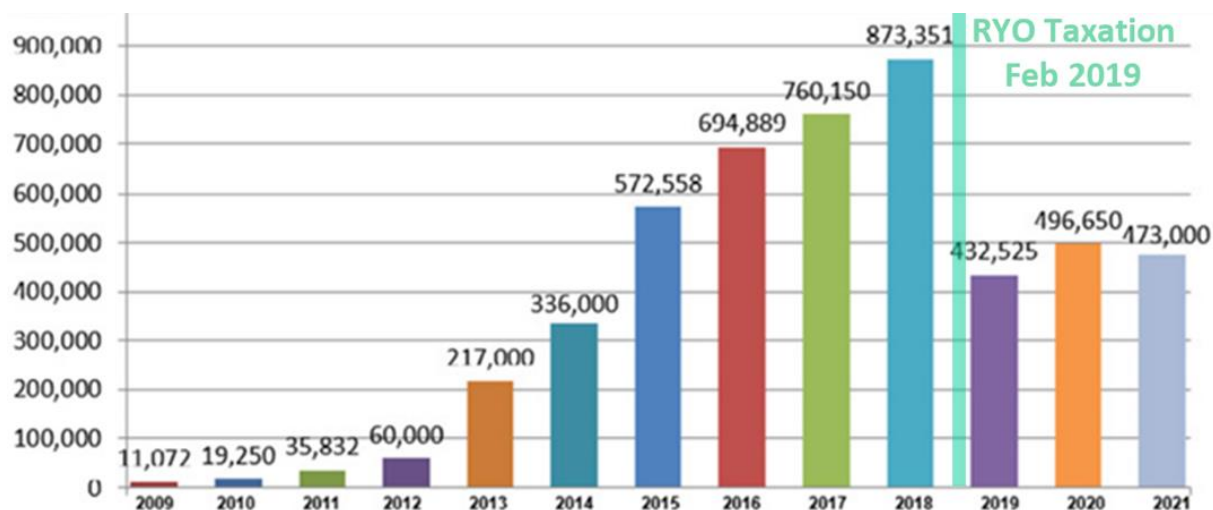


Figure 2: Yearly Imports of RYO to Israel (Kilograms) 2009-2021

All RYO products in Israel are imported, meaning that the clear decrease in its imports right after the taxation directly implies a reduction in the RYO use in the population. Precisely speaking, consumption was cut in half right after the taxation.

Sometimes when one product gets more expensive, instead of stopping using tobacco products at all, customers turn to alternative products (Morris & Tynan, 2012; Ross et al., 2017; Tynan & Morris, 2014). To test if the RYO taxation caused such a trade, we use national taxation data on tobacco products, as published by the Israeli Tax Authority (and can be found online on [their official site](#)). We collected monthly data on the total sales volume, and the sales tax of tobacco products in Israel, which are distinguished (by the tax authority) into two categories: “Packed cigarettes”, and “Other tobacco products”. The latter includes Roll Your Own (RYO) tobacco, hookah tobacco, pipe tobacco, cigars, and heated tobacco (IQOS). 2017-2022 data is displayed below, with a mark for the reviewed tax intervention for a before-after analysis:

Tobacco Products Sales Value In Israel

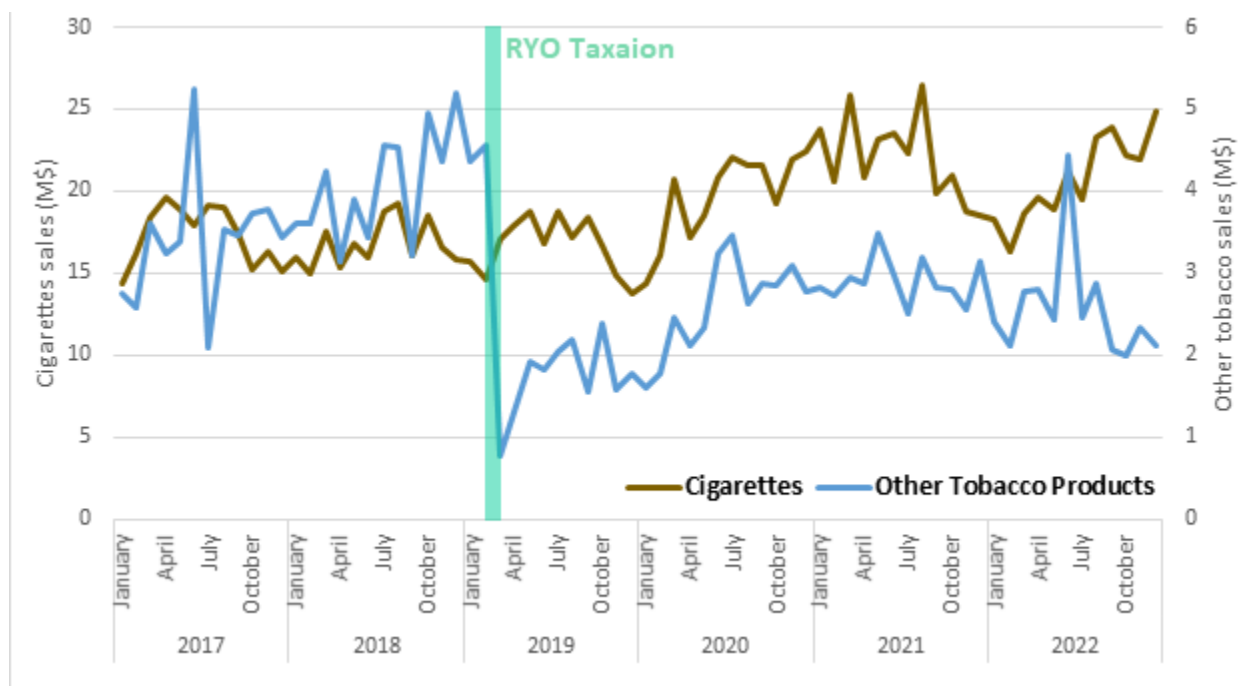


Figure 3: Tobacco Products Sales Value in Israel 2017-2022

In the above figure a precise decrease in the Other Tobacco Products (which includes RYO) can be seen right after the taxation. The decrease is unique to this category, and it is not reflected in the Cigarette market, which is the main RYO alternative. Meaning that the RYO taxation had directly caused people to reduce smoking, and almost no change to other products.

According to the Israeli Tax Authority data shown in *Figure 3*, the monthly average sales of tobacco products before the taxation (quarter 4 of 2018) was 21.8M\$, while after the taxation (quarter 2 of 2019) it was 19.5M\$. It is a 14% decrease in the total Israeli tobacco sales. Though this assessment method also accounts for many other events and trends that affected the smoking habits of the population⁵, making it hard to rely on it for longer periods.

⁵ According to INHIS surveys, the rate of smokers in the Israeli adult population increased by 1% each year during 2012-2016, from 17.7% to 21.6% (no 2017 data). In 2018 (the year of IQOS intervention) it dropped from 21.6% to 19.8% in 2018, and then to 20.1% in 2019 (RYO intervention & COVID-19). NHIS results for the following years are yet to be published (Ministry of Health of Israel, 2023).

We will note that although the taxation halved the usage amount, it actually still increased the Israeli tax income from tobacco products, as can be seen in the following data, also taken from the Israeli Tax Authority:

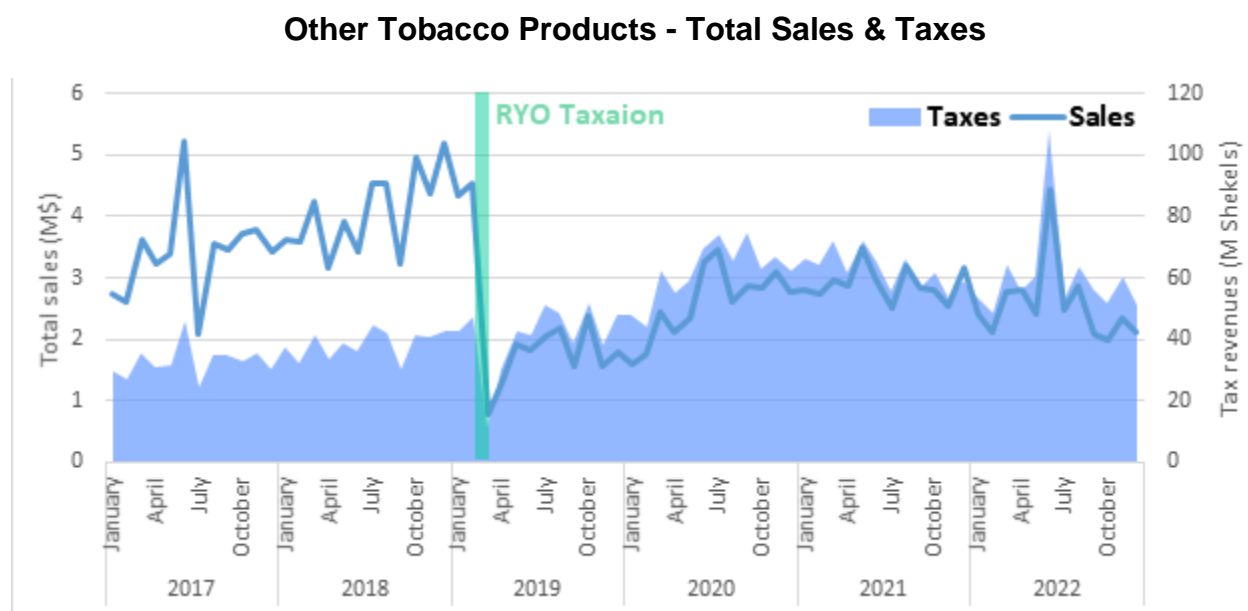


Figure 4: Other Tobacco Products Sales Value & Taxes in Israel 2017-2022

RYO Effectiveness - Summary & Discussion

For 5 years there was a cigarette-RYO tax gap causing RYO sales to increase, and many users started smoking it due to its low price. The tax gap was fixed only after the examined taxation intervention. We use several methods to estimate the RYO taxation effect on the population's tobacco consumption from then. While the prevention of smoke-starts was difficult to estimate, we could clearly show that active users stopped smoking. This result is backed up by a direct question in which the survey's subjects stated that the taxation caused them to smoke less, and also in nationwide data on imports and taxation of tobacco products.

Moreover, according to the Israeli Ministry of Health's data in Figure 2 RYO tobacco imports decreased by 50% after the taxation and stayed that low for years later. Furthermore, according to the Israeli Tax Authority data shown in Figure 3, the sales of the entire tobacco market decreased by 14% after the taxation. The safest estimation arises from SFI surveys, according to it, 2.3% of the population have stopped smoking completely directly because of taxation which leveled the taxation between all products.

We calculate the intervention effectiveness according to this safest estimation:

$$\begin{aligned} \text{Population} \times \text{decrease smoking rate} \times 4.75 &= \text{QALY gained} \\ 9,600,000 \times 2.3\% \times 4.75 &= 1,048,800 \text{ QALY gained} \end{aligned}$$

1.05 million QALY relative to 73,000\$ intervention cost means **14.37 QALY per dollar**.⁶

To further enumerate, according to *Table 4* the intervention effect of 2.3% population decrease, is 15.75% decrease out of the smokers population. According to the Ministry of Health of Israel (2017), smoking in Israel causes 8,000 deaths per year. 15.75% decrease from 8,000 means that the intervention is estimated to save 1,260 lives per year. Not only that, for every person who dies because of smoking, at least 30 people live with a serious smoking-related illness (WHO, 2011). That means another 4,726 healthy people saved from serious smoking-related illness for that intervention alone.

⁶ The likelihood of success in future interventions is detailed in chapter "Room for more funding". Other effects of this intervention are increased tax incomes and reduction in the smoking periodicity of people that still smoke. Despite their positive QALY gain, they are omitted from this calculation since they are too ambiguous.

IQOS Results and Discussion

At the beginning of 2017, Philip Morris International Inc. launched its new tobacco product in Israel – IQOS. During that year, IQOS was not taxed at all (excluding VAT). To enumerate, the pack of cigarettes tax burden is estimated to be as high as 80%, while the IQOS tax burden included only 14.5% VAT at the time (Rosen & Kislev, 2018). Almost a year later, following the SFI and the Israeli Association for Progressive Democracy action, on Jan 17th, 2018 the minister of finance signed the taxation order that compared the IQOS tax burden to that of cigarettes. The following table presents IQOS users in Israel:

What tobacco products have you used last month?

Mark what products have you used last month?	2018	2019	2020	2021
Other products *	523 (31%)	913 (40%)	1600 (56%)	1333 (50%)
IQOS	9 (1%)	22 (1%)	14 (0%)	25 (1%)
None	1178 (69%)	1365 (59%)	1223 (43%)	1298 (49%)
Total	1,710	2,300	2,837	2,656

* This was a multiple-choice question, meaning that some of the IQOS users marked other products as well. Yet, the 'Other products' category here counts only those who used other products and did not use IQOS.

Comparing this result to global usage data of the same product in similar countries, Israel's usage rates are much lower:

Rate of IQOS Active Users - World Compression

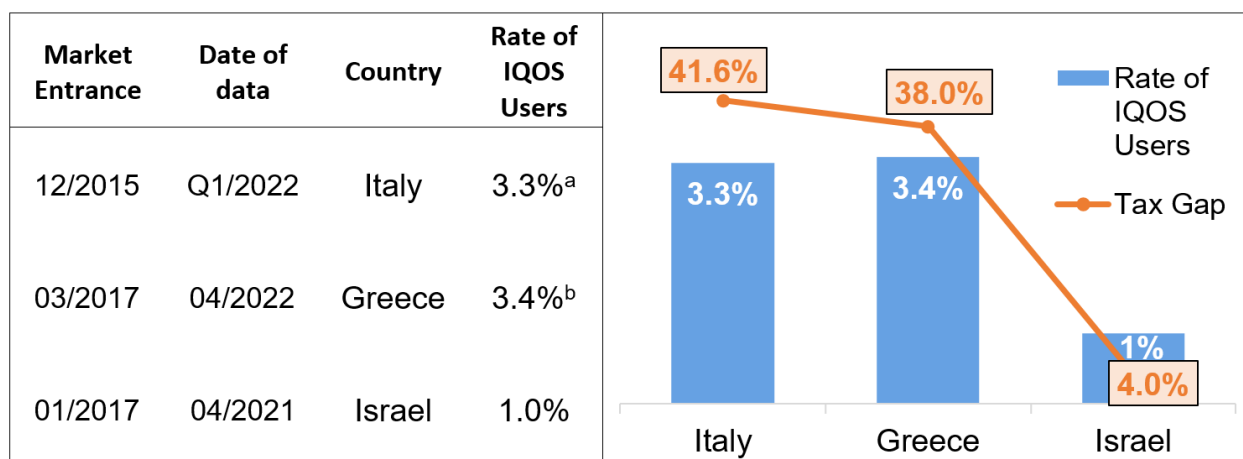


Figure 5: IQOS worldwide. Tax gap data is from [Heated Tobacco Products Tax Gap Map: Excise Tax Gap \(2023\)](#), and it was unchanged for the years 2020-2023. The tax gap is calculated as Cigarettes tax burden – IQOS tax burden.

^a [Istituto Superiore di Sanità \[ISS\]](#), 2022

^b Interview with PMI CEO published in [Ellis \(2022\)](#)

The above shows that in Israel the rate of IQOS users is lower compared to other similar countries by 2.3%. Israel's low rate of IQOS users is attributed to its low tax gap between cigarettes and IQOS, which prevented users from becoming users of the new product. This result matches the 2.3% decreased smokers rate displayed in the RYO section.

When one product is taxed, the RYO in this case, while the other aren't, 'down trading' often occurs – instead of stopping using tobacco people shift to the cheaper product. Since the taxation on IQOS and RYO was almost simultaneous, we assume that the IQOS taxation year earlier stopped the down-trading from RYO when it was taxed. This result is backed in *Table 4* where we asked the subjects how the RYO taxation has affected their use – less than 0.1% have stated that they change their product to IQOS.

This means that the effectiveness of tax interventions in the market are not additive, but supplementary to each other, creating a price threshold for tobacco use. There are several evidences of down-trading occurring when one product wasn't taxed the same (Jawad et al., 2018). For that, we don't assume the IQOS taxation to prevent another 2.3% of the population from using tobacco, but supplement the RYO intervention. We will safely assume that the entire prevention was supplementary, not preventing any tobacco use on its own.

$$\text{Population} \times \text{decrease smoking rate} \times 4.75 = \text{QALY gained}$$

$$9,600,000 \times 2.3\% \times 4.75 = 1,048,800 \text{ QALY gained}$$

That is roughly 1.05 million QALY. Relative to both interventions (RYO + IQOS) instead of one, making its costs 146,000\$, which means **7.18 QALY per dollar**.

Research Limitations

The effectiveness of prevention is hard to predict, 'What would happen without the intervention?'. Prevention takes place in two areas of our research. First, in the effect of preventing youth from initiating smoking and getting addicted – The estimation there was so ambiguous that we chose not to include youth smoke prevention in the final effectiveness estimation. Answers to questions in the form of "Why didn't you ever start smoking?" are commonly unknown to the subjects themselves. Not just whether our intervention caused people not to start, but if it did – for how long it helped, and how much would they smoke without it? Thus, we focused on the effectiveness of our interventions in reducing smoking rates. Even though any intervention that caused people to smoke less probably caused some to never start, we chose to neglect the prevention effect.

Secondly, prevention is expressed when a new product emerges on the market. Heated Tobacco Products (IQOS) is a new brand of tobacco products emerging worldwide. When preventing the use of a new product, people don't 'leave' it, but rather just don't start using it. For that, we assumed on the safe side that any decrease in the IQOS use rate compared to other countries is replicable with other tobacco products, thus effectively reducing the additional effect of this intervention to 0.

Moreover, stopping a product in its early market penetration phase prevents the tobacco market from refreshing, which affects the market in the long run. Yet, we could only estimate the decrease in the smoking rates of IQOS today, and so did not include other effects like additional customers, or longer-lasting use of tobacco products of current consumers that would occur as a result of market variety enrichment.

Lastly, in the RYO section, we had a lot of data sources that point out decreased use of the product. The data published by the Ministry of Health suggested a 50% decrease in imports, and the Tax Authority suggested a 14% decrease in sales value. We chose the estimation that arises from the direct survey question – since it is the final customer experience, unaffected by the black market or other reasons. It was also close to the lower limit of effectiveness out of all of the data sources, making it a 'safe' option - a 15.75% decrease, or alternately 2.3% decrease from the entire population.

Coupled with the above, 2019 and 2020 were not 'regular' years. In January 2019 a law that bans advertising and limits the marketing of tobacco and nicotine products got into force. It was applied in four phases, relevant limitations took place in the phases of March 2019, 01/01/2020. 01/03/2019 - ban on advertising. 01/01/2020 - Limits on marketing (Details on all phases are in Appendix D). Additionally, the COVID-19 epidemic started in Israel in March 2019 and its regulatory effects regarding the epidemic (lockdowns) took place until 2021. The lockdowns, coupled with mental stress resulting from the epidemic, affected the population's smoking habits (Kislev & Kislev, 2021, p.8 for adults, p. 15,17 for youth). Since both took place after the RYO intervention (01/2019), and we had monthly tax data, we could still estimate its effect in a 'clean' manner for the first quarter of 2019. Yet, long-lasting estimations after the epidemic, as well as some of the yearly surveys' data may be biased by those events. For that, we avoided presenting the public smoking habits using the surveys' data alone and backed up our results using the monthly tax data.

Method-wise: (A) we could not find QALY estimation for ages younger than 25. Thus we chose the lowest limit, which was the estimation for the ages of 25-29 itself. We further chose to rely on the article that provided lower estimations. (B) We only addressed QALY gained from stopping smoking. Although there are pieces of evidence for a reduction in smoking periodically, they were ignored since they are too ambiguous to measure, as well as their health gains.

To summarize, we estimate that the intervention effect is bigger, especially because of the prevention. Yet, we could not support this argument. Furthermore, for the RYO effectiveness estimation, we used the survey data which is at the lower bound of our three sources estimations. We assume that prevention plays a key role in creating a smoke-free society. Though it is too soon to be able to estimate its effect now, we urge future research on the subject.

Room for More Funding

Acts of product taxation affect the entire population and that is what makes them so cost-effective. The effectiveness of fast reaction to new emerging products is a key point to prevent smoking rates from increasing. The IQOS example in this paper is a good case study, as Israel was the first country to tax it like cigarettes. Countries that delayed that taxation, like Italy, suffer from increased smoking rates in recent years. We assume that by fast reactions to the market, one can prevent new users from getting addicted to tobacco and joining the smoking market, as well as prevent down-trading.

SFI costs for the surveyed interventions are:

Section	Description	Total Costs (USD)
Program Administration	Costs of all full-time staff who worked throughout all phases of the intervention and implementation (not just for a portion of the intervention) and other costs related to program administration. Include any overhead costs here. Please do not include staff that were hired only to identify potential program recipients, or staff costs associated with evaluating the program.	\$14,852.42
Targeting	Costs that were incurred to target, identify, and raise awareness among potential subjects as part of the intervention. Targeting/identification costs may include costs of a pre-program census or targeting survey given to identify those within a specific region who are eligible and meet certain criteria. This category also includes marketing costs, such as the costs incurred to print and distribute flyers or host information sessions.	\$17,263.24
Implementation Costs	Costs of implementing the intervention. This can include the costs of items distributed to participants or the costs of creating and maintaining technologies or resources developed for the intervention.	\$113,902.14
Total:		\$146,017.80

The main implementation costs are detailed in Appendix B.

The taxation interventions reviewed in this paper are complementary. To maintain their effectiveness all tobacco products should be taxed the same, resulting in a unified price threshold in the tobacco market. The years between 2013 to 2019 when the RYO was taxed lower than Cigarettes are a good example of that – due to the tax gap, the RYO has received a substantial market share. On the other hand, the IQOS is a good example of a unified price threshold, in this paper, we show how the IQOS taxation contributed to preventing the down-trade of 2.3% of the population

Since tobacco products’ taxation interventions are complementary, similar interventions on other tobacco and nicotine products, specifically e-cigarettes and

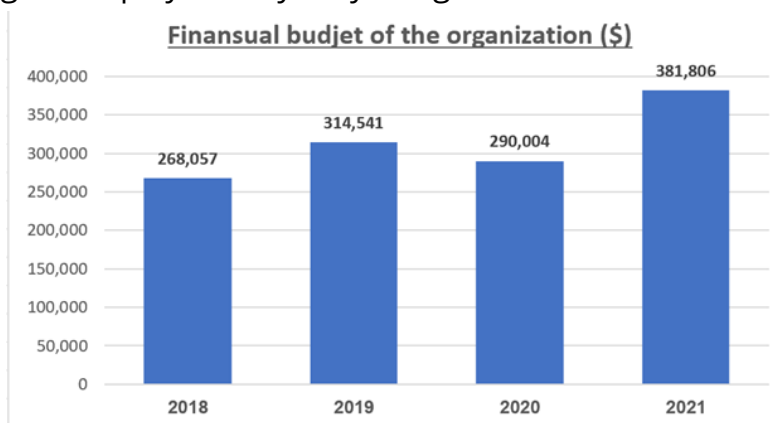
Hookah, are expected to be at least as effective as the above, preventing down-trading for the following years. The following plans are designated for more funding:

Plan	Estimated Cost
New Products* - Continue with the work on taxation of other Tobacco and nicotine products	\$170,000
Monitor tobacco use and prevention policies – includes deeper surveys and analysis of interventions	\$20,000
Awareness: Policy makers – Raise awareness to tobacco and nicotine harmfulness within the policy makers (conferences, lobbying)	\$30,000
Subtotal:	\$220,000

*New products are calculated of 50,000\$ remaining to complete the taxation on e-cigarettes, 120,000\$ needed for Hookah.

The SFI uses preparation work, and background checks to prove policy and regulation processes from the world, alongside surveys and fitting the Israeli smoking and regulatory characteristic, and to the local politics. This method of work has proven high success rates for promoting regulation. Another advantage is that each taxation approved makes the following one easier. For that, and because e-cigarette intervention has already started, future interventions are estimated with at least 90% success for that funding with at least the same QALY gain. Means 4.30 QALYS per dollar donation ($1,050,000/220,000 \times 90\%$).

The following figure displays SFI’s yearly budget since its foundation:



Summary and Conclusions

Tobacco usage is harmful, causing damage to life, and to the economy. Thus tobacco usage has been recognized as an epidemic by the World Health Organization. The most effective way to deal with it is by increasing taxation on tobacco products.

SFI has led to increased taxes on two tobacco products and matched them to cigarettes: Roll Your Tobacco (RYO) and IQOS – a heated tobacco product. Thus creating a unified price threshold for tobacco products. Using surveys, governmental data, and comparison to other countries, we find the combinations of the interventions to result in 2.3% of the population fewer smokers, which means 220,800 people. To enumerate its effect, we find it to save the lives of 1,260 people per year, and save many more people from smoking-related diseases.

The cost of both interventions is roughly 146,000\$. Making each 115\$ donation to save the life of one man, and another 30 others from serious smoking-related illness. QALY wise, **7.18 QALYS per dollar**. Future interventions are expected to succeed at 90% with at least the same QALY gain. Means 4.30 QALYS per dollar donation ($1,050,000/220,000 \times 90\%$). The highly effective results of these interventions relative to their cost are a result of the taxation effect on the entire population.

Also note that there is another indirect wealth achieved when increasing the tax on tobacco products – the taxes themselves. Even though the population consumed less, the country earned more taxes that are routed to better use (*Figure 4*).

All the above also regards the reduction in the smokers' population. Moreover, there is a prevention effect happening when taxes are raised that prevents youth from becoming tobacco users, yet this effect was too ambiguous to be counted in the intervention effectiveness. Future research is needed to estimate the effect of the prevention caused by taxation.

We find that a unified price threshold on all tobacco products is a key factor to reduce tobacco consumption. Thus future interventions are planned to address the entrance of e-cigarettes to the Israeli market, which is yet to be taxed as cigarettes. Also, the Hookah, which is a relatively popular product in Israel is yet to be taxed as cigarettes.

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Appendix A - Surveys' Summary Statistics

Demographics

		2018	2019	2020	2021
Gender	Male	965	1,205	1,443	1,453
	Female	745	1,095	1,394	1,203
Religious identity	religious	384	393	449	547
	secular	639	1,152	1,356	873
	traditional	465	460	929	753
	ultra-orthodox	221	295	103	483
Age group	Age 10 - 14	42	27	202	91
	Age 15 - 17	269	212	175	277
	Age 18 - 19	164	335	413	391
	Age 20 - 24	498	729	898	815
	Age 25 - 29	259	257	254	232
	Age 30 - 34	285	192	277	222
	Age 35 - 49	96	188	283	398
	Age 50 - 64	67	215	267	111
	Age 65 and above	30	145	68	119
District	Center	467	663	882	735
	Haifa	194	237	375	312
	Jerusalem	208	312	233	323
	Judea and Samaria	172	153	173	130
	North	128	201	306	350
	South	242	276	352	327
	Tel-Aviv	284	458	516	479
	Unknown	15	2300	2837	2656
Total		1,710	2,300	2,837	2,656

Smoking Habits

Do you, if at all, smoke or vape?	2018*	2019	2020	2021
<i>Every day</i>	281	422	507	378
<i>Once a week</i>	190	156	201	180
<i>Rarely</i>	47	233	458	377
<i>Smoked for a certain period (at least two month) and then stopped completely</i>	314	285	206	166
<i>Tried once or twice but didn't continue</i>	11	345	286	294
<i>Never tried</i>	865	859	1179	1261
Total	1,708**	2,300	2,837	2,656

* In the 2018 survey, possible answers for that question were different than the rest of the years.

** Two answers were removed, since participants reported “other” smoking habits, though supplied meaningless text inputs (s.a. “gnvijs”)

Why stopped?	2018	2019	2020	2021
<i>Price</i>		18 (5%)	7 (3%)	3 (1%)
<i>Health issues/concerns</i>		226 (65%)	125 (46%)	98 (40%)
<i>Other*</i>		105 (30%)	142 (52%)	141 (58%)
Total	-	349	274	242

* Other includes 15 possibilities: ‘Due to friend or spouse stopped’, ‘no one to borrow from’, ‘It bothered my spouse’, ‘pregnancy’, ‘rehab workshop’, ‘I felt addicted’, ‘Just did’, ‘Smell’, ‘Change in family status (married, had children)’, ‘other’ (open text).

** While less than 5% stated ‘Price’ to be the reason to quit smoking, the real number is higher (as can be seen in a direct question about price effect on RYO smoke). Yet subjects could only mark one out of more than 15 answers, while more often there is more than one reason to quit smoking. So even at times where the price was the ‘deal breaker’, other reasons like Health issues have been marked.

Appendix B - Detailed Implementation costs

Labor	\$34,160.05	For CEO, Statistics, and Medical expert time spent on the above interventions.
Legal representation of Smoke Free Israel	\$23,013.90	Representation for two lawsuits.
Legal representation of for the Israel Association for Progressive Democracy	\$3,372.00	est. value
Legal representation of for the Israeli Medical Association	\$5,620.00	Rough est.
Legal consulting (internal)	\$9,082.40	
Advocacy & Policy	\$9,764.47	
Public relation	\$6,213.75	
New media	\$3,641.76	
New media	\$4,215.00	for 3 different <u>campains</u>
Data Suppliers	\$14,341.96	Surveys 2019, 2020, 2021
Subtotal:	\$113,425.28	

Appendix C - Statistical Tools and Inferences

We used stratification to adjust the survey's data to the population demographics ([Stata manual](#), slide 3 / Smith, 1991). When used, both the unadjusted result and the adjusted one are displayed (the adjusted is under the column "Cal.%"). For the stratification we used age, district, and gender. Population demographics are according to the Israeli's Central Bureau of Statistics. When only a few subjects answered, specifically in the IQOS section, stratification was not displayed.

For the stratification and further statistical inferences we used R:

R Core Team (2023). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>

And for CI calculations we used MOE package:

Dahlgren P (2023). *moe: Calculate Margin of Error for Simple Probability Samples*. R package version 0.9.1, <https://github.com/peterdalle/moe>

Appendix D - Other Changes During the Intervention Period

COVID-19 pandemic

December/2019 - Virus spread in China.

27/02/2020 - First infection in Israel.

11/03/2020 - COVID-19 was declared as a worldwide epidemic by the WHO.

14/03/2020 - Prohibition on a gathering of more than 10 people.

15/03/2020 - Closing schools.

19/03/2020 - first lockdown, 100 meters from home.

18/09/2020 - 17/10/2020 - Second lockdown.

27/12/2020 - January/2021 Third lockdown.

January/2021 - 06/02/2021 - Partial lockdowns

Dates of events are according to the State Comptroller's Office and Public Complaints Commission of Israel (2021), with adjustments to lockdowns' end-dates and partial lockdowns made according to a report published by the Ministry of the Environment of Israel (2021).

Law Prohibiting Tobacco and Smoking Product Advertising and Marketing

At the beginning of 2019, the law regarding the advertising and marketing of tobacco and smoking products was updated. It was applied in four phases:

01/01/2019 - immediately when the law passed:

- Prohibition on selling e-cigarettes to minors (under the age of 18).
- Prohibition on smoking e-cigarettes in public places.

01/03/2019 - Two months after the entry into force of the law:

- Prohibition of tobacco and smoking products published anywhere (including online), discluding printed papers which had to include a warning in the size of 30% of the advertisement size.
- Removing tobacco and smoking products images from websites that sell them - only a list of product names is presented to the customer.
- Limitations regarding e-cigarettes (nicotine concentration, child-proof mechanism for the filling liquid)
- No free distribution of tobacco and smoking products.
- Mandatory mark of tobacco products and additional bulletin in the package (depends on the Ministry of Health).

01/06/2019 - Half a year after the entry into force of the law:

- Duty-free tobacco and smoking products must be the same as the products inside the country (must include Hebrew and Arabic warnings).
- No fruit or vegetable images on smoking packages.
- No candies in the shape of cigarettes.

01/01/2020 - A year after the entry into force of the law:

- Prohibition on presenting smoking products for sale (must be covered in the stores).
- A warning must be printed on both sides of the smoking product's package.
- Plained packages to all smoking products, the name of the product will be noted in gray.

Appendix E - QALY Differences by Age

Estimated QALYs lost associated with cigarette smoking status, overall and by sex.

Age (years)	Overall			Male			Female		
	Current cigarette smokers vs. never users	Former cigarette smokers vs. never users	Current cigarette smokers vs. former smokers	Current cigarette smokers vs. never users	Former cigarette smokers vs. never users	Current cigarette smokers vs. former smokers	Current cigarette smokers vs. never users	Former cigarette smokers vs. never users	Current cigarette smokers vs. former smokers
25-29	8.0	2.9	5.1	8.1	2.7	5.4	7.7	2.6	5.1
30-34	7.7	2.9	4.9	7.7	2.7	5.1	7.4	2.6	4.9
35-39	7.4	2.8	4.6	7.4	2.6	4.8	7.1	2.5	4.6
40-44	7.1	2.8	4.3	7.1	2.6	4.5	6.8	2.4	4.4
45-49	6.7	2.7	4.0	6.7	2.5	4.2	6.5	2.4	4.1
50-54	6.3	2.6	3.7	6.2	2.4	3.8	6.0	2.3	3.8
55-59	5.7	2.4	3.3	5.6	2.2	3.5	5.6	2.1	3.4
60-64	5.2	2.3	2.9	5.0	2.0	3.1	5.1	2.0	3.1
65-69	4.6	2.1	2.5	4.4	1.8	2.7	4.5	1.8	2.7
70-74	4.0	1.9	2.1	3.8	1.6	2.2	4.0	1.7	2.3
75-79	3.4	1.7	1.8	3.2	1.4	1.8	3.4	1.5	1.9
80-84	2.9	1.5	1.4	2.6	1.2	1.4	2.8	1.3	1.5
85+	2.5	1.4	1.2	2.3	1.1	1.2	2.5	1.2	1.3

Table E.1 QALYs assessment for cigarette smokers, quitters, and never-users (prevention).

Taken from Xu et. al, (2021). No significant difference between genders.

Age group	Subjects that quit smoking because of taxation	QALYs - Current vs. former smoker (Xu et al., 2021)	QALY by Weighted age average
14-17	5.04%	5.1*	0.26
18-24	49.58%	5.1*	2.53
25-29	8.40%	5.1	0.43
30-34	15.13%	4.9	0.74
35-39	3.36%	4.6	0.15
40-44	2.52%	4.3	0.11
45-49	4.20%	4	0.17
50-54	2.52%	3.7	0.09
55-59	4.20%	3.3	0.14
60-64	1.68%	2.9	0.05
65-69	2.52%	2.5	0.06
70-74	0.84%	2.1	0.02
Total	100%		4.75

Table E.2 QALYs assessment - Sample average. * Both literature estimations for QALY gained when quitting smoking are for ages 25 and above (Xu et al., 2021; Jia & Lubetkin, 2017). In our survey, the majority of quitters are younger than that. Since QALYs gained increases for younger ages of smoking, we safely assumed it to be equal. Namely, that the gain for the ages of less than 25 is equal to the gain at ages 25-29. Furthermore, the age group of 14-17 better accommodates the prevention category, meaning the QALY gained for this age group is for smokers compared to never smokers - which is at least 8.0 QALYs (*Table E.1; RYO - Prevention* section relates to age of smoking and future use). Yet, since some of them do not smoke for 2 years, and since this group is too small, we avoided further assumptions and set their QALY to be 5.1 like the older ones.

When assumptions were needed, we used the safest assumption to get the lowest QALY estimation (assumptions are detailed below in *Table E.2*). This resulted in a relatively low QALY gain for the intervention. Our QALY estimation per quitter is 4.75. This is lower than the 5.4 that Jia & Lubetkin (2017) estimated as the minimum for a person who quit smoking, and it is lower than all of Xu et al.'s (2021) estimations for ages less than 35. Thus we find it safe enough.

Appendix F - Health effect of RYO compared to cigarettes

According to a legal opinion provided for the RYO taxation intervention, RYO is more addictive and more harmful than cigarettes. (Israel Medical Association, 2018). They detail their opinion according to the following studies:

RYO users may be more exposed to nicotine, tobacco, and other harmful chemicals compared to cigarettes (Darrall et al., 1998). RYO users may smoke more per unit, intake more smoke, and for longer periods (Laugesen et al., 2009). According to data from Australia, Canada, Britain, and the US: RYO is characterized to be more addictive (7), and are less likely to try to stop smoking (Leatherdale et al., 2009).

A study made in Norway found the risk for lung cancer to be higher (almost doubled) for RYO smokers relative to packed cigarettes (De Stefani et al., 1992). Moreover, studies found RYO users to be at higher risk for esophagus cancer compared to packed cigarette smokers (De Stefani et al., 1998).

There is a myth that RYO is natural, and contains fewer additives compared to packed cigarettes. Yet, following a request by the New-Zealand government WD & WO Hills tobacco company published a document in which packed cigarettes contain 0.2% additives from their weight, while 22.5% in RYO (Simon, 2003). The same publication also reports abnormally high levels of pesticides in RYO. Toxicological studies demonstrated that RYO has stronger genotoxic and oxidative effects compared to cigarettes (Kocyigit et al., 2011) and its chemical emissions are not lower (Marcilla et al., 2011). A study made on rats found RYO to be more addictive than cigarettes for the same nicotine levels, suggesting that there are other addictive ingredients in it (Brennan et al., 2015).