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# **ROLL-YOUR-OWN CIGARETTES IN EUROPE: USE, WEIGHT AND IMPLICATIONS FOR FISCAL POLICIES**

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## ABSTRACT

*Objective.* Excise duties on roll-your-own (RYO) tobacco, which are generally based on RYO cigarettes containing 1g of tobacco, are lower than duties on factory-made (FM) cigarettes. This provides a price-incentive for smokers to switch to RYO, use of which is increasing across Europe. To effectively approximate duties on the two types of products requires accurate data on the weight of RYO cigarettes. We provide updated information on RYO use and RYO cigarette weight across Europe.

*Methods.* From a representative face-to-face survey conducted in 2010 in 18 European countries (Albania, Austria, Bulgaria, Czech Republic, Croatia, England, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Poland, Portugal, Romania, Spain and Sweden), we considered data from 5158 current smokers aged  $\geq 15$  years, with available information on daily consumption of, separately, FM and RYO cigarettes.

*Results.* In Europe, 10.4% of current smokers (12.9% of men and 7.5% of women) were "predominant" RYO users (i.e., >50% of cigarettes smoked). This proportion was highest in England (27.3%), France (16.5%) and Finland (13.6%). The median weight of one RYO cigarette is 0.75g (based on 192 smokers consuming exclusively RYO cigarettes).

*Conclusion.* The proportion of RYO smokers is substantial in several European countries. Our finding on the weight of RYO cigarettes is consistent with the scientific literature and industry documents showing that the weight of RYO cigarettes substantially lower than that of FM ones. Basing excise duties on RYO on an average cigarette weight of 0.75g rather than 1g would help increase excise levels to those on FM cigarettes.

**Keywords:** tobacco smoking; roll-your-own cigarettes; hand-rolled tobacco; fine-cut tobacco; cigarette weight; tobacco taxation; Europe.

## **Introduction**

Roll-your-own (RYO) cigarettes are becoming increasingly popular, particularly in Europe, with many smokers switching to RYO in response to the increasing prices of factory-made (FM) cigarettes, and/or to the financial stress due to the global economic crisis (Anonymous, 2012; Chaloupka *et al.*, 2011; Gallus *et al.*, 2013a; Gallus *et al.*, 2013b; Hanewinkel *et al.*, 2008; Lopez-Nicolas *et al.*, 2012; Lopez-Nicolas *et al.*, 2013; Raisamo, 2011; Young *et al.*, 2012). This is fuelled by the tax differential between the two types of products – with RYO tobacco taxed at a lower level, and therefore cheaper, in most countries (Gallus *et al.*, 2013a; Gallus *et al.*, 2013b; Hanewinkel *et al.*, 2008; IARC, 2011; Lopez-Nicolas *et al.*, 2012; Lopez-Nicolas *et al.*, 2013; Spanopoulos *et al.*, 2012). Accordingly, the latest European Union (EU) Directive on tobacco excise duty requires EU Member States (MS) to have a minimum tax of 57% of the Weighted Average Price (WAP) on FM cigarettes, or €64 per 1000 cigarettes, while the minimum tax on RYO is 40% of the WAP or €40 per kilogram (European Commission, 2010). A recent Euromonitor report indicated that of the 20 leading RYO markets, RYO products are cheaper than FM cigarettes in 16, with the price advantage ranging from 6.5% in Australia to 66% in Belgium (Euromonitor, 2012). However, several observational epidemiological studies on selected cancers showed that RYO cigarettes were even more harmful than FM cigarettes (Benhamou *et al.*, 1985; de Granda-Orive and Jimenez-Ruiz, 2011; De Stefani *et al.*, 1992; De Stefani *et al.*, 1998a; De Stefani *et al.*, 1998b; De Stefani *et al.*, 1994; Menvielle *et al.*, 2004), highlighting the alarming consequences of its increasing usage. Despite these issues, only limited information on the use of RYO is available in Europe.

Tax and price increases are one of the most effective means of reducing tobacco use (Chaloupka *et al.*, 2011; Gallus and La Vecchia, 2012; IARC, 2011), and recent evidence shows that the ready availability of cheap cigarettes constrains the ability of higher cigarette prices to promote smoking cessation (Ross *et al.*, 2011). Closing the gap in price between FM and RYO cigarettes is therefore important to maximise the public health impact of tobacco tax policies. Most tax authorities base taxation for fine-cut tobacco intended for RYO cigarettes on weight (European Commission, 2010), assuming a RYO cigarette is equivalent to a gram of tobacco. However, taxation should be based on quantity (number of items) in order to reflect the equivalence between the

two different forms of tobacco smoking (Lopez-Nicolas et al., 2012). Thus, in order to address the difference in tax between FM and RYO cigarettes, it is important to be able to accurately compare their tax levels and prices, which in turn requires an accurate measure of the weight of RYO cigarettes. There is currently relatively little published on the weight of RYO cigarettes, and the International Organization for Standardization (ISO) norm uses a wide estimate of 0.40 to 0.75g per RYO cigarette (ISO 15592-3:2008).

Given the paucity of research examining RYO cigarette use and weight, this paper aims to provide data on both the prevalence of RYO users across Europe, and on the average weight of a RYO cigarette. It does so using a large European survey conducted in 2010 (Gallus and La Vecchia, 2012; Gallus *et al.*, 2012; Gallus *et al.*, 2013c; Joossens *et al.*, 2012).

## **Methods**

Within the Pricing Policy And Control of Tobacco in Europe (PPACTE) project, in 2010 we conducted a face-to-face survey on smoking in 18 European countries (Albania, Austria, Bulgaria, Czech Republic, Croatia, England, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Poland, Portugal, Romania, Spain and Sweden) (Gallus and La Vecchia, 2012; Gallus *et al.*, 2012; Gallus *et al.*, 2013c; Joossens *et al.*, 2012). In each country, we enrolled a sample of around 1000 participants representative of the general population aged 15 years or over in terms of age, sex, geographic area and socio-economic characteristics. The survey was based on a total of 18,056 individuals.

Trained interviewers administered a standardized questionnaire. For current cigarette smokers (5268 individuals), besides socio-demographic characteristics, information was collected on daily consumption of, separately, FM and RYO cigarettes (information available for 5158 smokers), weekly expenditure on tobacco products and intention to quit smoking within the next 6 months. Overall, 5254 smokers showed the interviewer their latest pack of tobacco or provided information on it. The information collected on the latest pack included: type of pack (20-cigarette pack, 10-cigarette pack, RYO tobacco pouch), amount in grams of the RYO pouch and price paid.

Based on responses to daily cigarette consumption, RYO users was categorized in six different ways: 1) “Exclusively FM users”; 2) “Sometime RYO users” (mainly FM; i.e., 1% to 50% of cigarettes smoked are RYO), 3) “Mainly RYO users” (51% to 99% of cigarettes smoked are RYO); 4) “Exclusively RYO users”; 5) “Predominant RYO users” (categories 4 and 5 combined, i.e., either “mainly” or “exclusively” RYO users); 6) “Any RYO users” (i.e., either “sometime” or “predominant” RYO users). Furthermore, based on the information collected by the interviewer on the latest pack of cigarette, smokers showing a RYO tobacco pouch were defined as “Latest pack RYO users”. To explore the factors influencing RYO use we used “predominant RYO users”.

When examining weight of RYO cigarettes, we focused on exclusive RYO users and calculated the number of pouches per week by dividing weekly expenditure by the cost of the latest pouch. From this information and the observed number of grams per pouch, we calculated the number of grams consumed per day, which was divided by the number of cigarettes per day, to derive the average weight in grams per RYO cigarette. This analysis was based on 313 “exclusively RYO users”. We excluded 101 smokers with missing information on weekly expenditure, cost or weight of the latest pack. We further excluded 20 smokers providing an extremely low (<0.1g) or an extremely high (>3.0g) weight per cigarette since these values are likely due to misreporting. Therefore findings on weight of RYO cigarettes are based on 192 RYO cigarette smokers.

Current smokers were also asked to report their response to a hypothetical tobacco price increase of 20%. Possible answers were: i) quit smoking; ii) consume less cigarettes; iii) switch to/use also smokeless tobacco; iv) switch to/use also illegal or smuggled cigarettes; v) switch to RYO; vi) switch to cheaper brands; vii) not change smoking habits.

Education was categorized in three levels (low/intermediate/high) according to country-specific school systems. According to geographic area, countries were categorized into four European regions - northern (England, Finland, Ireland, Sweden), western (Austria, France), southern (Greece, Italy, Portugal, Spain) and central/eastern (Albania, Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Poland, Romania) Europe. For each country, the 2010 per capita Gross Domestic Product (GDP) based on Purchasing Power Parity (PPP), in Euros (€), was obtained from International Monetary Fund (IMF) databases (IMF, 2011). Countries were dichotomised in 2010 per capita

Gross Domestic Product (GDP) adjusted for Purchase Power Parity (PPP): <16,000€ (Albania, Bulgaria, Croatia, Hungary, Latvia, Poland, Romania) and ≥16,000€ (Austria, Czech Republic, England, Finland, France, Greece, Ireland, Italy, Portugal, Spain, Sweden). For each EU MS (Albania and Croatia excluded), a “price score” (i.e., a score based on the price of Marlboro and most popular price category, adjusted by per capita GDP) was retrieved by the 2010 version of the Tobacco Control Scale (TCS) report (Joossens and Raw, 2011). Countries were thus dichotomised into those having relatively low FM cigarette prices (“price score”<17, 17 being the median value among the countries considered; Austria, Czech Republic, Greece, Hungary, Italy, Poland, Spain) and countries with relatively high FM cigarette prices (“price score”≥17 (Bulgaria, England, Finland, France, Ireland, Latvia, Portugal, Romania, Sweden).

#### *Weighting and Statistical Analyses*

Statistical weights were used to assure representativeness of the sample for various country populations. To estimate findings for the overall sample, we applied an additional weighting factor, with each country contributing in proportion to its population aged 15 years or over (Eurostat, 2010).

Odds ratios (OR), and corresponding 95% confidence intervals (CI), for “predominant RYO users” compared to all other smokers (either exclusively FM users or sometime RYO users) for individual-level characteristics were estimated using multilevel (two-levels) logistic random effects models (random intercept) in order to take into account the heterogeneity between the 18 European countries. The study country effects were considered as random, and age, sex level of education and smoking intensity as adjusting variables. ORs and 95% CIs for country specific characteristics were estimated by unconditional multiple logistic regression models, after allowance for age, sex, level of education and smoking intensity. The analyses were conducted using the GLIMMIX procedure in SAS 9.2 (SAS Institute).

#### **Results**

Current RYO smokers (any RYO smokers) comprised 4.8% of the whole sample of European participants aged ≥15 years (6.3% among men and 3.4% among women);

predominant RYO smokers comprised 2.8% (3.9% among men and 1.8% among women). This proportion was highest in Northern (5.4%) and Western Europe (4.0%) and lowest in Southern (1.9%) and Eastern Europe (1.3%; **Appendix Table**).

**Figure 1** shows the proportion of different patterns of RYO use among current smokers, overall and by country. Overall, 82.0% of current smokers smoked exclusively FM cigarette 7.5% were sometime RYO smokers, 2.0% mainly smoked RYO, while 8.4% smoked only RYO cigarettes. Therefore any RYO users (either sometime, mainly or exclusively) comprised 18.0% of current smokers and predominant RYO users (either mainly or exclusively) 10.4% (12.9% in men and 7.5% in women). The proportion of current smokers showing, as the latest pack bought, a RYO tobacco pouch was very similar to that of predominant RYO cigarette users, overall (considering “predominant RYO users” as the gold standard, sensitivity was 0.76 and specificity was 0.98) and by country (correlation coefficient,  $r=0.99$ ).

Among current smokers, the proportion of predominant RYO users was highest in England (27.3% overall; 38.4% in men and 15.1% in women), and also exceeded 10% in France (16.5% overall; 19.7% in men and 12.9% in women), Finland (13.6% overall; 19.4% in men and 2.8% in women), Spain (13.2% overall; 17.0% in men and 10.0% in women) and Greece (13.1% overall; 16.6% in men and 8.5% in women). It was 22.2% in Northern Europe, 14.9% in Western, 7.1% in Southern and 4.4% in Eastern and Central Europe.

**Table 1** shows the multivariate ORs for predominant RYO use among current smokers according to selected socio-demographic, smoking and country-specific characteristics. RYO use was less frequent in women than in men (OR 0.47; 95% CI: 0.38-0.58) No consistent differences were observed according to age group. RYO smokers tended to be less educated: compared to low level of education, the OR for intermediate education was 0.74 (95% CI: 0.59-0.93) and for high level of education was 0.59 (95% CI: 0.43-0.81;  $p<0.001$ ). Overall, no difference was observed according to number of cigarettes smoked per day. RYO smokers were also less likely to report an intention to quit (OR 0.70; 95% CI: 0.56-0.87). Compared to Northern European countries, the OR was 0.56 (95% CI: 0.43-0.72) for Western, 0.25 (95% CI: 0.19-0.33) for Southern and 0.15 (95% CI: 0.11-0.21) for Eastern and Central European countries.



RYO smokers were more frequent in countries with a higher per capita GDP based on PPP (OR 3.06; 95% CI: 2.27-4.13) and in countries where the price of FM cigarettes are less affordable (OR 2.13; 95% CI: 1.74-2.62).

When asked about a hypothetical 20% price increase, overall, 33.6% of all current smokers reported they would not change their smoking habit, 30.6% would consume a lower number of cigarettes per day, 14.2% would quit smoking, 13.7% would switch to cheaper brands, 3.8% would switch to RYO cigarettes, 3.5% would switch to/use also illegal or smuggled cigarettes and 0.5% would switch to/use also smokeless tobacco. The proportion reporting a switch to RYO cigarettes was highest among young smokers (5.0%) and those with a low level of education (4.4%).

**Table 2** shows the median weight of one RYO cigarette, estimated among 192 current smokers exclusively smoking RYO cigarettes. Overall, the median weight of one RYO cigarette was 0.75g (IQR: 0.51-1.20). Significant differences were observed across various countries ( $p < 0.001$ ), with median estimate ranging between 0.48g in England (N=42) and 1.15g in Spain (N=13). The weight of one RYO cigarette did not significantly differ in strata of sex, age and level of education. The weight of RYO cigarettes for smokers consuming  $\geq 20$  RYO cigarettes per day (median: 0.69g; IQR: 0.48-1.07) was lower than that for smokers of  $< 20$  RYO cigarettes per day (median: 0.86g; IQR: 0.56-1.27;  $p = 0.059$ ).

## **Discussion**

We found that the prevalence of RYO users among all current cigarette smokers exceeds 10% in our European population. This proportion exceeds 20% in Northern Europe and is highest in England, where 7% of the adult population and 27% of smokers most frequently consume RYO cigarettes. The latter result is in broad agreement with a survey conducted in the UK in 2008 showing that 32% of smokers predominantly used RYO cigarettes (Young et al., 2012). RYO use among smokers was also substantial in France, Finland, Spain, and Greece.

Overall, RYO use was most frequent among less educated subjects, in broad agreement with surveys from Canada (Leatherdale and Burkhalter, 2012; Leatherdale et al., 2009), Malaysia and Thailand (Young et al., 2008), New Zealand (Li et al., 2010;

Sheerin et al., 2012; Young et al., 2010; Young et al., 2012), with the International Tobacco Control (ITC) Four Country Survey, conducted in Australia, Canada, the UK and the USA (Young et al., 2006) and with other data from the UK (Tavakoly et al., 2013). This further confirms the strict relationship between economic aspects and RYO tobacco use, since individuals with lower socio-economic levels are more responsive to tobacco price changes (Gallus and La Vecchia, 2012; IARC, 2011).

We found that RYO use was more common among smokers who were less likely to consider quitting. This is in line with several studies conducted in high-income countries, showing that RYO use was more frequent among smokers with higher levels of nicotine addiction (Leatherdale and Burkhalter, 2012; Leatherdale *et al.*, 2009; Young *et al.*, 2010; Young *et al.*, 2006; Young *et al.*, 2012). RYO use is significantly higher in countries with higher prices of FM cigarettes. Moreover, 3.8% of smokers reported they would switch to RYO rather than quit in response to a 20% price increase. The latter two findings are consistent with a price-driven demand for RYO cigarettes, i.e. people switch towards cheaper products as an alternative to quitting (IARC, 2011).

Although we found differences among countries, our original data indicate that a reliable estimate of the weight of 1 RYO cigarette in Europe is around 0.75g. This estimate may be somewhat biased by the proportion of exclusively RYO users with missing data on variables used to derive weight of RYO cigarettes (39%), the lack of the validation with measured estimates, and the complexity of the computation of the weight of RYO cigarettes. Still, to our knowledge, this study is the largest to date to provide data on this issue. Only six other studies available in the scientific literature provided data on the weight of RYO cigarettes (Darrall and Figgins, 1998; Gallus et al., 2013a; Laugesen et al., 2009; Rosenberry et al., 2013; Shahab et al., 2008; Wood et al., 2005). The number of smokers studied varied from 20 to 56 and the weight of cigarettes varied from 0.43g to 0.88g (**Table 3**), being therefore in broad agreement with the estimate of the present study.

Industry documents also note some national variation in the size of RYO cigarettes. In 1995 a survey of six European markets found a relatively low average in the UK at 0.487g, with other countries ranging between 0.76g and 0.9g (Dymond, 1996; Sadler, 1995). The study was undertaken by a European Smoking Tobacco Association (ESTA) consultant for the Cooperation Centre for Scientific Research Relative to

Tobacco (CORESTA) task force on RYO cigarette weights (Pangritz, 1996). The CORESTA task force subsequently settled on weights of 0.4g and 0.75g depending on the length of the cigarette paper (Shillabeer, 1998). Despite this research, ESTA claimed in response to an EU consultation on excise duties in 2007 that an estimate of 0.75g per cigarette is inappropriate for calculating tax levels due to the inherent variation in RYO product sizes (European Smoking Tobacco Association, 2007). Instead ESTA insisted that the 1 gram per cigarette should be used (European Smoking Tobacco Association, 2007).

Transnational Tobacco Companies (TTC) generally publish little data on the estimated weight of RYO cigarettes. However Imperial Tobacco's Annual Report from 2010 includes data on global fine cut tobacco sales by weight and stick equivalents. The report details Imperial Tobacco's 2009 sales as 25,950 tonnes or 36.6 billion stick-equivalents and 2010 sales as 27,550 tonnes or 39.8 billion stick-equivalents. Allowing for rounding, these data suggest that Imperial Tobacco is using a figure of approximately 0.7g per RYO cigarette in their calculations. Similarly Philip Morris International investor presentations from 2010 and 2012 indicate that the company is using a conversion rate of 0.75g of fine cut tobacco per cigarette (JTI, 2012; Olczak, 2012). Project Star, an annual report on the illicit tobacco trade produced by KPMG on behalf of Philip Morris International, also gives similar figures: 0.73g of tobacco for make your own products and 0.6g for RYO (KPMG, 2013). Yet a report by Japan Tobacco International on levels of non-domestic tobacco use in the UK used a considerably lower figure of 0.4g per cigarette (JTI, 2012). This report was being used to scaremonger about levels of non-domestic use in the UK during negotiations over standardised packaging and the use of 0.4g rather than a higher figure would lead to a larger non-domestic estimate.

In conclusion, our study shows that the consumption of RYO cigarettes is substantial in several European countries and is related to the relatively low price of RYO compared to FM cigarettes. This in turn raises the issue as to whether RYO and FM should be considered as close substitutes from a fiscal point of view. Indeed, there is no theoretical ground to justify any differential taxation among the two types of products. It is therefore particularly important to understand how to equalize prices and taxes between RYO and FM. According to our findings the weight of RYO cigarettes is

significantly lower than that of FM ones. TTCs are using similar figures, mainly estimating the weight of RYO cigarettes at 0.70g or 0.75g. Therefore, a kilogram of RYO tobacco yields approximately 1300-1400 cigarettes rather than 1000 cigarettes as assumed by most tax authorities. Consequently the tax on a kilogram of RYO tobacco should be higher than for 1000 FM cigarettes (European Commission, 2010). Presently RYO cigarettes play a crucial role in the industry's strategy to attract or retain price-sensitive smokers (Gilmore et al., 2011; Leatherdale et al., 2009; Young et al., 2012). Given evidence that price is the most effective means of reducing smoking rates (Chaloupka et al., 2011; Gallus and La Vecchia, 2012; IARC, 2011) and inequalities in smoking (Amos et al., 2011; Thomas et al., 2008), and given evidence that RYO use may be more harmful than FM cigarette use (Benhamou *et al.*, 1985; de Granda-Orive and Jimenez-Ruiz, 2011; De Stefani *et al.*, 1992; De Stefani *et al.*, 1998a; De Stefani *et al.*, 1998b; De Stefani *et al.*, 1994; Menvielle *et al.*, 2004), eliminating the price differential would have significant benefits for public health and could narrow health inequalities.

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**Legend to the figure:**

**Figure 1:** Percent prevalence\* (%) of different patterns of RYO use among 5158 current smokers. PPACTE, 2010.

Figure 1 footnote: \* Prevalence estimates for the overall population were computed weighting each country in proportion to the country specific population aged 15 years or over.

**Table 1:** Odds ratios (OR) for predominant use of RYO compared to all other smoking patterns (exclusively FM cigarette users or sometime RYO users), and corresponding 95% confidence intervals (CI), according to selected individual-level and county-specific characteristics. PPACTE, 2010.

|  | N of current smokers <sup>^</sup> | % predominant RYO users | OR for predominant RYO vs other smoking patterns (95% CI) <sup>‡</sup> |
|--|-----------------------------------|-------------------------|--|
| <b>Total*</b>  | 5158                              | 10.4                    | -  |
| <b>Individual-level characteristics*</b>                                 |                                   |                         |  |
| Sex  |                                   |                         |  |
| Men  | 2892                              | 12.9                    | 1§   |
| Women  | 2266                              | 7.5                     | 0.47 (0.38-0.58)   |
| Age group (years)  |                                   |                         |  |
| <25  | 831                               | 9.4                     | 1§   |
| 25-44  | 2281                              | 11.0                    | 1.17 (0.86-1.59)   |
| 45-64  | 1647                              | 10.7                    | 1.13 (0.81-1.57)   |
| ≥65  | 399                               | 8.2                     | 0.62 (0.39-1.01)   |
| p for trend  |                                   |                         | 0.167  |
| Level of education <sup>°</sup>  |                                   |                         |  |
| Low  | 1521                              | 11.9                    | 1§   |
| Intermediate   | 2576                              | 10.0                    | 0.74 (0.59-0.93)   |
| High   | 1059                              | 8.5                     | 0.59 (0.43-0.81)   |
| p for trend  |                                   |                         | <0.001   |
| Smoking intensity (cigarettes/day)                                       |                                   |                         |  |
| <15  | 2091                              | 11.1                    | 1§   |
| 15-24  | 2336                              | 9.0                     | 0.93 (0.75-1.16)   |
| ≥25  | 731                               | 13.0                    | 0.94 (0.70-1.26)   |
| p for trend  |                                   |                         | 0.559  |
| Intention to quit within the next 6 months <sup>°</sup>                  |                                   |                         |  |
| No   | 3194                              | 11.3                    | 1§   |
| Yes  | 1447                              | 10.3                    | 0.70 (0.56-0.87)   |
| <b>Country-specific characteristics*#</b>                                |                                   |                         |  |
| Geographic area  |                                   |                         |  |
| Northern Europe  | 1032                              | 22.2                    | 1§   |
| Western Europe   | 573                               | 14.9                    | 0.56 (0.43-0.72)   |
| Southern Europe  | 1185                              | 7.1                     | 0.25 (0.19-0.33)   |
| Eastern and Central Europe   | 2368                              | 4.4                     | 0.15 (0.11-0.21)   |
| Per capita Gross Domestic Product (GDP) based on Purchasing Power Parity |                                   |                         |  |

|              |      |      |                  |
|--------------|------|------|------------------|
| (PPP)        |      |      |                  |
| <16,000 €    | 2081 | 4.6  | 1§               |
| ≥16,000 €    | 3077 | 12.4 | 3.06 (2.27-4.13) |
| Price score† |      |      |                  |
| <17          | 2053 | 7.1  | 1§               |
| ≥17          | 2586 | 14.2 | 2.13 (1.74-2.62) |

^ 110 current smokers were excluded since they had missing information on predominant RYO use.

‡ ORs for individual-level characteristics were estimated using generalized linear mixed models for binary outcome variables. The study country effects were considered as random intercepts, and adjusting variables were sex, age, level of education and smoking intensity. ORs for country-specific characteristics were estimated by unconditional multiple logistic regression models after adjustment for sex, age, level of education and smoking intensity. Estimates were weighted for statistical weights that consider country specific population.

\* Prevalence estimates for the overall population were computed weighting each country in proportion to the country specific population aged 15 years or over.

§ Reference category.

° The sum does not add up to the total because of some missing values.

# Classification of countries - Northern Europe: FI, IE, SE, UK; western Europe: AT, FR; southern Europe: ES, GR, IT, PT; eastern and central Europe: AL, BG, CZ, HR, HU, LV, PL, RO. Per capita GDP based on PPP <16,000€: AL, BG, HR, HU, LV, PL, RO; per capita GDP based on PPP ≥16,000€: AT, CZ, ES, FI, FR, GR, IE, IT, PT, SE, UK. Price score <17: AT, CZ, ES, GR, HU, IT, PL; price score ≥17: BG, FI, FR, IE, LV, PT, RO, SE, UK.

† Albania and Croatia excluded.

**Table 2:** Median estimate and inter-quartile range (IQR) of the weight (in grams) of one roll-your-own cigarette, overall and by selected characteristics. PPACTE, 2010.

|                           | N   | Median weight in grams (IQR) | p-value* |
|---------------------------|-----|------------------------------|----------|
| <b>Total</b>              | 192 | 0.75 (0.51-1.20)             |          |
| <b>Country</b>            |     |                              |          |
| England                   | 42  | 0.48 (0.34-0.71)             |          |
| Finland                   | 29  | 1.07 (0.76-1.38)             |          |
| France                    | 32  | 0.89 (0.80-1.39)             |          |
| Greece                    | 37  | 0.59 (0.48-0.89)             | <0.001   |
| Ireland                   | 13  | 0.51 (0.45-0.84)             |          |
| Spain                     | 13  | 1.15 (0.75-1.63)             |          |
| Other countries           | 26  | 1.04 (0.71-1.70)             |          |
| <b>Sex</b>                |     |                              |          |
| Men                       | 137 | 0.72 (0.53-1.22)             |          |
| Women                     | 55  | 0.86 (0.48-1.19)             | 0.543    |
| <b>Age group (years)</b>  |     |                              |          |
| <25                       | 32  | 0.70 (0.55-0.93)             |          |
| 25-44                     | 81  | 0.86 (0.51-1.37)             |          |
| 45-64                     | 72  | 0.74 (0.53-1.25)             | 0.487    |
| ≥65                       | 7   | 0.87 (0.36-1.19)             |          |
| <b>Level of education</b> |     |                              |          |
| Low                       | 51  | 0.80 (0.57-1.30)             |          |
| Intermediate              | 81  | 0.71 (0.48-1.19)             | 0.347    |
| High                      | 60  | 0.87 (0.56-1.22)             |          |
| <b>Smoking intensity</b>  |     |                              |          |
| <20 cigarettes/day        | 113 | 0.86 (0.56-1.27)             |          |
| ≥20 cigarettes/day        | 79  | 0.69 (0.48-1.07)             | 0.059    |

\* p-values were derived using the Wilcoxon Rank Sum test.

**Table 3:** Summary of studies from the scientific literature providing data on the weight of RYO cigarettes.

| Country, study, year of publication | No. of RYO smokers studied  | Weight of RYO cigarette                    | Notes   |
|-------------------------------------|---|--|---|
| UK, Darrall & Figgins, 1998         | 26 habitual RYO cigarette smokers rolling 20 cigarettes each  | Average weight: 0.505g;<br>Range: 0.3-0.8g | Limited within-consumer variation   |
| UK, Wood et al., 2005               | 20 hospital in-patients   | Average: 0.73g                             |   |
| UK, Shahab et al., 2008             | 29 RYO cigarette smokers, who rolled 3 cigarettes each  | Average: 0.511g                            |   |
| New Zealand, Laugesen et al., 2009  | 26 RYO and 22 FM volunteer male cigarette smokers   | Average: 0.46g                             | The discrepancy with the weight of FM cigarettes was statistically significant ( $p < 0.001$ ). |
| USA, Rosenberry et al., 2013        | 56 habitual RYO cigarette smokers rolling 30 cigarettes each  | Average weight range: 0.43-0.45g           | Significant internal consistency in the weight of RYO cigarettes                                |
| Italy, Gallus et al., 2013          | 49 RYO users (36 regular and 13 occasional users), reporting information on the weight of their RYO tobacco pouch and the number of cigarettes rolled from it | Median: 0.63g;<br>Mean: 0.88g<br>(SD 0.60) | Among regular RYO users:<br>Median: 0.63g;<br>Mean: 0.74g (SD 0.35)                             |

RYO: Roll-your-own; FM: Factory-made.