

Manufactured and roll-your-own cigarettes: a changing pattern of smoking in Barcelona, Spain.

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ABSTRACT

Aims: The objectives of the present study were to describe smoking prevalence and compare the smoking attributes of adult smokers according to the type of tobacco product consumed.

Methods: Repeated cross-sectional surveys (2004-2005 and 2011-2012) of a representative sample of the adult (≥ 16 years) population in Barcelona, Spain, were used to assess self-reported tobacco consumption, smoking attributes, and salivary cotinine concentration. The survey conducted in 2004-2005 included information on 1,245 subjects and the survey in 2011-2012 on 1,307 individuals.

Results: Smoking prevalence decreased over the study period (from 26.6% to 24.1% in self-reported daily smokers). The prevalence of daily smokers who reported the use of manufactured cigarettes declined from 23.7% in 2004-2005 to 17.3% in 2011-2012. The prevalence of roll-your-own cigarette users increased from 0.4% to 3.7%. According to data obtained in 2011-2012, the proportion of self-reported roll-your-own cigarette users was higher among men (19.8% vs. 9.5% of women), participants aged 16-44 years (22.9% vs. 5.8% of participants aged 45-65 years and 4.0% of participants aged ≥ 65 years), and participants with secondary and university education (17.7% and 18.5% vs. 7.9% of participants with less than primary and primary education). We did not observe differences in cotinine concentrations according to the type of tobacco product consumed.

Conclusions: Systematic collection of data on smoking prevalence and smoker attributes from representative samples of the population is necessary for policymakers to develop efficient tobacco control interventions. Considering the increase among roll-your-own cigarette users and the unclear health consequences of their use, policymakers should aim to implement tax policies to equalize the prices of different types of tobacco products.

Key words: smoking, roll-your-own cigarettes, manufactured cigarettes, tobacco policies, cotinine

Competing interests: None

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INTRODUCTION

Tobacco kills approximately 6 million people and causes more than half a trillion dollars of economic damage each year [1]. In Spain, smoking-related deaths among individuals aged ≥ 35 years accounts for 14.7% of total mortality (25.1% in men and 3.4% in women) [2].

There is strong evidence that tobacco control policies promoted by the WHO Framework Convention on Tobacco Control (FCTC), when implemented in an integrated way, reduce the prevalence of smoking[3,4]. In Spain, smoking prevalence rates from 1940 through 2007 showed a decrease after 1980 for men (from 58.5% in 1980 to 31.7% in 2007) and after 2000 for women (from 26.7% in 2000 to 21.9% in 2007) [5]. The prevalence rate was 23% in Spain in 2014 (27.6% for men and 18.6% for women) [6].

Regulations implemented in recent years have not been shown to have a direct effect on tobacco consumption, and the decline in smoking prevalence and the number of cigarettes consumed describe a continuation of the short- and medium-term temporal evolution observed prior to the introduction of smoke-free legislation [7,8].

Stepwise smoke-free legislation has been implemented in Spain in the last decade. Law 28/2005, which passed January 1, 2006, banned smoking in all public and work places, with some exceptions in hospitality venues [9]. Law 42/2010 came into force January 2, 2011, extending the smoking ban to all hospitality venues without exception (bars, cafes, pubs, restaurants, discos, and casinos), including some outdoors areas [10].

In the same time period when the tobacco smoke-free laws were implemented, Spain suffered an economic crisis that seems to have favored an increase in the consumption of other tobacco products subject to lower taxes, making them cheaper alternatives for smokers [11,12].

The objective of this study was to describe smoking prevalence and to compare smoker attributes according to the type of tobacco product consumed in the Spanish adult population based on self-reported data and the levels of salivary cotinine in two time periods: 2004-2005 and 2011-2012, before and after smoke-free legislation.

METHODS

Study design and selection of study participants

This study had a repeated cross-sectional design. We included a representative, random sample by age, sex, and district of the population of Barcelona, Spain. Surveys were conducted before and after the implementation of smoke-free legislation. Pre-legislation data were obtained between March 2004 and December 2005. We used the same strategy to collect post-legislation data between June 2011 and March 2012. We selected participants from the official 2001 (participants in the pre-legislation survey) and 2010 (participants in the post-legislation survey) population census of Barcelona, a reliable source of population based information. Detailed information about the pre-legislation survey was provided in previous studies [13-15].

Briefly, for each survey we determined a sample size of 1,560 people with standard procedures (α error 5%, beta error 20%, and 20% loss for independent samples). The survey conducted in 2004-2005 included a final sample of 1,245 individuals and the survey conducted in 2011-2012 included a final sample of 1,307 individuals. These sample sizes were sufficient to detect a 40% difference in salivary cotinine concentrations between the two surveys.

We obtained data and addresses for Barcelona residents from the city census (years 2001 and 2010). Individuals aged 16 years and older were eligible to participate in this study. A letter was mailed to eligible individuals to describe the purpose of the study and to inform them that they had been selected at random. Participants that could not be located after several attempts (at different times of the day and different days of the week) and those that declined to participate in the study were replaced at random. The replacements were chosen from eligible individuals of the same sex, within a 5-year age group, and within the same district of residence.

Substitutions accounted for 50.7% and 54.6% of the 2004-2005 and 2011-2012 surveys, respectively. Individuals who agreed to participate were interviewed at home by trained interviewers. Participants were asked to sign an informed consent form before proceeding with the face-to-face interview. The same questionnaire was used in both surveys (on traditional paper in the 2004-2005 survey and in computer-assisted form in the 2011-2012 survey). Additional questions were included in the second survey regarding smoke-free legislation. After completing the questionnaire, respondents were asked to provide a sample of saliva for the cotinine analysis. The Research and Ethics Committee of Bellvitge University Hospital approved the study protocols and informed consent forms.

Self-reported tobacco consumption and smoking characteristics

Self-reported smoking behavior was determined with the question, "Which of the following statements describes your behavior relative to tobacco?" Daily smokers were defined as individuals who, at the time of the interview, reported that they smoke at least one cigarette per day; occasional smokers as individuals who, at the time of the interview, reported that they smoke occasionally; former smokers as individuals who, at the time of the interview, reported that they did not smoke currently but had smoked at least one cigarette per day or occasionally in the past; and never smokers were those who declared that they had never smoked. Self-reported non-smokers (never and former) who had a salivary cotinine concentration > 10 ng/mL were considered missing data because they had cotinine concentrations consistent with active smoking [16] and we did not collect the smoking-related information.

For daily smokers, detailed information was collected on smoking characteristics: cigarettes smoked per day (CPD), age when they started smoking, number of cigarettes smoked during the previous 24 and 48 hours, brand of cigarettes smoked most often, type of tobacco product smoked (manufactured cigarettes, roll-your-own cigarettes, cigars, small cigars (*puritos*), pipes, or other tobacco), use of filter tips, depth and frequency of inhalation, and use of nicotine gum or patches for smoking cessation.

We collected information on nicotine dependence using the Fagerström Test for Cigarette Dependence (FTCD) [17-19]. Based on the FTCD scores (range 0–10 points), we classified subjects according to their nicotine dependence (0–4, low; 5, medium; 6–10, high).

Finally, we registered the stage of change based on the Prochaska and DiClemente algorithm [20]. We considered three smoking stages of change: precontemplation, smokers that were not seriously considering quitting within the next 6 months; contemplation, smokers that were seriously considering quitting within the next 6 months but not within the next 30 days, or smokers that had not attempted to quit for at least 24 hours in the past year, or both; and preparation, smokers that were planning to quit within the next 30 days and had attempted to quit for at least 24 hours in the past year [21,22]. In the present study we focused on current daily smokers; therefore, we did not consider the other two stages, action (those who had quit during the past 6 months) and maintenance (those who had quit for more than 6 months).

Sociodemographic covariates

The sociodemographic covariates were sex, age (categorised into three age-groups: 16–44 years, 45–64 years, and ≥ 65 years old), and educational level categorized in three groups as “Less than primary and primary education” (illiterate subjects, subjects with uncompleted elementary education, and subjects with complete primary education); “Secondary education” (subjects with compulsory secondary education and/or voluntary high school, or vocational training); and 'University education' (subjects with University degree or postgraduate studies).

Salivary cotinine

We asked the participants to provide a saliva sample to determine the cotinine levels. Cotinine is the main metabolite of nicotine and a stable, specific, and sensitive biomarker of tobacco consumption [23]. We followed the same protocol in both surveys for collecting the saliva sample, as explained previously [15]. Cotinine analysis was performed in the laboratory of the IMIM-Hospital Research Institute in Barcelona. The limit of quantification was 0.1 ng/mL, the limit of detection 0.03 ng/mL, and quantification error <15%.

Statistical analysis

We calculated prevalence rates to characterize smoking behavior for the period studied among the population. For current daily smokers we computed the proportion of tobacco products consumed in 2004-2005 and in 2011-2012. The results were stratified by sex, age, and education level. For continuous variables, except cotinine, we computed the mean and standard deviation (SD). For cotinine concentrations, we used geometric means (GMs) and geometric standard deviations (GSDs) due to a skewed distribution. We compared smoking attributes for daily smokers according to the type of tobacco consumed using the data obtained in 2011-2012. We used relative frequencies (%) for categorical variables and mean and SD for numerical data. We also computed the GM and GSD to describe the cotinine concentrations among current daily smokers of manufactured cigarettes only and roll-your-own cigarettes only and stratified by sociodemographic and other smoking attributes. Samples with cotinine concentrations below the limit of quantification were assigned a value of 0.05 ng/mL (half the limit of quantification). Statistical analyses were performed in SPSS v17.0 and Stata 10.

RESULTS

Sample and smoking prevalence

We had information on 2,552 participants: 1,245 subjects in the pre-legislation survey and 1,307 in the post-legislation survey. The samples were similar in regards to the proportions of men and women, but we found significant differences in age and education level. Nineteen participants in the pre-legislation survey were excluded because they were <16 years old. Of the self-reported non-smokers (former and never smokers), 110 (62 in the pre-legislation and 48 in the post-legislation surveys) were not included in this analysis because they did not provide a saliva sample. In addition, 12 (10 in the pre-legislation and 2 in the post-legislation survey) were excluded because cotinine analysis was not possible (i.e., insufficient sample). A total of 83 non-smokers from the pre-legislation survey and 19 from the post-legislation survey were excluded because they had cotinine concentrations consistent with active smoking (>10 ng/mL).

Therefore, the final sample for analysis included a total of 1,071 participants before the legislation and 1,238 participants after the legislation.

Smoking prevalence decreased over the period 2004-2005 and the period 2011-2012: from 26.6% (95%CI 24.0-29.2) to 24.1% (95%CI 21.7-26.5) in daily smokers, and from 5.8% (95%CI 5.5-6.1) to 5.0% (95%CI 4.7-5.3) in occasional smokers (Fig. 1). Self-reported former smokers represented 27.7% (95%CI 25.0-30.4) of participants in 2004-2005 and 26.8% (95%CI 24.3-29.3) of participants in 2011-2012. As shown in Fig. 1, none of these changes were significant.

[Fig 1 about here]

The prevalence of daily smokers fell from 32.5% (95%CI 28.3-36.7) to 29.4% (95%CI 25.7-33.1) among men and from 21.7% (95%CI 18.4-25.0) to 19.3% (95%CI 16.3-22.3) among women. The decline in smoking prevalence among daily smokers between 2004-2005 and 2011-2012 was higher among participants aged 16-44 years (from 36.4%, 95%CI 31.8-41.0, to 29.4%, 95%CI 25.7-33.1) with substantial changes in the prevalence of daily smokers among participants aged 45-64 years and ≥ 65 years. When comparing by education level, we observed the highest decrease among participants with secondary education (from 38.9%, 95%CI 32.9-44.9, to 26.1%, 95%CI 22.2-30.0), followed by participants with university education (from 24.3%, 95%CI 19.9-28.7, to 22.00%, 95%CI 18.0-26.0). The prevalence of daily smokers with less than primary and primary education increased from 21.3% (95%CI 17.5-25.1) to 23.8% (95%CI 19.1-28.5).

Type of tobacco consumed among daily smokers

Fig. 2 shows the prevalence of self-reported daily smokers according to the type of tobacco product smoked. The prevalence of smokers who reported using manufactured cigarettes (only or combined with other types of tobacco products different from roll-your-own cigarettes) declined from 23.7% (95%CI 21.2-26.2) in 2004-2005 to 17.3% (95%CI 15.2-19.4) in 2011-2012. Roll-your-own cigarette users (only or combined with other types of tobacco products

different from manufactured cigarettes) significantly increased from 0.4% (95%CI 0.02-0.8) to 3.7% (95%CI 2.6-4.8), and users of both manufactured cigarettes and roll-your-own cigarettes (with or without other types of tobacco products) increased from 0.9% (95%CI 0.3-1.5) to 1.7% (95%CI 1.0-2.4).

[Fig 2 about here]

Table 1 shows the percent distribution (overall and stratified by socio-demographic characteristics) of self-reported daily smokers according to the type of tobacco product consumed (same categories as in Fig. 2) before and after the legislation. We observed a significant increase in roll-your-own users among both men and women and among participants aged 16-44 years (Table 1). Roll-your-own was also more prevalent among participants with secondary and higher education (Table 1), and this association was modified by age. The stratified analysis by age showed roll-your-own use was more frequent among smokers aged 16-44 years (less than primary and primary: 16.1%, secondary: 23.8%, university: 25.5%) as compared to those ≥ 45 years (2.2%, 6.5%, and 8.1%, respectively). We observed the same pattern among participants aged 45-65 and ≥ 65 years and participants with less than primary and primary education, but the differences were not significant. According to data obtained in 2011-2012, the proportion of self-reported roll-your-own cigarette users was higher among men than women (19.8% vs. 9.5%), participants aged 16-44 years (22.9% vs. 5.8% among participants aged 45-65 years and 4.0% among participants ≥ 65 years), and among participants with secondary and university education compared to participants with less than primary and primary education (17.7% and 18.5% vs. 7.9%, respectively).

[Table 1 about here]

Smoking attributes among daily smokers in 2011-12 according to the use of manufactured and roll-your-own cigarettes

We analyzed the smoking attributes of daily smokers obtained in the 2011-12 survey according to the use of manufactured and roll-your-own cigarettes (manufactured cigarettes only, roll-

your-own cigarettes only, and both manufactured and roll-your-own only; n=260). From these smokers, we excluded 58 participants for different reasons (see footnote to Table 2); therefore, we finally included 202 participants in the analysis. Manufactured cigarette users reported the highest nicotine dependence levels (45.6% vs. 39.1% among roll-your-own cigarette users and 14.3% among users of both types of tobacco products) with no significant differences (p=0.151). The majority of smokers were precontemplators, independent of the tobacco product smoked (74.5% among manufactured cigarettes users, 87.5% among roll-your-own cigarette users and 70.0% among users of both types of tobacco products). More manufactured cigarette users were in the contemplation stage compared to roll-your-own and both manufactured and roll-your-own cigarette users. No roll-your-own cigarette users were in the preparation stage of change. More roll-your-own cigarette users reported smoking ≤ 10 CPD compared to manufactured cigarette users and users of both manufactured and roll-your-own cigarettes, who mostly reported between 11 and 20 CPD (Table 2).

We did not observe significant differences in the mean FTCD scores, the mean CPD, or the frequency and depth of inhalation according to the tobacco product smoked.

[Table 2 about here]

Table 3 shows the cotinine levels in daily smokers from the 2011-2012 survey stratified by socio-demographic and smoking attributes according to the use of manufactured cigarettes only and roll-your-own cigarettes only (n=192). Overall, the GM salivary concentration was 186.77 ng/mL among those who used roll-your-own cigarettes only and 185.05 ng/mL among those who used manufactured cigarettes only, with no significant differences between them (p=0.778). We did not observe differences in cotinine concentrations according to the type of tobacco product smoked when we stratified by socio-demographic characteristics and different smoking attributes, except for smokers with medium dependence and smokers of 11-20 CPD, for which we observed higher concentrations among users of roll-your-own cigarettes only.

DISCUSSION

Our results showed a nonsignificant reduction in smoking prevalence over the period 2004-2005 and the period 2011-2012 from 26.6% to 24.1% in daily smokers. Similar to our results, another study conducted in Spain with national data showed a nonsignificant decrease from 23.4% in 2006 to 20.7% in 2011 [24]. A study conducted in Galicia, Spain, found a decrease in the prevalence of tobacco consumption from 25.4% in 2007 to 21.8% in 2015 [25].

We observed a relative reduction in the smoking prevalence of 9.5% among men who smoke daily and 11.1% among women who smoke daily in the period between 2004-2005 and 2011-2012. The highest relative reduction in smoking prevalence was observed among participants aged 16-44 years (-19.2%) and among participants with secondary and university education. During this period, two tobacco smoke-free policies were implemented in Spain (Law 28/2005 and Law 42/2010). However, we did not take into account previous temporal trends. One study conducted in England to examine the impact of the legislation on smoking prevalence controlling for secular trends through the end of 2008 observed a reduction in smoking prevalence from 25% in 2003 to 21% in 2008. In this study, however, after taking into account the previous temporal, the implementation of smoke-free legislation was not associated with a significant change in smoking prevalence [26].

Our results indicate an important reduction in the prevalence of manufactured cigarette users in 2011-2012 compared to 2004-2005. In contrast, both roll-your-own cigarette users and mixed manufactured and roll-your-own cigarette users considerably increased. This data makes sense with the decrease in the sales of manufactured cigarettes per capita jointly with an increase in roll-your-own cigarette sales in Spain [11]. Among daily smokers, roll-your-own cigarette users (only or combined with other types of tobacco products different from manufactured cigarettes) represented 15.4% of total smokers in 2011-2012. A survey conducted in Galicia, Spain, found an increase in the consumption of roll-your-own tobacco from 1.8% in 2007 to 18.6% in 2015 [25]. These percentages observed in Spain are higher than the percentage reported in a similar study conducted in Italy in 2011 and 2012, in which 4.6% of smokers reported to smoke roll-your-own cigarettes most frequently [27], and higher than the 6.7% of smokers in the US who

smoke roll-your-own cigarettes only [28]. A study conducted in different countries within Europe showed that among current smokers, users of only roll-your-own cigarettes represented 8.4% of the whole sample [29]. Another study found that the prevalence of smokers using only roll-your-own cigarettes was 28.4% in the UK, 24.3% in Australia, and 17.1% in Canada, higher than our results [28].

The increase in roll-your-own tobacco users for the period studied is remarkable for both men and women, and those aged 16-44 years. We observed also an increase in roll-your-own tobacco users among people with secondary and university education, specially those aged 16-44 years. The increase in smokers of manufactured cigarettes combined with roll-your-own cigarettes was higher among women than men, and among people aged 16 to 44. According to the data obtained in 2011-2012, we could define the pattern of roll-your-own cigarette users as men, people aged 16-44 years, and people with a higher education level. This pattern is the same as that obtained in other studies focusing on the attributes of roll-your-own cigarette smokers [27,28].

Previous studies including data obtained from the ITC study in Australia, Canada, the UK, and the US found that roll-your-own cigarette users have a higher level of nicotine addiction than manufactured cigarette users [28]. Our results indicate no significant differences in nicotine dependence according to the type of tobacco product smoked, though the percentage of daily smokers with low nicotine dependence was higher among roll-your-own cigarette users than other types of tobacco products smoked. Similar to the ITC study [28] and another study conducted with in Europe [29], we found that roll-your-own cigarette users were more likely to be in the precontemplation stage of change, and our results indicated that none of them were in the preparation stage. Finally, almost all roll-your-own cigarette users reported smoking ≤ 20 CPD with only 7.4% of this group being heavy smokers (>20 CPD). In agreement to the ICT study results [28], we also found that the depth of inhalation among both roll-your-own and mixed manufactured and roll-your-own cigarette smokers was deeper than among manufactured cigarette smokers, though the difference was not significant. According to the smoking

attributes, we could describe the roll-your-own cigarette users as smokers with mainly low dependence on nicotine and no intention to quit, as they claim to smoke a few to a moderate number of cigarettes a day and to inhale more deeply than manufactured cigarette smokers. These smoking patterns among roll-your-own cigarette users and considering they are mainly young people, would make sense with the broad but false belief that roll-your-own tobacco is less harmful than other forms of tobacco, as well as a more positive perception of tobacco use and the satisfactory feeling they produced [28,30].

Contrary to the general belief that roll-your-own cigarettes users are less exposed to the harmful effects than manufactured cigarette users [28], we found that roll-your-own cigarette users have similar cotinine levels as manufactured cigarette users. Furthermore, these cotinine levels were similar for smokers with the same smoking characteristics (FTCD scores, stages of change, and depth and frequency of inhalation). These findings could be explained by people regulating their intake of nicotine to reach the desired doses [31]. An additional explanation could be that nicotine content of roll-your-own cigarettes is higher than in manufactured cigarettes [31,32] and hence eventhough roll-your-own users smoke less cigarettes per day they have similar cotinine levels to manufactured cigarette users.

Public Health Implication

Increases of cigarette prices are associated to decreasing smoking prevalence and number of CPD smoked [33-35]. In Spain, the government has strengthened tobacco policies, including regulations on tobacco taxes. However, these changes have mainly affected manufactured cigarettes, whereas other tobacco products have had less of an increase in taxation and become a cheaper alternative for smokers [12]. Thus, it is not rare to observe such an increase in the proportion of self-reported roll-your-own cigarette users, especially among young and middle-aged people, and considering the collateral effects of the current economic crisis in Spain. Economic crisis may affect smoking behaviour, but current research provides discrepant results. In the last decades of XX century in the US, periods of economic recessions led to a decrease in

the smoking prevalence [36] whilst in Italy the smoking prevalence increased in 2009 compared with 2008 possibly due to the economic crisis [37]. Some population groups (ie, poor, young people) may react in two different ways to economical crisis. Some smokers may decide to quit or reduce their consumption for affordability reasons [38]. In our data, the prevalence of smoking reduced but did not significantly change during the study period. Other groups may react by shifting to cheaper brands or to cheaper forms of tobacco. The cheaper prices of roll-your-own cigarettes have been reported to be the main reason why smokers switch from manufactured cigarettes to roll-your-own cigarettes [30].

Economics is not the only reason to switch from manufactured cigarettes to roll-your-own cigarettes. Some smokers enjoy the ritual of rolling a cigarette, whereas others think roll-your-own cigarettes are more satisfying and taste better [28]. In addition, some smokers think that rolled cigarettes reduce the amount of smoke, contain fewer additives and are safer [28,30]. However, rolling tobacco yields higher nicotine, tar, and carbon monoxide levels than manufactured cigarettes [28,32,39,40]. These reasons mimic the arguments raised several decades ago to favor the use of “less harmful cigarettes” under the mask of low tar and light brands [32].

Limitations and strengths of this study

One potential limitation of the study is information bias derived from the use of a questionnaire to obtain the information. However, we could validate our results on smoking status with salivary cotinine measurements and by excluding self-reported non-smokers with high cotinine concentrations, avoiding misclassification. Another potential limitation derives from the use of the limit of 35 ng/mL of cotinine per one cigarette smoked, as the boundary above which a level would be considered not biologically plausible in relation to the self-reported consumption for roll-your-own and mixed roll-your-own and manufactured cigarette users [31]. However, this limit was obtained in experimental studies with manufactured cigarettes and could be different

for roll-your-own cigarette smokers. To the best of our knowledge, no data on this topic have been published for roll-your-own cigarettes.

This study included representative, random samples of the population of Barcelona, Spain. Although both samples were representative from the target population, some changes in the population with regard to age and education occurred across time. Since the crude estimates are reliable and informative, we opted to present them together with the data in strata of sex, age, and education. This study is the first to systematically evaluate smoking prevalence and smoker attributes before and after the implementation of smoke-free legislation, using cotinine as a biological marker of tobacco consumption, and focusing on manufactured and roll-your-own cigarette users in Spain. Moreover, to the best of our knowledge, this study is the first that considers cotinine levels among smokers according to the type of tobacco product smoked.

Conclusions

It is necessary to systematically collect data on smoking prevalence and smoking attributes, including types of tobacco product consumed, from representative samples of the population for policymakers to develop efficient tobacco control interventions and recommendations for the population. Considering such an increase among roll-your-own cigarette users and the unclear consequences of their use on health, policymakers should aim to implement tax policies to equalize the prices of different types of tobacco products. Moreover, further research is needed to determine exposure to tobacco biomarkers and the health effects of using roll-your-own cigarettes. Specific tobacco control strategies should be developed to tackle roll-your-own cigarette smoking, as this emerging type of tobacco consumption is targeting young people.

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Figure 1. Smoking prevalence among the adult population of Barcelona, Spain (2004-05 and 2011-12).

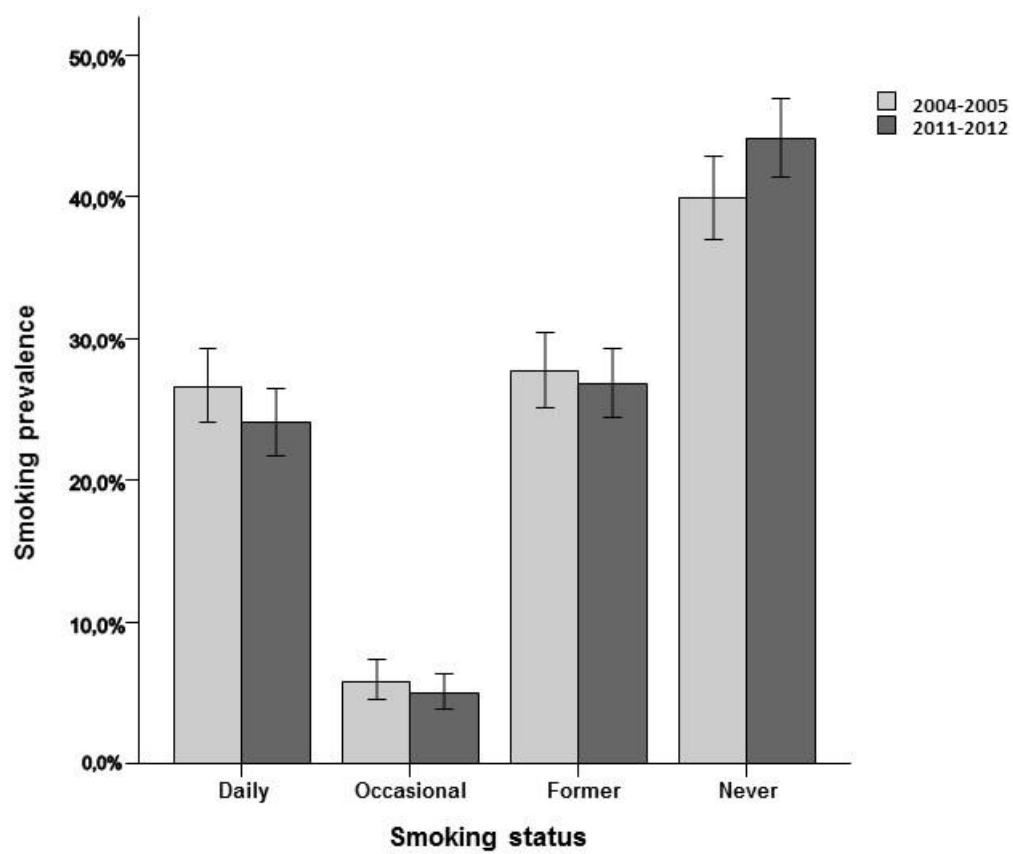
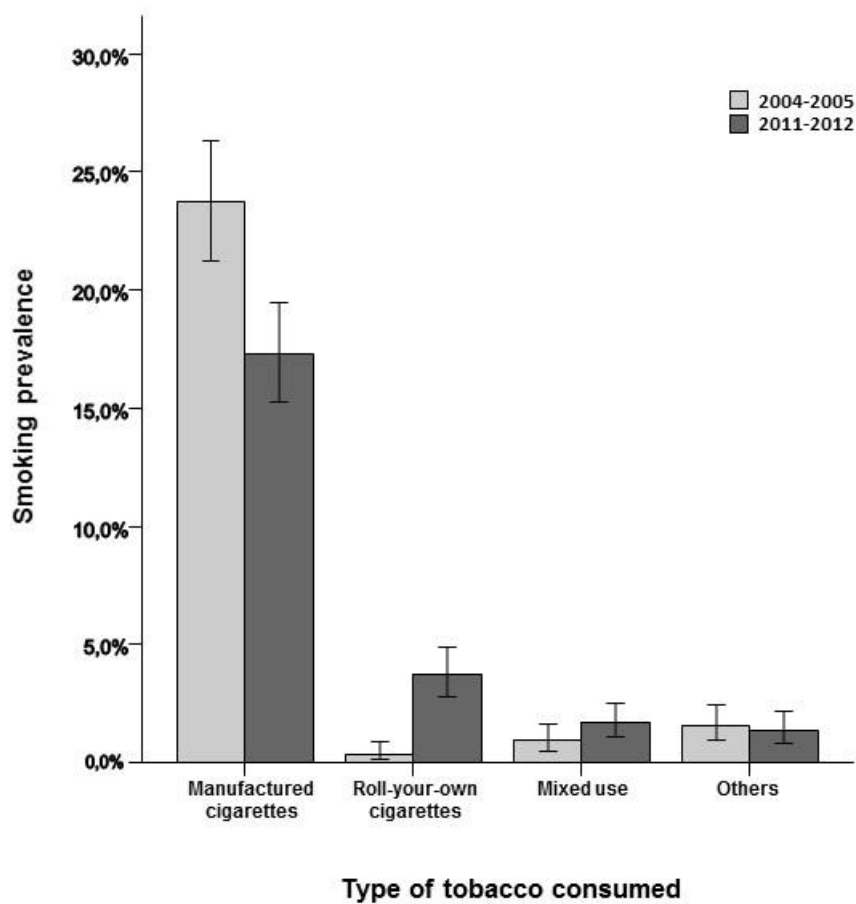


Figure 2. Prevalence of daily smokers among the adult population of Barcelona, Spain (2004-05 and 2011-12), according to the type of tobacco consumed.



Footnote to Figure 2.

Manufactured cigarettes refers to exclusive use of manufactured cigarettes or combined with other tobacco products including cigars, small cigars (puritos), pipes, or other tobacco different from roll-your-own cigarettes.

Roll-your-own cigarettes refers to exclusive use of roll-your-own cigarettes or combined with other tobacco products including cigars, small cigars (puritos), pipes, or other tobacco different from manufactured cigarettes.

Mixed use refers to manufactured and roll-your-own cigarettes combined use (exclusive use of both types or combined with other types of tobacco products).

Other types refers to exclusive use of tobacco products (cigars, small cigars (puritos), pipes, or other tobacco) other than manufactured and roll-your-own cigarettes.

Table 1. Self-reported tobacco product consumption among daily smokers in Barcelona, Spain (2004-05 and 2011-12)

	N		Manufactured cigarettes (%)		Roll-your-own cigarettes (%)		Manufactured and roll-your-own cigarettes (%)		Other types (%)		p-value
	2004-05	2011-12	2004-05	2011-12	2004-05	2011-12	2004-05	2011-12	2004-05	2011-12	
Overall	285	298	89.1	71.8	1.4	15.4	3.5	7.0	6.0	5.7	<0.001

Sex											
Men	158	172	82.9	64.0	1.9	19.8	5.1	6.4	10.1	9.9	<0.001
Women	127	126	96.9	82.5	0.8	9.5	1.6	7.9	0.8	0.0	0.001
Age (years)											
16-44	156	170	91.0	62.9	1.3	22.9	5.1	11.8	2.6	2.4	<0.001
45-64	102	103	90.2	85.4	2.0	5.8	2.0	1.0	5.9	7.8	0.440
≥65	27	25	74.1	76.0	0.0	4.0	-	-	25.9	20.0	0.526
Education level											
Less than primary and primary	96	76	89.6	82.9	2.1	7.9	2.1	5.3	6.3	3.9	0.175
Secondary	98	130	89.8	66.2	1.0	17.7	6.1	11.5	3.1	4.6	<0.001 *
University	89	92	87.6	70.7	1.1	18.5	2.2	2.2	9.0	8.7	0.002 *

*This association was modified by age (see Results text).

Footnote to Table 1.

Manufactured cigarettes refers to exclusive use of manufactured cigarettes or combined with other tobacco products including cigars, small cigars (puritos), pipes, or other tobacco different from roll-your-own cigarettes.

Roll-your-own cigarettes refers to exclusive use of roll-your-own cigarettes or combined with other tobacco products including cigars, small cigars (puritos), pipes, or other tobacco different from manufactured cigarettes.

Mixed use refers to manufactured and roll-your-own cigarettes combined use (exclusive use of both types or combined with other types of tobacco products).

Other types refers to exclusive use of tobacco products (cigars, small cigars (puritos), pipes, or other tobacco) other than manufactured and roll-your-own cigarettes.

Table 2. Smoking attributes of adult daily smokers (manufactured vs roll-your-own) in Barcelona, Spain (2011-12)

	Only manufactured	Only roll-your-own	Manufactured and roll-your-own	p-value
Overall (N)	165	27	10	
Nicotine dependence level (%)				0.151
Low	40.3	52.2	42.9	
Medium	14.1	8.7	42.9	
High	45.6	39.1	14.3	
Stages of change (%)				0.023
Precontemplation	74.5	87.5	70.0	
Contemplation	22.8	12.5	10.0	
Preparation	2.8	-	20.0	
Time to first cigarette (%)				0.501
>60 min	28.5	23.1	40.0	
31-60 min	14.5	26.9	20.0	
6-30 min	35.2	30.8	40.0	
≤5 min	21.8	19.2	-	
Cigarettes per day (CPD) (%)				0.046
≤10	32.7	51.9	-	
11-20	52.1	40.7	70.0	
21-30	10.3	7.4	30.0	
>30	4.8	-	-	
Frequency of inhalation (%)				0.549
All the time	22.6	18.5	10.0	
Half the time	66.5	74.1	90.0	
Seldom	11.0	7.4	-	
Depth of inhalation (%)				0.515
Light	8.0	3.7	10.0	
Moderate	39.3	29.6	20.0	
Deep	52.8	66.7	70.0	
Overall FTCD score, mean (SD)	5.10 (2.22)	4.70 (1.96)	4.57 (1.40)	0.659
Overall CPD, mean (SD)	15.40 (8.88)	12.28 (6.60)	18.21 (5.35)	0.064

Note: We excluded six participants using nicotine gum or nicotine patch for cessation and 18 participants who did not provide a saliva specimen or for whom cotinine determination was not possible. An additional 34 people were excluded because their cotinine concentrations were too high relative to the self-reported consumption, that is, over 35 ng/mL per one cigarette smoked.

Table 3. Salivary cotinine concentrations in daily smokers in Barcelona, Spain (2011-12), according to type of tobacco smoked (manufactured vs. roll-your-own)

	Only manufactured		Only roll-your-own		p-value*	*No n- par am etri c test for ind epe nde nt sam ples . The p- valu e co mp are d the GM of ma nuf act ure d vs. roll- you r- ow n. The co mp
	N	GM (GSD) ng/mL	N	GM (GSD) ng/mL		
Overall	165	185.05 (2.20)	27	186.77 (2.35)	0.778	
Sex						
Men	78	207.06 (2.19)	19	178.07 (2.33)	0.424	
Women	87	167.34 (2.18)	8	209.22 (2.53)	0.376	
Age (years)						
16-44	80	168.00 (2.24)	22	172.66 (2.50)	0.649	
45-64	72	213.99 (2.04)	4	235.34 (1.48)	0.926	
≥65	13	150.07 (2.66)	1	417.16	0.385	
Education level						
Less than primary and primary	48	198.61 (2.05)	5	200.26 (2.11)	1.000	
Secondary	65	191.12 (2.33)	12	255.33 (1.77)	0.273	
University	52	166.49 (2.18)	10	123.97 (2.91)	0.455	
Nicotine dependence level						
Low	60	115.35 (2.11)	12	118.00 (2.64)	0.618	
Medium	21	201.42 (1.97)	2	493.86 (1.27)	0.029	
High	68	279.25 (1.81)	9	269.77 (1.73)	0.800	
Stage of change						
Precontemplation	108	190.46 (2.35)	21	195.16 (2.49)	0.745	
Contemplation	33	211.11 (1.69)	3	282.10 (1.04)	0.317	
Preparation	4	92.75 (1.45)	-	-	-	
Time to first cigarette						
>60 min	47	96.41 (2.15)	6	111.89 (2.38)	0.715	
31-60 min	24	173.90 (1.63)	7	129.81 (2.86)	0.777	
6-30 min	58	235.88 (1.93)	8	249.12 (1.88)	0.814	
≤5 min	36	305.56 (1.80)	5	380.28 (1.16)	0.498	
Cigarettes per day						
≤10	54	90.47 (2.17)	14	105.93 (2.27)	0.339	
11-20	86	245.19 (1.62)	11	346.42 (1.35)	0.015	
21-30	17	292.89 (1.83)	2	331.21 (1.27)	0.690	
>30	8	424.23 (1.31)	-	-	-	
Frequency of inhalation						
All the time	37	200.22 (2.35)	5	191.82 (2.00)	0.771	
Half the time	109	169.51 (2.21)	20	210.81 (2.13)	0.207	
Seldom	18	250.15 (1.58)	2	52.08 (5.21)	0.059	
Depth of inhalation						
Light	13	144.51 (2.32)	1	280.48	0.264	
Moderate	64	181.05 (2.29)	8	93.80 (2.84)	0.058	
Deep	86	193.02 (2.11)	18	247.97 (1.81)	0.192	

arison between manufactured and roll-your-own and both manufactured and roll-your-own cigarette users did not provide any significant differences.