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Evaluation of a smoke-free beaches intervention in Barcelona: a quasi-experimental study

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ABSTRACT

Background We aim to assess the effect of a smoke-free beaches (SFB) intervention in Barcelona on smoking during the 2021 bathing season.

Methods Quasi-experimental pre-post design (pre-intervention period: 15–28 May; post-intervention period: 29 May–12 September). Based on users' profiles and location, four beaches were assigned to the intervention group (IG) and five to the comparison group (CG). The intervention involved: a mayoral decree (29 May), a communication campaign and beach on-site information. We established two 3 m × 3 m transects per beach from the coastline to the promenade. Trained teams collected smoking-related information in the transects through observations and surveys to beach users. Outcomes are as follows: percentage of people reporting witnessing smoking behaviours the last fortnight and percentage of people observed smoking. We calculated and compared prevalence ratios (PRs) with adjusted Poisson regressions.

Results 3751 interviews (1721 IG; 2030 CG) and 1108 observations (498 IG, 610 CG) were carried out. SFB were associated with a significant reduction in the percentage of people reporting witnessing smoking (IG (pre: 87.2%; post: 49.7%); CG (pre: 86.2%; post: 74.1%); PR (95% CI): 0.7 (0.6 to 0.8)); and in the users observed smoking in the beach (IG (pre: 3.8%; post: 3.0%); CG (pre: 2.3%; post: 9.9%); PR (95% CI): 0.3 (0.3 to 0.4)). Satisfaction scores were 8.3 (IG) and 8.1 (CG) out of 10.

Conclusion An SFB intervention is an effective and well-accepted measure to reduce smoking and smokers' visibility. Smoke-free measures should be extended to beaches and other non-regulated outdoor areas.

INTRODUCTION

Secondhand smoke (SHS) exposure causes 1.3 million deaths annually, mainly by increasing the risk of cancer, and cardiovascular and respiratory conditions.^{1,2}

Smoke-free policies have proven to be effective in reducing SHS exposure prevalence in indoor^{3,4} and outdoor⁵ settings. In Europe, however, smoking bans rarely cover outdoor public premises comprehensively,^{6–8} and studies evaluating their effectiveness in outdoor venues are scarce.⁹

Beaches attract large crowds who are potentially exposed to SHS.¹⁰ According to a recent study, beaches are one of the outdoor settings in Europe with a higher presence of people smoking.⁷ Likewise, tobacco is causing massive harm to the environment¹¹ and cigarettes butts and filters are the

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Smoke-free beach interventions, as well as initiatives to regulate outdoor settings, are increasing worldwide and are widely accepted.

WHAT THIS STUDY ADDS

⇒ The results show a significant decrease in the number of people smoking at those beaches where the smoke-free beaches decree was implemented.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ There are very few evaluated experiences of smoke-free beaches and none in the Mediterranean context.

most encountered individual item on Europe's coast.¹² Moreover, such tobacco litter is non-biodegradable, contain more than 7000 environmentally toxic chemicals, and at least 50 are known human carcinogens.¹¹

Smoke-free beaches began in the USA three decades ago¹³ and have spread through local or regional government bans around the world, such as in Australia (2004),¹⁴ Canada (2010),^{15,16} Italy (2011)¹⁷ and Spain (2012).¹⁸ However, only in a few areas, such as Vancouver^{15,16} or New York,^{19,20} the impact of smoke-free beaches was evaluated 10 years ago, with mixed results. We carried out an evaluation for the 2021 bathing season in Barcelona (Spain), a Mediterranean city with approximately 1.7 million inhabitants and more than 4.5 km of beach coastline. The intervention included a mayoral decree forbidding tobacco use on four beaches, accompanied by a communication campaign. This evaluation aimed to assess the effectiveness of smoke-free beaches on tobacco consumption at the beach.

METHODS

We used a quasi-experimental before-after with comparison group design. Study periods were 15–28 May 2021 (pre-intervention) and 29 May–12 September 2021 (post-intervention). Designed following the intervention mapping methodology and policy change methods,^{21–23} the intervention involved (1) a mayoral decree²⁴ banning tobacco use, exclusively on the four beaches of the intervention group (IG), during post-intervention period; (2) a communication campaign in the media and



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Table 1 Characteristics of beaches users; smoke-free beaches project (Barcelona, 2021) (n=3751)

| | Pre-intervention (15–28 May) | | Post-intervention (29 May–12 September) | |
|---|----------------------------------|------------------------------------|---|-------------------------------------|
| | Comparison (n=354) % (95% CI) | Intervention (n=265) % (95% CI) | Comparison (n=1676) % (95% CI) | Intervention (n=1456) % (95% CI) |
| Users by beach | | | | |
| Nova Mar Bella | – | 19.3 (14.9 to 24.4) | – | 26.5 (24.3 to 28.8) |
| Nova Icària | – | 25.7 (20.8 to 31.3) | – | 25.2 (23 to 27.5) |
| Somorrostro | – | 26.8 (21.8 to 32.4) | – | 23.8 (21.7 to 26) |
| Sant Miquel | – | 28.3 (23.2 to 34) | – | 24.5 (22.4 to 26.8) |
| Llevant | 20.6 (16.7 to 25.2) | – | 21.4 (19.5 to 23.4) | – |
| Mar Bella | 17.5 (13.9 to 21.8) | – | 21.6 (19.7 to 23.6) | – |
| Bogatell | 19.2 (15.4 to 23.7) | – | 21.2 (19.4 to 23.3) | – |
| Barceloneta | 19.8 (16 to 23.25) | – | 16.1 (14.4 to 17.9) | – |
| Sant Sebastià | 22.9 (18.8 to 27.5) | – | 19.8 (17.9 to 21.7) | – |
| Age (years) | | | | |
| 16–24 | 16.1 (12.3 to 19.9) | 15.8 (11.4 to 20.3) | 19.5 (17.6 to 21.4) | 18.4 (16.4 to 20.4) |
| 25–34 | 34.2 (29.2 to 39.1) | 41.5 (35.5 to 47.5) | 36.6 (34.3 to 39) | 32.1 (29.7 to 34.5) |
| 35–44 | 24 (19.5 to 28.5) | 22.6 (17.6 to 27.7) | 21.4 (19.4 to 23.4) | 20.2 (18.2 to 22.3) |
| 45–54 | 15.3 (11.5 to 19) | 9.8 (6.2 to 13.4) | 10.4 (8.9 to 11.9) | 12 (10.4 to 13.7) |
| 55–64 | 5.1 (2.8 to 7.4) | 5.7 (2.9 to 8.5) | 6.7 (5.5 to 7.9) | 8.9 (7.5 to 10.4) |
| ≥65 | 5.4 (3.0 to 7.7) | 4.5 (2.0 to 7.0) | 5.3 (4.3 to 6.4) | 8.3 (6.8 to 9.7) |
| Gender | | | | |
| Woman | 51.4 (46.2 to 56.6) | 62.3 (56.4 to 68.1) | 55.4 (53 to 57.8) | 59.1 (56.6 to 61.6) |
| Man | 47.7 (42.5 to 53) | 37.7 (31.9 to 43.6) | 42.9 (40.5 to 45.3) | 40.5 (38 to 43) |
| Others | 0.8 (0 to 1.8) | 0 | 1.7 (1.1 to 2.3) | 0.4 (0.1 to 0.7) |
| Place of residence | | | | |
| Barcelona | 72.3 (67.6 to 77) | 74.3 (69.1 to 79.6) | 49 (46.6 to 51.4) | 53.2 (50.6 to 55.8) |
| Rest of Catalonia | 15.5 (11.8 to 19.3) | 12.5 (8.5 to 16.4) | 16.8 (15 to 18.6) | 14.8 (13 to 16.6) |
| Rest of Spain | 4.5 (2.3 to 6.7) | 1.5 (0.0 to 3.0) | 9.1 (7.8 to 10.5) | 7.3 (6.0 to 8.6) |
| Out of Spain | 7.6 (4.9 to 10.4) | 11.7 (7.8 to 15.6) | 25.1 (23 to 27.2) | 24.7 (22.5 to 26.9) |
| Smoking status | | | | |
| Non-smoker | 64.1 (59.1 to 69.1) | 65.7 (59.9 to 71.4) | 58.3 (55.9 to 60.6) | 71.6 (69.3 to 73.9) |
| Occasional smoker | 16.1 (12.3 to 19.9) | 15.8 (11.4 to 20.3) | 13.4 (11.8 to 15.1) | 10.7 (9.1 to 12.3) |
| Daily smoker | 19.8 (15.6 to 23.9) | 18.5 (13.8 to 23.2) | 28.3 (26.1 to 30.4) | 17.7 (15.7 to 19.6) |
| Socioeconomic status* | | | | |
| <0.70 | 14.5 (10.1 to 18.8) | 8.6 (4.7 to 12.6) | 15.1 (12.8 to 17.4) | 9.8 (7.6 to 11.9) |
| 0.70 a 0.90 | 22.3 (17.1 to 27.4) | 25.4 (19.3 to 31.5) | 22.2 (19.5 to 24.8) | 24.1 (21.1 to 27.2) |
| 0.90 a 1.10 | 43.4 (37.3 to 49.5) | 39.1 (32.2 to 45.9) | 39.6 (36.4 to 42.7) | 42.7 (39.2 to 46.3) |
| 1.10 a 1.30 | 10.2 (6.4 to 13.9) | 10.7 (6.3 to 15) | 12.8 (10.6 to 14.9) | 12.3 (9.9 to 14.6) |
| >1.30 | 9.8 (6.1 to 13.4) | 16.2 (11.1 to 21.4) | 10.4 (8.5 to 12.4) | 11.1 (8.8 to 13.3) |
| District of residence in Barcelona | | | | |
| Ciutat Vella | 18.4 (13.6 to 23.1) | 17.3 (11.9 to 22.6) | 12.3 (10 to 14.6) | 13.7 (11.3 to 16.2) |
| Eixample | 25.8 (20.4 to 31.2) | 23.4 (17.4 to 29.3) | 18.9 (16.2 to 21.6) | 20.3 (17.4 to 23.2) |
| Sants-Montjuïc | 9 (5.5 to 12.5) | 8.1 (4.3 to 12) | 10.6 (8.4 to 12.7) | 6.5 (4.7 to 8.2) |
| Les Corts | 2.7 (0.7 to 4.7) | 1 (-0.4 to 2.4) | 1.7 (0.8 to 2.6) | 1.8 (0.9 to 2.8) |
| Sarrià-Sant Gervasi | 1.2 (0.2 to 2.5) | 4.6 (1.6 to 7.5) | 2.9 (1.7 to 4) | 1.6 (0.7 to 2.5) |
| Gràcia | 6.3 (3.3 to 9.2) | 10.7 (6.3 to 15) | 8.1 (6.2 to 10) | 5.7 (4.0 to 7.3) |
| Horta-Guinardó | 4.3 (1.8 to 6.8) | 4.6 (1.6 to 7.5) | 5.2 (3.7 to 6.8) | 8.7 (6.7 to 10.7) |
| Nou Barris | 1.6 (0 to 3.1) | 1 (-0.4 to 2.4) | 3.2 (2.0 to 4.5) | 4.1 (2.7 to 5.5) |
| Sant Andreu | 7.8 (4.5 to 11.1) | 5.6 (2.4 to 8.8) | 7.1 (5.3 to 8.9) | 6.9 (5.1 to 8.7) |
| Sant Martí | 23 (17.9 to 28.2) | 23.9 (17.9 to 29.8) | 30.1 (26.9 to 33.2) | 30.7 (27.4 to 34) |

Missing values=1.1%.

*Disposable Income per Capita Index 2019 (Barcelona reference=€122 229) ranging from <0.70 (most deprived) to >1.30 (least deprived)²⁷; only assigned to users living in the city of Barcelona: N Pre (IG: 197; CG: 256); N Post (IG: 758; CG: 805).

CG, comparison group; IG, intervention group.

social networks; and (3) on-site information at the beach: signage, loudspeakers regularly informing about the ban and teams of trained informants.²⁵

To achieve similar groups, the research team assigned four beaches to the IG and five to the CG considering the profile of their users (ie, families, teenagers and sports activities) and

Table 2 Comparison of tobacco use on beaches by groups (intervention and comparison), before and after the intervention; smoke-free beaches project (Barcelona, 2021)

| | | Pre-intervention % (N) | Post-intervention % (N) | Difference (Post–Pre) % | PR (95% CI) |
|--|--------------|---------------------------|----------------------------|----------------------------|-------------------|
| People witnessing smoking on the beach in the last fortnight | Comparison | 86.2 (354) | 74.1 (1669) | –12.1 | 1 |
| | Intervention | 87.2 (265) | 49.7 (1447) | –37.5 | 0.7 (0.6 to 0.8)* |
| | P value† | 0.91 | <0.001 | | |
| People observed smoking on the beach by the observation team | Comparison | 2.3 (388) | 9.9 (4008) | 7.6 | 1 |
| | Intervention | 3.8 (266) | 3 (2542) | –0.8 | 0.3 (0.3 to 0.4)‡ |
| | P value† | 0.28 | <0.001 | | |

*Robust Poisson regression with pre-post interaction adjusted by age, gender, smoking status, place of residence and socioeconomic level of Barcelona neighbourhood.
†P value χ^2 .
‡Crude robust Poisson regression.
PR, prevalence ratio.

location (that they were not adjacent to each other) (see online supplemental figure S1). We estimated that a sample of 2890 beach users (1445 per group) would allow us to detect a significant difference of 2% between the IG and CG.

Data were collected, as done in previous studies,^{15 19 26} on weekdays and weekends (from 11:30 to 18:00). On each beach, two standardised sections were established perpendicular to the sea from the coastline to the promenade, divided into 3 m × 3 m quadrants (18 transects), as shown in online supplemental figure S2.

In each transect, trained teams administered face-to-face questionnaires to beach users aged 16 years and older, after oral consent, asking for sociodemographic characteristics (place of residence, neighbourhood, age, gender, smoking status); having witnessed people smoking on the beach in the last 15 days (response options: never, sometimes, often, most of the time, don't know); and satisfaction with the smoke-free beaches (SFB) project (scores from 0 to 10). For beach users living in Barcelona, we assigned a socioeconomic status based on their neighbourhood's score on a socioeconomic index of household disposable income per capita ranging from <0.70 (most deprived) to 1.30 (least deprived).²⁷

In the transects, trained teams counted the number of people who smoked, put out or lit a cigarette, and the total number of beach users in daily 20-minute non-participant observations, with 5-minute interval.

Outcome variables were (1) percentage of people witnessing smoking on the beach in the last fortnight and (2) percentage of people observed smoking by the observation teams. We ran descriptive analyses and compared study outcomes between groups before and after the intervention using χ^2 tests and robust Poisson regressions to calculate adjusted prevalence ratios (with 95% CIs). Statistical analyses were performed with STATA V.15.2.

RESULTS

In total, 3751 beach users were interviewed (pre-intervention period: 619 (IG: 265; CG: 354); post-intervention period: 3132 (IG: 1456; CG: 1676)), with 1.1% (41) beach users refusing to participate. The trained teams performed 1108 observations (pre-intervention period: 144 observations (IG: 64; CG: 80); post-intervention period: 964 observations (IG: 434; CG: 530)) in which 7204 beach users were observed.

In the pre-intervention period, there were no differences in sociodemographic variables and beach users' smoking status between study groups (table 1). In the post-intervention period, the percentage of beach users who were daily smokers (IG: 17.7

(95% CI: 15.7 to 19.6) vs CG: 28.3 (95% CI: 26.1 to 30.4)), who identified with other genders (IG: 0.4 (95% CI: 0.1 to 0.7) vs CG: 1.7 (95% CI: 1.1 to 2.3)) and living in the most deprived neighbourhoods (IG: 9.8 (95% CI: 7.6 to 11.9) vs CG: 15.1 (95% CI: 12.8 to 17.4)) were higher in the CG, whereas the percentage of non-smokers (IG: 71.6 (95% CI: 69.3 to 73.9) vs CG: 58.3 (95% CI: 55.9 to 60.6)), and beach users over 65 years (IG: 8.3 (95% CI: 6.8 to 9.7) vs CG: 5.3 (95% CI: 4.3 to 6.4)) were higher in the IG.

The results show a 30% significant reduction in the percentage of beach users who reported noticing someone smoking, and a 70% significant reduction of beach users observed smoking in the IG compared with CG beaches after the intervention (table 2).

Interviewed users rated their satisfaction with the SFB project on a 1–10 scale, with an 8.3 score in IG and an 8.1 score in the CG (data not shown in the tables).

DISCUSSION

The evaluation of the Barcelona SFB intervention indicates that banning smoking is a feasible and well-accepted measure to decrease tobacco consumption on the city's beaches.

These findings are consistent with previous literature^{15 19 20} assessing the presence of smokers and smoking litter in recreational areas, before and after introducing a smoking ban. Two studies analysed the effects of the 2011 New York City parks and beaches smoking ban.^{19 20} The evaluation over a year of the law taking effect proved a significant decline in the visibility of smoking behaviours.²⁰ Similarly, the 2010 smoke-free bylaw on parks and beaches in Vancouver evaluation described a decrease in the presence of smokers, only in parks.¹⁵

The percentage of users declaring witnessing people smoking on the beach before the municipal decree was similar to the presence of smokers reported for beaches in Spain (87.7%).⁷ After the intervention, the proportion of users who were daily smokers increased in the CG and of users who were non-smokers in the IG, suggesting a displacement of smokers to areas where smoking is still permitted. This result mirrors what has been described in terraces of hospitality venues.²⁸ Moreover, the increase of older users in smoke-free beaches after the intervention may show a positive effect on a vulnerable population.

In terms of satisfaction, previous research assessing the attitudes towards smoke-free legislation in Spain found that beaches were among the least supported outdoor settings.²⁹ These results differ from the positive reception of smoke-free beaches in Barcelona and could be explained by respondents prioritising areas devoted to children and healthcare. Our results were similar to those obtained in Vancouver, where smoke-free beaches were

What this paper adds

- ⇒ Smoke-free beaches (SFB) interventions are increasing worldwide, but the literature evaluating the effectiveness of such measures is scarce.
- ⇒ The present study evaluated the effects of the Barcelona SFB initiative in the summer of 2021 using a quasi-experimental study design.
- ⇒ The results show a significant decrease in smoking behaviours on SFB after the local ordinance.
- ⇒ Our findings suggest that SFB is a feasible and well-accepted measure to decrease tobacco product use on beaches and similar measures should be extended to other non-regulated outdoor areas such as parks and terraces of hospitality venues.

supported by 84.2% of the interviewees.³⁰ Growing support for smoke-free outdoor spaces might reflect the increasing denormalisation of outdoor smoking behaviours over the years.³¹

To complement the reach of this study, trained civic entities, in collaboration with the Council, counted once a month, from May to August, the number of discarded cigarette butts on one IG beach (Nova Icaria) and in one CG (Bogatell) (online supplemental figure S3). Although the low number of butt pick-ups did not allow us to perform hypothesis tests, the results showed a reduction of cigarette waste in the IG compared with the beaches in the CG. The low number of cigarette butts collected in the pre-intervention period was probably an effect of low beach attendance before the peak bathing season. The seeming reduction in butt collection is consistent with the New York study results, which found a significant reduction in tobacco litter on beaches and parks over a short period after law implementation.¹⁹ However, this differs from the Vancouver study, which did not find a reduction of cigarette-related litter on beaches over 3 years.¹⁶ Recently, to curb the impact of cigarette butts on the marine environment, Spain has passed Law 7/2022 on waste and contaminated soils, which allows municipalities to regulate smoking on beaches to reduce the generation of waste at these venues.³²

One limitation of this study is the different influx of users and length of intervention periods pre (May) and post (June–September). Even so, this variability will have affected the IG and CG in the same way. On the other hand, the profile of users might differ between study periods, so we adjusted the analysis of the visibility of smoking behaviours by sociodemographic variables. Also, a proportion of smokers may have chosen to use the comparison group beaches. Even though, we found a decrease in people witnessing smoking on the beach in both groups. Finally, data were collected immediately after the intervention, limiting our results to the short-term effect. Among the main strengths of these study are the use of standardised and previously employed methodology to assess smoking behaviours and the presence of a control group.

The implementation in Barcelona of new smoke-free recreational spaces had a positive impact and contributed to denormalising tobacco use in outdoor settings. The results of the study prompted a smoking ban on all the city's beaches in the 2022 bathing season.³³ This study provides new evidence on the effectiveness of outdoor smoking bans and supports the extension to other non-regulated outdoor areas.

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Contributors ED, SV, MJL, PL, PG, AR-C and MIP conceptualised and designed the study. SV, PL, PG, AR and ED coordinated the implementation of the intervention. KG and SV performed statistical analysis and drafted the first version of the manuscript. ED and MJL supervised the analysis. All authors contributed to the interpretation of the results, critically revised the manuscript and agreed with the final version of the manuscript. Guarantor: ED.

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Patient consent for publication Not applicable.

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