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# Temporal Evolution and Associated Factors of Adherence to Mammography Screening among Women in Spain: Results from Two National Health Surveys (2017–2020)

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**Abstract:** Ensuring equity in cancer screening is recommended by the European Commission. Despite the fact that breast cancer screening is a free population-based program in Spain, there remains considerable variation in the adherence to screening rate among population groups. This study was designed to describe the adherence of breast cancer screening in women in Spain, to evaluate the evolution in the period from 2017 to 2020, and to determine the variables that influence choosing to undergo breast cancer screening. A nationwide cross-sectional study with 7220 females aged 50–69 years from the 2017 Spanish National Health Survey and the 2020 European Health Survey for Spain was performed. We investigated mammography uptake rates, with socio-demographic factors, lifestyle habits, and health-related characteristics as independent variables. Multivariable logistic regression was used to identify the associated factors of mammography adherence. Of the women, 78% had undergone mammography in the previous two years, and there was a significant decrease in the uptake rate for breast cancer screening from 2017 (81.23%) to 2020 (74.68%) ($p < 0.001$). Educational level, marital status, residential location, nationality, smoking status, alcohol consumption, and leisure-time physical activity were all associated factors of mammography uptake.

**Keywords:** breast neoplasms; guideline adherence; healthcare disparities; mammography; mass screening



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## 1. Introduction

Breast cancer is the most frequent disease and the leading cause of cancer mortality globally. By 2040, the number of newly diagnosed cases is projected to increase by over 40%, while deaths are expected to rise by more than 50% [1]. In Europe, an estimated 384,800 women were diagnosed with breast cancer, and 98,500 died from this cause in 2022 [2]. Surprisingly, the death rates for breast cancer in Spain are among the lowest among European Union member countries [3].

Nowadays, despite the decreased sensitivity of mammography shown in women with high breast density (which varies from 43 to 60%) [4], mammography is the only method used for screening [5], which has been shown to reduce breast cancer-related mortality [6–8], enabling early breast cancer therapy and limiting the need for severe treatment such as mastectomy [9]. In Spain, a population screening program for breast cancer based on biennial mammography is available to females aged 50 to 69 who have had no family history of the disease [10]. At the age of 40, women with risk indicators are asked to join the program. Nevertheless, several private healthcare centers provide yearly mammograms from the age of 40 [11]. Currently, all women in the target group are individually invited every two years (by post and/or phone) to have a mammogram [12].

Previous studies have found that population-based cancer screening programs have led to a reduction in breast cancer mortality [13,14]. Nevertheless, the success of cancer screening programs is determined by the uptake rate among target groups [15]. As a result, it is important to research screening adherence and discover the factors that influence having breast cancer screening performed. Various Spanish research projects in this area have found varying adherence rates for mammography screening (from 72% to 80%) [11,16], with increased (82.6%) [16] and decreased (62%) [14] involvement in recent years. On the other hand, some determinants of mammography screening attendance are suggested by the scientific literature, including women's socioeconomic level and certain lifestyle choices [17]. The lower involvement of less educated women is especially striking [18]. Similarly, ethnic minorities [19], rural living [20], and less healthy lifestyle behaviors [21] are linked to lower rates of screening attendance. Nonetheless, at this time, it is critical to understand the positive and negative characteristics related to breast cancer screening adherence as this will provide guidance for local health care providers and health departments in developing and implementing steps to reduce this imbalance.

The Spanish population may be regarded as a suitable target group for examining the variables related to the screening program adoption rate [14]. The current study's main goals were to describe the adherence of breast cancer screening in women in Spain, to evaluate the evolution in the period from 2017 to 2020, and to determine the variables that influence having breast cancer screening performed.

## 2. Materials and Methods

Data from the Spanish National Health Survey (SNHS, 2017) [22] and the European Health Survey for Spain (EHSS, 2020) [23] were used to carry out a cross-sectional study. The data for the SNHS 2017 were gathered from October 2016 to October 2017, and the data for the EHSS 2020 were gathered from July 2019 to July 2020. Both surveys were conducted by the National Statistics Institute, under the auspices of the Spanish Ministry of Health and Social Affairs, and both were home-based computer-assisted personal interviews that obtained a representative sample of non-institutionalized persons (aged 15 and above) who lived in family homes (households) in Spain. The sampling design was multistage probabilistic, stratified by census areas (first stage), family homes (second stage), and individuals (third stage). An adult from each household was randomly chosen to complete the survey and was mailed the rationale behind the questionnaire, as well as the characteristics and anonymous nature of their participation.

For the current research, we selected 7220 women aged 50–69 years for mammography update evaluation (SNHS 2017: n = 3709; EHSS 2020: n = 3511) based on screening guideline age groups (18). The sample initially included 7902 women aged 50–69 years, of whom 682 respondents (9.45%) were later excluded owing to their reluctance to answer the questions (SNHS 2017: n = 320; EHSS 2020: n = 362), despite having identical characteristics to the other women.

The variables were determined by the questions included in the questionnaires, which were the same in all the surveys.

The dependent variable was breast cancer screening uptake, which was measured by asking, "Have you ever had a mammogram?" Those who said yes were then asked, "When was the last time you had a mammogram?" According to the classification of women who complied with the recommended screening period [24], those who reported having their most recent mammography within the past two years were called "uptakers". The remaining participants were labeled "non-uptakers".

The independent variables were as follows:

– Socio-demographic: age group (50–56/57–63/64–69 years), educational level (without studies/primary/secondary/university), marital status (single/married/widowed/separated or divorced), residential location (rural/urban) [25], nationality (Spanish/foreigner), and social class. The social class was determined based on the neo-Weberian classification, the origins of which lie in the occupation of the primary breadwinner as developed by the Working Group on Determinants of the Spanish Society of Epidemiology [26]: upper social class (directors and managers of companies with 10 or more employees and professionals normally qualified with university degrees, directors and managers of companies with fewer than 10 salaried employees, professionals normally qualified with university degrees, other technical support professionals, athletes, and artists), middle social class (intermediate professions and self-employed workers, supervisors and workers in skilled technical work), and lower social class (skilled workers in the primary sector and other semi-skilled workers and unskilled workers).

– Health status: number of chronic conditions (0/1/$\geq$2), self-perceived health status (very good/good, fair, poor, very poor), type of healthcare insurance (public/private), and visits to the primary care physician in the previous four weeks (yes/no). The existence of physician-diagnosed mental disorders, such as chronic anxiety, chronic depression, and other mental diseases, was assessed based on self-reported occurrence. Any woman diagnosed with one or more of these three disorders was labeled as "suffering a mental illness".
– Lifestyle behaviors: body mass index (underweight/normal weight/overweight/obesity) [27], smoking status (never smoker/former smoker/current smoker), alcohol use (never/former/current), and leisure-time physical activity (non/lower [occasional–several times a month]/higher [several times a week]).

The anonymized data are available to the general public on the website of the Ministry of Health, Consumer Affairs and Social Welfare [22,23]. The study was evaluated by the Research Ethics Committee of Córdoba (Spain), and it was determined that ethical approval was not necessary because secondary data were used, and the database was obtained from the website of Spanish Ministry of Health, which is accessible to the public.

The categorical variables were expressed as frequencies and percentages. Chi-squared test was used to make comparisons in the variable distributions between 2017 and 2020 and to detect significant changes in mammography adherence from 2017 to 2020. Last, a binary logistic regression was performed. The dependent variable was adherence to mammography screening, with two possible values: uptakers (yes) and non-uptakers (no). The independent variables were socio-demographic factors, health status, and lifestyle behaviors. Those factors with >2 categories were incorporated into the model via dummy variables.

The independent variables were introduced one by one into the crude model. Those with a potential relationship with dependent variable ($p \leq 0.15$) were included in the multivariable model, and non-significant variables were excluded, using backward selection based on the likelihood of the Wald statistic. All possible interaction terms between variables in the logistic regression model were taken into consideration. The crude and adjusted odds ratios (ORs) with their 95% confidence intervals were used to measure the strength of association. The Nagelkerke $R^2$, Hosmer–Lemeshow statistics, and $-2$ log likelihood ($-2$ LL) change in deviance were calculated as measures of model fit. The level of statistical significance was fixed at $\alpha = 0.05$. All analyses in this study were based on the unweighted data due to the nature of our research question and also following the recommendations of other authors [28]. SPSS 25.0 software, licensed to the University of Córdoba (Spain), was used to conduct the statistical analysis.

## 3. Results

The records of 7220 women residing in Spain over 50 years of age were analyzed, resulting in a mean age of 59.15 (SD $\pm$ 5.69) years old. In 2017, and compared with 2020, women were more frequently married (2017: 63.39%, 2020: 58.93%, $p < 0.001$), belonged to the lower social class (2017: 48.58%, 2020: 45.54%, $p < 0.01$), had primary studies (2017: 22.54%, 2020: 19.11%, $p < 0.001$), lived in rural settings (2017: 42.68%, 2020: 45.00%, $p = 0.04$), perceived a better health status (2017: 8.41%, 2020: 6.58%, $p < 0.01$), had $\geq$2 chronic conditions (2017: 31.63%, 2020: 26.92%, $p < 0.001$), visited a general practitioner (2017: 34.92%, 2020: 26.55%, $p < 0.001$), and were overweight (2017: 36.07%, 2020: 35.63%, $p = 0.02$). Table 1 shows the uptake rates for mammography based on socio-demographic characteristics, health-related status, and lifestyle behaviors. Compliance with mammography practice was higher in women who were married, were born in Spain, had a university education, belonged to the upper class, and lived in rural settings. Moreover, a higher mammography adherence was found among women with private health insurance, those who visited a general practitioner in the four weeks preceding the survey completion, and those who had two or more chronic diseases. However, lower uptake was associated with former alcohol use, being underweight, being a current smoker, and not doing physical activity during leisure time.

**Table 1.** Uptake of mammography according to socio-demographic characteristics, health-related status, and lifestyle behaviors (N = 7220).

| **Variables** | **Uptake of Mammography** | | | **$p$-Value** |
|---|---|---|---|---|
| | **Total n (%)** | **Yes n = 5635 (%)** | **No n = 1585 (%)** | |
| Age group | | | | |
| 50–56 years old | 2667 (36.94) | 2083 (78.10) | 584 (21.90) | 0.22 |
| 57–63 years old | 2570 (35.60) | 2029 (78.95) | 541 (21.05) | |
| 64–69 years old | 1983 (27.47) | 1523 (76.80) | 460 (23.20) | |
| Educational level | | | | |
| Without studies | 495 (6.86) | 352 (71.11) | 143 (28.89) | <0.001 *** |
| Primary | 1507 (20.87) | 1145 (75.98) | 362 (24.02) | |
| Secondary | 3808 (52.74) | 3000 (78.78) | 808 (21.22) | |
| University | 1410 (19.53) | 1138 (80.71) | 272 (19.29) | |
| Marital status | | | | |
| Single | 922 (12.77) | 658 (71.37) | 264 (28.63) | <0.001 *** |
| Married | 4420 (61.22) | 3554 (80.41) | 866 (19.59) | |
| Widowed | 875 (12.12) | 685 (78.29) | 190 (21.71) | |
| Separated or divorced | 1003 (13.89) | 738 (73.58) | 265 (26.42) | |
| Social class | | | | |
| Lower | 3401 (47.11) | 2600 (76.45) | 801 (23.55) | <0.01 ** |
| Middle | 2441 (33.81) | 1927 (78.94) | 514 (21.06) | |
| Upper | 1378 (19.09) | 1108 (80.41) | 270 (19.59) | |
| Residential location | | | | |
| Urban | 3163 (43.81) | 2403 (75.97) | 760 (24.03) | <0.001 *** |
| Rural | 4057 (56.19) | 3232 (79.66) | 825 (20.34) | |
| Nationality | | | | |
| Spanish | 6929 (95.97) | 5486 (78.91) | 124 (42.61) | <0.001 *** |
| Foreigner | 291 (4.03) | 167 (57.39) | 1461 (21.09) | |
| Number of chronic conditions | | | | |
| 0 | 2815 (38.99) | 2142 (76.09) | 673 (23.91) | <0.01 ** |
| 1 | 2287 (31.68) | 1806 (78.97) | 481 (21.03) | |
| ≥2 | 2118 (29.34) | 1687 (79.65) | 431 (20.35) | |
| Mental illness | | | | |
| No | 5666 (78.48) | 4401 (77.67) | 1265 (22.33) | 0.14 |
| Yes | 1554 (21.52) | 1234 (79.41) | 320 (20.59) | |
| Self-perceived health status | | | | |
| Very good | 925 (12.81) | 719 (77.73) | 206 (22.27) | 0.53 |
| Good | 3693 (51.15) | 2896 (78.42) | 797 (21.58) | |
| Fair | 1892 (26.20) | 1482 (78.33) | 410 (21.67) | |
| Poor | 543 (7.52) | 415 (76.43) | 128 (23.57) | |
| Very poor | 167 (2.31) | 123 (73.65) | 44 (26.35) | |

**Table 1.** *Cont.*

| Variables | Uptake of Mammography | | | |
|---|---|---|---|---|
| | Total n (%) | Yes n = 5635 (%) | No n = 1585 (%) | *p*-Value |
| Type of healthcare insurance | | | | 0.03 * |
| Public | 6840 (5.26) | 5321 (77.79) | 1519 (22.21) | |
| Private | 380 (5.26) | 314 (82.63) | 66 (17.37) | |
| Visits to the primary care physician in the previous 4 weeks | | | | 0.01 * |
| No | 4993 (69.16) | 3856 (77.23) | 1137 (22.77) | |
| Yes | 2227 (30.84) | 1779 (79.88) | 448 (20.12) | |
| Body mass index | | | | 0.03 * |
| Normal weight | 3146 (43.57) | 2476 (78.70) | 670 (21.30) | |
| Underweight | 131 (1.81) | 89 (67.94) | 42 (32.06) | |
| Overweight | 2589 (35.86) | 2021 (78.06) | 568 (21.94) | |
| Obesity | 1354 (18.75) | 1049 (77.47) | 305 (22.53) | |
| Smoking status | | | | <0.001 *** |
| Never smoker | 3695 (51.18) | 2871 (77.70) | 824 (22.30) | |
| Former smoker | 1831 (25.36) | 1497 (81.76) | 334 (18.24) | |
| Current smoker | 1694 (23.46) | 1267 (74.79) | 427 (25.21) | |
| Alcohol use | | | | <0.001 *** |
| Never | 1732 (23.99) | 1307 (75.46) | 425 (24.54) | |
| Former | 1128 (15.62) | 823 (72.96) | 305 (27.04) | |
| Current | 4360 (60.39) | 3505 (80.39) | 855 (19.61) | |
| Leisure-time physical activity | | | | <0.001 *** |
| Non | 2446 (33.88) | 1802 (73.67) | 644 (26.33) | |
| Lower | 2937 (40.68) | 2353 (80.12) | 584 (19.88) | |
| Higher | 1837 (25.44) | 1480 (80.57) | 357 (19.43) | |

Statistical test used: Chi-squared test. Significance at the level: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Of the total of women aged 50–69 years, 78% had received breast cancer screening in the previous two years. There was a significant decrease in mammography adherence during the previous two years in 2020 (79.22%) with respect to 2017 (85.59%) ($p < 0.001$). Moreover, the percentage of women who attended the screening between >2–3 years (2017: 8.04%, 2020: 13.29%, $p < 0.001$) and more than 3 years (2017: 6.36%, 2020: 7.49%, $p < 0.001$) was lower in 2017 than in 2020 (Figure 1).

In general, the mammography uptake rate decreased from 2017 to 2020 in each group of analyzed variables, except for people with university studies and those who were single, were foreigners, had public insurance, belonged to the upper social class, and had a self-perceived very poor health status, in which the mammography uptake rate did not vary over time. On the contrary, the compliance increased from 2017 to 2020 among women who had private insurance (Table 2).

A number of determinants were associated with mammography adherence in 2017 and 2020 (Table 3). In 2017, women with secondary and university studies had 37% and 45% higher odds of compliance (OR = 1.37, 95% CI 1.01–1.85 and OR = 1.45, 95% CI 1.02–2.07, respectively). Being married was associated with 86% higher odds of adherence (OR = 1.86 95% CI 1.46–2.38). Similarly, current alcohol consumption and higher levels of physical activity during leisure time were both associated with 30% and 46% higher odds of mammography uptake (OR = 1.30, 95% CI 1.19–1.75 and OR = 1.46, 95% CI 1.16–1.82, respectively). On the contrary, the odds of adherence decreased 63% among foreigner women (OR = 0.37, 95% CI 0.26–0.52), 27% in the case of current smokers (OR = 0.73, 95% CI

0.59–0.89), and 16% in women who lived in rural settings (OR = 0.84, 95% CI 0.71–0.93). The probability of adherence to mammography screening is given by the following equation:

$$P\ (\text{adherence}) = 1/(1 + e^{-Z})$$

$$Z = \text{logit}\ (P) = 0.508 + 0.17X_1 + 0.32X_2 + 0.37X_3 + 0.62X_4 + 0.75X_5 + 0.27X_6 - 0.17X_7 - 0.99X_8 + 0.02X_9 - 0.32X_{10} - 0.33X_{11} + 0.26X_{12} + 0.19X_{13} + 0.38X_{14}$$

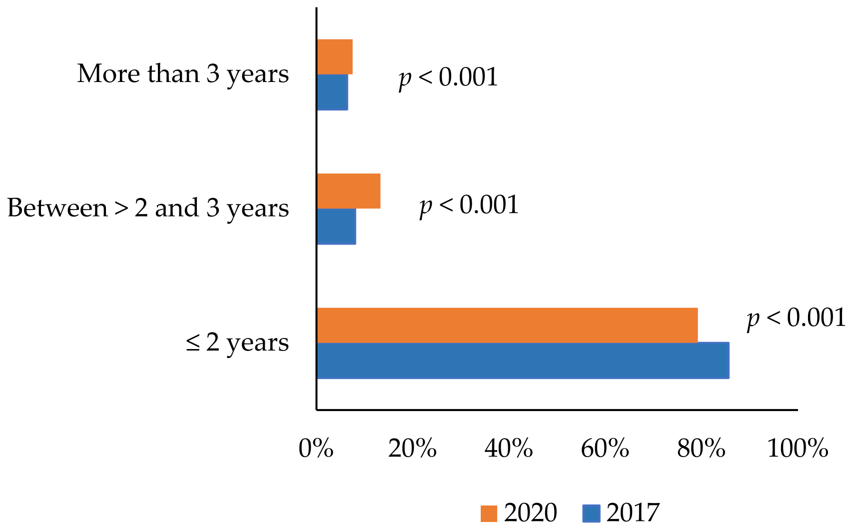


**Figure 1.** Frequency of mammography adherence in the period 2017–2020 in Spain.

**Table 2.** Distribution of uptakers of mammography, according to sociodemographic, health, and lifestyle variables from 2017 to 2020 (n = 5635).

| **Variables** | **Mammography Screening (n = 5635)** | | |
|---|---|---|---|
| | **2017 n = 3013 n (%)** | **2020 n = 2622 n (%)** | ***p*-Value** |
| Age group | | | |
| 50–56 years old | 1140 (80.91) | 943 (74.96) | <0.001 *** |
| 57–63 years old | 1061 (81.99) | 968 (75.86) | <0.001 *** |
| 64–69 years old | 812 (80.72) | 711 (72.77) | <0.001 *** |
| Educational level | | | |
| Without studies | 246 (77.12) | 106 (60.23) | <0.001 *** |
| Primary | 671 (80.26) | 474 (70.64) | <0.001 *** |
| Secondary | 1554 (81.96) | 1446 (75.63) | <0.001 *** |
| University | 542 (82.37) | 596 (79.26) | 0.14 |
| Marital status | | | |
| Single | 313 (72.29) | 345 (70.55) | 0.61 |
| Married | 1959 (83.33) | 1595 (77.09) | <0.001 *** |
| Widowed | 392 (83.94) | 293 (71.81) | <0.001 *** |
| Separated or divorced | 349 (76.20) | 389 (71.38) | 0.09 |
| Social class | | | |
| Lower | 1453 (80.63) | 1147 (71.73) | <0.001 *** |
| Middle | 1022 (81.89) | 905 (75.86) | <0.001 *** |
| Upper | 538 (81.64) | 570 (79.28) | 0.27 |
| Residential location | | | |
| Urban | 1257 (79.41) | 1146 (72.53) | <0.001 *** |
| Rural | 1756 (82.60) | 1476 (76.44) | <0.001 *** |

**Table 2.** *Cont.*

| Variables | Mammography Screening (n = 5635) | | |
|---|---|---|---|
| | **2017 n = 3013 n (%)** | **2020 n = 2622 n (%)** | ***p*-Value** |
| Nationality | | | |
| Spanish | 2914 (82.11) | 2554 (75.56) | <0.001 *** |
| Foreigner | 99 (61.88) | 68 (51.91) | 0.10 |
| Number of chronic conditions | | | |
| 0 | 1108 (80.23) | 1034 (72.11) | <0.001 *** |
| 1 | 934 (80.87) | 872 (77.03) | 0.02 * |
| ≥2 | 971 (82.78) | 716 (75.77) | <0.001 *** |
| Mental illness | | | |
| No | 2280 (81.02) | 2121 (74.37) | <0.001 *** |
| Yes | 733 (81.90) | 501 (76.02) | <0.01 ** |
| Self-perceived health status | | | |
| Very good | 339 (78.47) | 380 (77.08) | <0.001 *** |
| Good | 1505 (82.24) | 1391 (74.66) | <0.001 *** |
| Fair | 845 (81.72) | 637 (74.24) | <0.001 *** |
| Poor | 249 (79.81) | 166 (71.86) | 0.03 * |
| Very poor | 75 (74.26) | 48 (72.73) | 0.83 |
| Type of healthcare insurance | | | |
| Public | 2864 (81.23) | 2457 (74.14) | <0.001 *** |
| Private | 149 (81.42) | 165 (83.76) | <0.001 *** |
| Visits to the primary care physician in the previous 4 weeks | | | |
| No | 1945 (80.57) | 1911 (74.10) | <0.001 *** |
| Yes | 1068 (82.47) | 711 (76.29) | <0.001 *** |
| Body mass index | | | |
| Normal weight | 1277 (81.65) | 1199 (75.79) | <0.001 *** |
| Underweight | 46 (68.66) | 43 (67.19) | 0.86 |
| Overweight | 1101 (82.29) | 920 (73.54) | <0.001 *** |
| Obesity | 589 (79.59) | 460 (74.92) | 0.04 * |
| Smoking status | | | |
| Never smoker | 1556 (81.98) | 1315 (73.18) | <0.001 *** |
| Former smoker | 771 (83.53) | 726 (79.96) | 0.04 * |
| Current smoker | 686 (77.25) | 581 (72.08) | 0.01 * |
| Alcohol use | | | |
| Never | 851 (77.36) | 456 (72.15) | <0.001 *** |
| Former | 317 (81.28) | 506 (68.56) | <0.001 *** |
| Current | 1845 (83.15) | 1660 (77.53) | <0.001 *** |
| Leisure-time physical activity | | | |
| Non | 986 (77.33) | 816 (69.68) | <0.001 *** |
| Lower | 1209 (82.41) | 1806 (77.82) | <0.001 *** |
| Higher | 818 (84.59) | 662 (76.09) | <0.001 *** |

Statistical test used: Chi-squared test. Significance at the level: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

**Table 3.** Variables associated with adherence to mammography screening among women residing in Spain stratified by year (2017 and 2020).

| Variables | 2017 | | | | 2020 | | | |
|---|---|---|---|---|---|---|---|---|
| | **OR (CI 95%)** | **B** | **ORa (95% CI)** | ***p*-Value** | **OR (CI 95%)** | **B** | **ORa (95% CI)** | ***p*-Value** |
| Age group | | | | | | | | |
| 50–56 years old | Reference | | | | Reference | | | |
| 57–63 years old | 1.08 (0.89–1.31) | | | | 1.05 (0.88–1.26) | | | |
| 64–69 years old | 0.91 (0.80–1.21) | | | | 0.89 (0.74–1.08) | | | |
| Educational level | | | | | | | | |
| Without studies | Reference | | Reference | | Reference | | Reference | |
| Primary | 1.21 (0.88–1.65) | 0.17 | 1.18 (0.86–1.63) | 0.30 | 1.59 (1.13–2.24) | 0.38 | 1.46 (0.48–2.07) | 0.31 |
| Secondary | 1.35 (1.01–1.80) | 0.32 | 1.37 (1.01–1.85) | 0.04 | 2.05 (1.49–2.82) | 0.60 | 1.82 (1.29–2.54) | <0.01 |
| University | 1.39 (0.99–1.93) | 0.37 | 1.45 (1.02–2.07) | 0.04 | 2.52 (1.78–3.58) | 0.75 | 2.12 (1.44–3.09) | <0.001 |
| Marital status | | | | | | | | |
| Single | Reference | | Reference | | Reference | | Reference | |
| Married | 1.92 (1.51–2.43) | 0.62 | 1.86 (1.46–2.38) | <0.001 | 1.41 (1.13–1.75) | 0.34 | 1.41 (1.12–1.77) | <0.01 |
| Widowed | 2.00 (1.45–2.77) | 0.75 | 2.11 (0.89–2.96) | 0.26 | 1.06 (0.80–1.42) | 0.15 | 1.16 (0.85–1.57) | 0.17 |
| Separated or divorced | 1.23 (0.91–1.66) | 0.27 | 1.31 (0.96–1.77) | 0.10 | 1.04 (0.80–1.36) | 0.05 | 1.05 (0.80–1.39) | 0.74 |
| Social class | | | | | | | | |
| Lower | Reference | | | | Reference | | | |
| Middle | 1.09 (0.90–1.31) | | | | 1.24 (1.04–1.47) | | | |
| Upper | 1.07 (0.85–1.34) | | | | 1.51 (1.22–1.86) | | | |
| Residential location | | | | | | | | |
| Urban | Reference | | Reference | | Reference | | Reference | |
| Rural | 0.81 (0.69–0.96) | −0.17 | 0.84 (0.71–0.93) | <0.01 | 0.81 (0.70–0.95) | −0.22 | 0.80 (0.68–0.94) | <0.01 |
| Nationality | | | | | | | | |
| Spanish | Reference | | Reference | | Reference | | Reference | |
| Foreigner | 0.35 (0.25–0.49) | −0.99 | 0.37 (0.26–0.52) | <0.001 | 0.35 (0.25–0.50) | −0.91 | 0.40 (0.28–0.57) | <0.001 |
| Number of chronic conditions | | | | | | | | |
| 0 | Reference | | | | Reference | | Reference | |
| 1 | 1.04 (0.86–1.27) | | | | 1.30 (1.08–1.55) | 0.30 | 1.35 (1.13–1.63) | <0.01 |
| ≥2 | 1.18 (0.97–1.45) | | | | 2.21 (1.01–1.46) | 0.33 | 1.39 (1.14–1.70) | <0.01 |
| Mental illness | | | | | | | | |
| No | Reference | | | | Reference | | | |
| Yes | 1.06 (0.87–1.29) | | | | 1.09 (0.90–1.33) | | | |
| Self-perceived health status | | | | | | | | |
| Very good | Reference | | | | Reference | | | |
| Good | 1.27 (0.98–1.65) | | | | 1.26 (0.71–2.26) | | | |
| Fair | 1.23 (0.93–1.62) | | | | 1.11 (0.64–1.92) | | | |
| Poor | 1.08 (0.76–1.55) | | | | 1.08 (0.62–1.90) | | | |
| Very poor | 0.79 (0.48–1.319 | | | | 0.96 (0.52–1.77) | | | |
| Type of healthcare insurance | | | | | | | | |
| Public | Reference | | | | Reference | | Reference | |
| Private | 1.01 (0.69–1.48) | | | | 1.80 (1.22–2.65) | 0.45 | 1.56 (1.05–2.34) | 0.03 |
| Visits to the primary care physician in the previous 4 weeks | | | | | | | | |
| No | Reference | | | | Reference | | | |
| Yes | 1.13 (0.95–1.35) | | | | 1.13 (0.94–1.34) | | | |
| Body mass index | | | | | | | | |
| Normal weight | Reference | | | | Reference | | | |
| Underweight | 0.49 (0.29–0.84) | | | | 0.65 (0.38–1.12) | | | |
| Overweight | 1.04 (0.86–1.26) | | | | 0.89 (0.75–1.05) | | | |
| Obesity | 0.88 (0.70–1.10) | | | | 0.95 (0.77–1.18) | | | |

**Table 3.** *Cont.*

| Variables | 2017 | | | | 2020 | | | |
|---|---|---|---|---|---|---|---|---|
| | **OR (CI 95%)** | **B** | **ORa (95% CI)** | ***p*-Value** | **OR (CI 95%)** | **B** | **ORa (95% CI)** | ***p*-Value** |
| Smoking status | | | | | | | | |
| Never smoker | Reference | | Reference | | Reference | | Reference | |
| Former smoker | 1.12 (0.90–1.38) | 0.02 | 1.02 (0.81–1.26) | 0.81 | 1.46 (0.80–1.77) | 0.22 | 1.25 (0.73–1.53) | 0.12 |
| Current smoker | 0.75 (0.61–0.91) | −0.32 | 0.73 (0.59–0.89) | <0.01 | 0.95 (0.79–1.14) | −0.11 | 0.90 (0.74–0.93) | 0.03 |
| Alcohol use | | | | | | | | |
| Never | Reference | | Reference | | Reference | | Reference | |
| Former | 0.68 (0.41–1.11) | −0.33 | 0.72 (0.59–1.13) | 0.11 | 0.84 (0.67–1.06) | −0.19 | 0.83 (0.65–1.07) | 0.14 |
| Current | 1.27 (1.14–1.64) | 0.26 | 1.30 (1.19–1.75) | <0.01 | 1.29 (1.08–1.63) | 0.16 | 1.18 (1.10–1.52) | <0.01 |
| Leisure-time physical activity | | | | | | | | |
| Non | Reference | | Reference | | Reference | | Reference | |
| Lower | 1.37 (1.14–1.66) | 0.19 | 1.20 (1.10–1.58) | <0.01 | 1.39 (1.13–1.69) | 0.18 | 1.20 (1.08–1.54) | <0.01 |
| Higher | 1.61 (1.29–2.01) | 0.38 | 1.46 (1.16–1.82) | <0.01 | 1.53 (1.28–1.82) | 0.32 | 1.38 (1.15–1.65) | <0.01 |

OR, odds ratio; ORa, odds ratio adjusted for all socio-demographic characteristics, health-related status, and lifestyle behaviors; 95% CI, 95% confidence interval. B, regression coefficient. 2017: Constant = 0.508; Hosmer–Lemeshow test $\chi^2$ = 13.67, $p$ = 0.09; −2 log likelihood for the intercept = 3581.409, −2 log likelihood for the final model = 3461.485, −2 log likelihood $\chi^2$ = 119.925, $p$-value < 0.001; Nagelkerke's $R^2$ square = 0.38; $p$-value < 0.001. 2020: Constant = −0.004; Hosmer–Lemeshow test $\chi^2$ = 7.68, $p$ = 0.47; −2 log likelihood for the intercept = 3973.244, −2 log likelihood for the final model = 3831.468, −2 log likelihood $\chi^2$ = 141.777, $p$-value < 0.001; Nagelkerke's $R^2$ square = 0.43; $p$-value < 0.001.

In 2020, while most of the factors associated to adherence remained consistent with those identified in 2017, certain determinants, such as the presence of 1 or ≥2 chronic conditions and having private insurance showed an increase in the odds of compliance with mammography screening of 35%, 39%, and 56% (OR = 1.35, 95% CI 1.13–1.63; OR = 1.39, 95% CI 1.14–1.70; OR = 1.56, 95% CI 1.05–2.34, respectively). The following equation shows the probability of adherence to breast cancer screening:

$$P\ (\text{adherence}) = 1/(1 + e^{-z})$$

$$Z = \text{logit}\ (P) = -0.004 + 0.38X_1 + 0.60X_2 + 0.75X_3 + 0.34X_4 + 0.15X_5 + 0.05X_6 - 0.22X_7 - 0.91X_8 + 0.30X_9 + 0.33X_{10} + 0.33X_{11} + 0.45X_{12} + 0.22X_{13} - 0.11X_{14} - 0.19X_{15} + 0.16X_{16} + 0.18X_{17} + 0.32X_{18}$$

In none of the logistic regression models were the interaction terms statistically significant ($p > 0.05$).

Table 4 shows the logistic regression model for independent associated factors of mammography screening adherence in both years. Having completed secondary and university studies were associated with 57% and 84% higher odds of mammography uptake (OR = 1.57, 95% CI 1.26–1.89 and OR = 1.84, 95% CI 1.37–2.27, respectively). Also, married participants had 60% higher odds of compliance (OR = 1.60, 95% CI 1.36–1.90). Likewise, the year 2017 and having visited a general practitioner were associated with 48% and 13% higher odds of mammography adherence (OR = 1.48, 95% IC 1.32–1.67 and OR = 1.13, 95% CI 1.05–1.35, respectively). Moreover, the odds of adherence increased 20% and 30% among women who had 1 or ≥2 chronic diseases (OR = 1.20, 95% CI 1.04–1.37 and OR = 1.30, 95% CI 1.13–1.50, respectively). Also, current alcohol consumption and higher levels of physical activity during leisure time were both associated with 34% higher odds of mammography uptake (OR = 1.34, 95% CI 1.19–1.51 and OR = 1.34, 95% CI 1.15–1.56, respectively). In contrast, the odds of adherence decreased 18% among women who lived in rural settings or were current smokers (OR = 0.82, 95% CI 0.73–0.92 and OR = 0.82, 95% CI 0.73–0.92, respectively) and 62% among foreigners (OR = 0.38, 95% CI 0.30–0.49). The probability of adherence to screening is depicted in the following equation:

$$P\ (\text{adherence}) = 1/(1 + e^{-Z})$$

$$Z = \text{logit}\ (P) = -0.025 + 0.39X_1 + 0.26X_2 + 0.45X_3 + 0.61X_4 + 0.47X_5 + 0.42X_6 + 0.14X_7 - 0.20X_8 - 0.97X_9 + 0.18X_{10} + 0.26X_{11} + 0.12X_{12} + 0.12X_{13} - 0.20X_{14} - 0.02X_{15} + 0.29X_{16} + 0.27X_{17} + 0.29X_{18}$$

None of the interaction terms were statistically significant ($p > 0.05$).

**Table 4.** Variables associated with adherence to mammography screening among women residing in Spain during 2017 and 2020.

| Variables | OR (95%CI) | B | ORa (95% CI) | *p*-Value |
|---|---|---|---|---|
| Year | | | | |
| 2020 | Reference | | Reference | |
| 2017 | 1.47 (1.31–1.64) | 0.39 | 1.48 (1.32–1.67) | <0.001 |
| Age group | | | | |
| 50–56 years old | Reference | | | |
| 57–63 years old | 1.05 (0.92–1.20) | | | |
| 64–69 years old | 0.93 (0.81–1.07) | | | |
| Educational level | | | | |
| Without studies | Reference | | Reference | |
| Primary | 1.29 (1.02–1.61) | 0.26 | 1.29 (0.98–1.63) | 0.06 |
| Secondary | 1.51 (1.22–1.86) | 0.45 | 1.57 (1.26–1.89) | <0.001 |
| University | 1.70 (1.34–2.15) | 0.61 | 1.84 (1.37–2.27) | <0.001 |
| Marital status | | | | |
| Single | Reference | | Reference | |
| Married | 1.65 (1.40–1.93) | 0.47 | 1.60 (1.36–1.90) | <0.001 |
| Widowed | 1.45 (0.89–1.33) | 0.42 | 1.52 (0.93–1.42) | 0.24 |
| Separated or divorced | 1.12 (0.92–1.37) | 0.14 | 1.15 (0.73–1.14) | 0.17 |
| Social class | | | | |
| Lower | Reference | | | |
| Middle | 1.16 (1.02–1.31) | | | |
| Upper | 1.26 (1.08–1.48) | | | |
| Residential location | | | | |
| Urban | Reference | | Reference | |
| Rural | 0.81 (0.72–0.90) | −0.20 | 0.82 (0.73–0.92) | <0.01 |
| Nationality | | | | |
| Spanish | Reference | | Reference | |
| Foreigner | 0.36 (0.28–0.46) | −0.97 | 0.38 (0.30–0.49) | <0.001 |
| Number of chronic conditions | | | | |
| 0 | Reference | | Reference | |
| 1 | 1.18 (1.03–1.35) | 0.18 | 1.20 (1.04–1.37) | 0.01 |
| ≥2 | 1.23 (1.07–1.41) | 0.26 | 1.30 (1.13–1.50) | <0.01 |
| Mental illness | | | | |
| No | Reference | | | |
| Yes | 1.11 (0.97–1.28) | | | |
| Self-perceived health status | | | | |
| Very good | Reference | | | |
| Good | 1.04 (0.88–1.24) | | | |
| Fair | 1.04 (0.86–1.25) | | | |
| Poor | 0.93 (0.72–1.20) | | | |
| Very poor | 0.80 (0.55–1.17) | | | |

**Table 4.** *Cont.*

| Variables | OR (95%CI) | B | ORa (95% CI) | *p*-Value |
|---|---|---|---|---|
| Type of healthcare insurance | | | | |
| Public | Reference | | | |
| Private | 1.36 (1.04–1.78) | | | |
| Visits to the primary care physician in the previous 4 weeks | | | | |
| No | Reference | | Reference | |
| Yes | 1.17 (1.04–1.32) | 0.12 | 1.13 (1.05–1.35) | 0.02 |
| Body mass index | | | | |
| Normal weight | Reference | | | |
| Underweight | 0.57 (0.39–0.84) | | | |
| Overweight | 0.96 (0.85–1.09) | | | |
| Obesity | 0.93 (0.80–1.09) | | | |
| Smoking status | | | | |
| Never smoker | Reference | | Reference | |
| Former smoker | 1.15 (0.82–1.26) | 0.12 | 1.13 (0.97–1.30) | 0.12 |
| Current smoker | 0.79 (0.69–0.89) | −0.20 | 0.82 (0.73–0.92) | 0.02 |
| Alcohol use | | | | |
| Never | Reference | | Reference | |
| Former | 0.88 (0.74–1.04) | −0.02 | 0.98 (0.82–1.18) | 0.13 |
| Current | 1.33 (1.17–1.52) | 0.29 | 1.34 (1.19–1.51) | <0.001 |
| Leisure-time physical activity | | | | |
| Non | Reference | | Reference | |
| Lower | 1.44 (1.27–1.64) | 0.27 | 1.31 (1.15–1.50) | <0.001 |
| Higher | 1.48 (1.28–1.72) | 0.29 | 1.34 (1.15–1.56) | <0.001 |

OR, odds ratio; ORa, odds ratio adjusted for all socio-demographic characteristics, health-related status, and lifestyle behaviors; 95% IC, 95% confidence interval; B, regression coefficient. Constant = −0.025; Hosmer–Lemeshow test $\chi^2$ = 2.21, $p$ = 0.11; −2 log likelihood for the intercept = 7599.935, −2 log likelihood for the final model = 7314.203, −2 log likelihood $\chi^2$ = 285.732, $p$-value < 0.001; Nagelkerke's $R^2$ square = 0.33; $p$-value < 0.001.

## 4. Discussion

### *4.1. Main Findings*

The present population-based study performed in Spain describes the uptake of mammography and identifies the factors associated with breast cancer screening compliance in a sample of women from 2017 to 2020.

The data analyses showed that 78% of women aged 50–69 years had undergone breast cancer screening in the previous two years. This adherence is higher than the European mean participation rate (60.2%) and is considered desirable, according to the European recommendation on breast cancer screening [29]. Although the total examination coverage varies from 49% in Eastern Europe to 69% in Southern Europe [14], it is difficult to establish a comparison of breast cancer screening adherence among European Union countries due to the considerable differences in the target populations and screening strategies. The highly extended screening as is observed in Spain and the improvements in access to healthcare services have a favorable impact on the early diagnosis of breast cancer at more localized stages, all of which lead to a reduction in mortality [14,30]. On the other hand, the adherence to mammography screening decreased by 6.37% from 2017 (85.59%) to 2020 (79.22%) in the current study. Given that the last five months of the 2020 data collection occurred during the COVID-19 pandemic, this result is consistent with similar studies in which reductions in screening mammography rates ranged from 2.7% to 100% during the pandemic period [31,32]. Particularly, screening uptake reduced by 35–100% during the pandemic peak in March–May 2020 [31,33,34]. The findings mentioned above illustrate the impact of the pandemic on populations and the global health system's response. This response included the suspension of screening programs, the closure of non-urgent healthcare services, and the implementation of regional lockdowns, all of which contributed to some of the initial reductions. While these response measures increased health system capacity for improved COVID-19 containment and mitigation, they also had some negative consequences on the provision of healthcare services to the general population, especially cancer prevention and control initiatives [35]. Additional factors that could have played a significant role in the decrease, apart from the healthcare system's response, include anxiety and the fear of COVID-19 infection [36], which also likely explains the observed reductions in early diagnosis rates [37]. Another possible reason for this reduction could be the greater effort put forth to develop and implement colorectal screening programs by the National Health System. Colorectal screening is being progressively implemented in Spain to cover the whole population and takes up considerable resources, which might otherwise be used to maintain the quality standards of breast cancer screening programs [38]. Whatever the reason, it is a high priority to identify the reasons for this decreased participation in order to act accordingly.

This study enabled us to investigate the variables that influenced breast cancer screening uptake. We observed that women with higher education reported greater screening participation. Although prior research did not discover a link between educational attainment and breast cancer screening uptake [39], the results obtained in the current study agreed with previous evidence [39–41]. People with a higher level of education perceived good financial status and had a better ability to learn about preventive practices [42]. According to Willems and Bracke [43], in countries with nationally organized screening programs for breast cancer, such as Spain, women with higher levels of education are more likely to follow their general practitioner's advice rather than a screening program, when compared with their less educated counterparts. To support this, and consistent with our findings, past research has also demonstrated that increased engagement with the primary care physician promotes breast cancer screening participation [44]. This could represent an indirect result of general practitioners recalling, educating, and encouraging screening to the women [45]. These findings underscore the relevance of primary care for overall screening efforts, as well as the relevance of radiology departments working closely with primary care departments to enhance accessibility and promote the use of mammography.

Regarding the place of residence, research on breast cancer screening utilization among urban and rural women is variable and dissimilar. Our findings showed a reduced utilization of breast screening among rural women. This was consistent with previous findings in mammography in urban versus rural populations [46,47]. Numerous obstacles to cancer screenings are prevalent in rural communities. The distance to mammography facilities can be a significant factor, as shown by Chandak et al. [48], who revealed that certain rural regions had greater distances to mammography centers, leading to increased rates of late-stage cancer diagnoses. On the other hand, although rural women have fewer mammography facilities close to their homes and longer driving times to travel to the facilities, which decrease breast cancer screening frequency [47], Jewett et al. [49] reported that the presence of one or two mammography facilities near women's homes may enhance mammography uptake but that the benefits decrease with more than two nearby facilities. Another possible explication for the lower mammography adherence found in the current research among rural women is the higher frequency of fatalistic ideas regarding cancer prevention in rural regions compared with urban areas [50].

When considering the civil status, married participants had 60% higher odds of compliance, which was consistent with previous studies across different countries [51–53]. It is thought that married persons tend to have a wider social network, which provides them with more emotional and practical support to seek preventive testing, as well as assisting them in adopting healthier behaviors [15,54].

Our study revealed that the greatest comorbidity was linked with increased involvement in mammography screening. Nevertheless, some authors demonstrate that women with two to four coexisting health disorders are less likely to receive a mammography screening than those who do not have comorbidities and suggest that higher workload, administrative demands, and the difficulty of managing numerous comorbidities might result in physician exhaustion, thereby compromising the screening implementation [55]. The observed outcome in our study might be explained in a variety of ways. On one hand, because healthy women have fewer overall healthcare visits, they have fewer chances of hearing advice about the advantages of mammography compared with women with comorbid diseases. On the other hand, healthy women who have less contact with the health sector may depend more on mass culture, where messages about the advantages and dangers of mammography are frequently inconsistent [56]. Another noteworthy feature is that even women with chronic conditions that are well managed may not survive long enough to benefit from early identification [57]. This point emphasizes the importance of considering tailored screening that takes into consideration the severity of chronic conditions, as well as the women's age and interests, in order to maximize the benefit gained from screening and optimize healthcare services.

When analyzing nationality, it is crucial to consider that immigrants make up around 11.25% of Spain's overall population [58], and evidence suggests that immigrant women continue to have lower rates of mammographic screening [59], despite the significance of breast cancer screening in the early identification and treatment of breast cancer. This is in line with our findings. Several variables impact this condition, including socio-economic uncertainty, lack of understanding about the Spanish National Health System, and language issues [60].

Regarding the type of healthcare insurance, having private insurance increased 55% the odds of adherence to mammography screening in 2020. The COVID-19 pandemic and, consequently, the collapse in public healthcare led to a 5.29% increase in private insurance usage among women in 2020 compared with 2017 [61,62]. Individuals with private insurance typically choose this coverage to avoid waiting times and gain direct access to specialists [63]. Our finding possibly suggests that economic position is one of the factors influencing the decision to undergo mammography [64].

In the present study, certain lifestyle behaviors were associated with adherence to breast cancer screening. For example, our results revealed that physical activity was linked to a greater uptake rate for mammography screening, in line with past studies [65,66]. This might be explained by the fact that women who are concerned about their physical appearance and health are more likely to engage in physical activity. Previous research has found a link between mammography utilization and smoking status [67,68]. We found that the odds of adherence decreased 18% among women who were current smokers. In that sense, smokers' perceptions of large obstacles to care may be associated to lower participation in cancer prevention services [69]. Also, women who smoke might be less motivated to seek further health screenings while managing their tobacco addition; therefore, their smoking habits could impact their limited participation in preventative programs [70].

Additionally, we observed that current alcohol users were associated with 34% higher odds of mammography uptake. At first glance, this may appear contradictory; nonetheless, moderate alcohol intake is widespread among women with a high socioeconomic position in Spain, which in turn is connected with increased cancer screening uptake [15]. Although our results support previous findings [71], the data about the effect of alcohol consumption on breast cancer screening adherence are inconsistent. Some authors did not find any association [72,73], while others revealed a negative association [20,74]. This suggests that more research is needed to clarify the relationship between alcohol consumption and screening participation.

### 4.2. Strengths and Limitations

Our findings were susceptible to several limitations, which should be highlighted. First, because a cross-sectional design was used, causality could not be inferred. Second, the use of self-reported variables caused the presence of memory and social desirability biases to be more likely. Third, the representativeness of sample may have been compromised because a multistage stratified sampling design was applied and unweighted data were used. Fourth, analyzing the complete cases as a method to handle missing data could have produced biases in the point estimation and larger sampling variances. Thus, these findings should be considered only as hypothesis-generating results. Fifth, there was a lack of information in the surveys about the screening invitation coverage among non-uptakers, which may have affected the uptake rate result. Finally, since mammography can be used for screening or diagnostic purposes, it was not possible to determine from the used surveys why these women received a mammogram. Nonetheless, the use of a national sample of the Spanish population to measure breast cancer screening adherence and the examination of a significant number of socio-demographic variables, lifestyle behaviors, and health-related factors not found in other health care records were strengths of this study.

### *4.3. Implications for Research and Practice*

The findings could have important clinical implications. Although mammography adherence in Spain is satisfactory, there was a decline in participation in 2020 compared with 2017. The most concerning possible negative consequence of the decline in participation would be a rise in cancer morbidity and death in the future. Disruptions in cancer screening programs might delay tumor diagnoses, resulting in a higher number of cancer cases detected at more advanced stages in the following screening round for women who missed the pandemic round, which could lead to a less favorable prognosis. Furthermore, this could probably raise the number of avoidable deaths from cancer and healthcare costs. It remains uncertain if the proposed initiatives to minimize the backlog of women who missed screening during the pandemic, such as calling them to make an appointment, will aid in the detection of tumors missed during screening disruption. Given this situation, it is crucial to take actions to reestablish cancer screening as a fundamental component of preventive healthcare, particularly among people with lower socioeconomic status, such as removing geographical obstacles, enhancing the participation of primary care physicians, and implementing personalized proactive communication. Since there is an unfortunate potential for future pandemics produced by viral or other outbreaks, the prioritization of eligible individuals appears to be a particularly valuable strategy, especially in situations with limited resources, where maximal efficiency is essential. The objective would be to give preference to individuals who have a higher probability of developing cancer and, consequently, receiving positive screening results: women who have not had a checkup in many years or those from disadvantaged social and economic backgrounds facing substantial barriers to healthcare access and, as a result, having a reduced inclination to seek screening on their own.

## 5. Conclusions

Despite the fact that breast cancer screening is a free population-based program in Spain, our results suggest that there was a decline in participation in 2020 compared with 2017 and the influence of sociodemographic, health status, and lifestyle factors in compliance, suggesting that there may still be social differences in screening adherence. These findings have important implications for public health efforts on how to enhance compliance since they provide information about which populations are likely to have less breast cancer screening adherence. Periodic reviews of the participation of women of diverse origins and socioeconomic groups in preventative programs should be conducted by public health services. Moreover, it would be better if awareness was raised among this population of the need for disease prevention by extra reminders, such as mail or phone. Finally, public health agencies should examine ways to increase access to mammography screening, including the use of mobile screening units [75].

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/healthcare11222934/s1, File S1: Research data.

**Author Contributions:** Conceptualization, S.P.d.l.C., L.M.B. and J.C.; methodology, S.P.d.l.C. and J.C.; software, S.P.d.l.C. and J.C.; validation, S.P.d.l.C., L.M.B. and J.C.; formal analysis, S.P.d.l.C.; investigation, S.P.d.l.C., L.M.B., and J.C.; resources, S.P.d.l.C. and J.C.; data curation, S.P.d.l.C. and J.C.; writing—original draft preparation, S.P.d.l.C., L.M.B. and J.C.; writing—review and editing, S.P.d.l.C., L.M.B. and J.C.; visualization, S.P.d.l.C., L.M.B. and J.C.; supervision, J.C.; project administration, S.P.d.l.C., L.M.B. and J.C. All authors have read and agreed to the published version of the manuscript.

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**Informed Consent Statement:** Not applicable because the study utilizes anonymized data available in the public domain.

**Data Availability Statement:** The data presented in this study are available as Supplementary Material (File S1: Research data).

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