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# Cervical cancer screening pathways in France in 2015–2021, a nationwide study based on medico-administrative data

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ABSTRACT

To better document cervical cancer screening (CCS) pathways, the purpose of our study was to examine CCS pathways among women who had undergone a screening test (opportunistic or organised programme), based on real-life data over a 7-year period. This study used data from the French national health care database (SNDS), which covers almost 100 % of the French population of around 66 million inhabitants. Data from 2015 to 2021 were extracted. More than one quarter (27 %) of women who were at least 25 years old in 2015 and up to 65 years old in 2021 were not screened over the 2015–2021 period. Compared to women who had undergone screening at least once, women who were not screened were older (36 % vs. 23 % in the 50–59 years age group in 2015) and lived in the most deprived urban areas (21 % vs 16 % for less and most deprived respectively). 57 % of women underwent screening within recommended intervals, 13 % of women were under-screened, and 30 % were overscreened. Overall, our study identified that, in 2021, women who participated in the French organised screening programme were less likely to be screened within the recommended interval over the 7-year period. These analyses need to be continued over time in order to assess whether the programme helps reintegrate women into the screening process.

## 1. Introduction

Cervical cancer is the fourth most commonly diagnosed cancer among women worldwide. In France, approximately 3000 new cases and 1000 deaths were recorded in 2018 alone (IARC, 2021). Screening for cervical cancer has proven to be effective in decreasing mortality and incidence (Peirson et al., 2013; Jansen et al., 2020). However, inequalities in cervical cancer screening (CCS) uptake have been consistently observed, with socially deprived and older women being less likely to be screened (Menvielle et al., 2014; Limmer et al., 2014; Luque et al., 2018). The World Health Organization believes in a strategy for the elimination of Cervical Cancer as a Public Health Problem based on two effective and complementary interventions: screening (with a population-based programme), and vaccination. The expected benefits of an organised CCS programme are: decreased incidence of cervical cancer (Bucchi et al., 2019), increased coverage of CCS among the population (Minozzi et al., 2015), and fewer disparities surrounding participation.

Up to 2018 in France, CCS uptake was mainly opportunistic. Since 2018, a national organised screening programme has been rolled out throughout the country. The regional cancer screening coordination centres (RCSCC) were tasked with implementing the organised CCS programme at a regional level. The eligible population consists of immunocompetent women aged between 25 and 65, who have not had a total hysterectomy. The screening guidelines are the same, irrespective of whether women have been vaccinated against HPV or not.

In keeping with European guidelines, the programme includes:

- A process of invitations and reminders limited to women who have not undergone opportunistic screening within the recommended time intervals
- Follow-up of all eligible women with abnormal screening test results (opportunistic screening or organised CCS screening)
- Streamlining of screening practices and improvement of professional practices (intervals between two tests, follow-up of women with an abnormal/positive result)

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- Information campaigns targeting professionals and women
- Two types of interventions for the vulnerable, developed by the RCSCCs: temporary large-scale CCS information events (market stands) or empowerment interventions (training women to act as "CCS ambassadors", health mediation, mobile units, self-sampling, etc.)
- Multiplication of screening locations and of health professionals providing screening tests (general practitioners, gynaecologists, midwives and other health professionals)
- Since 2019, in France, in accordance with a WHO strategy, the official guidelines have been to undergo one screening test every 3 or 5 years depending on age range, from 25 to 65 years of age. Between 25 and 29 years of age, a cytology test sequence of two cytology tests performed 1 year apart is recommended, with further testing after 3 years if the results of the first two are normal. From the age of 30 to the age of 65, a high-risk human papillomavirus (HR-HPV) test is recommended: 3 years after the last normal cytology test, or from the age of 30 in the absence of previous cytology tests. The interval between two HPV tests is 5 years, as long as the tests are negative

In France, triennial CCS uptake (%) remained stable around 59 % among women aged 25–65 years for the 2016–2020 period. However, some disparities were observed, with uptake decreasing with increasing age (44.5 % among women aged 60–65 years compared to 66 % among women aged 25–29 years). In that context, the target population of the CCS programme was women whose screening was not up-to-date, assuming that these women had been out of contact with the health-care system for a long time.

What's more, screening uptake provides a population-based approach, but not one based on women's individual screening pathways. In fact, some women may be screened more often than recommended (over-screening), while others may be screened less often (under-screening). Screening uptake does not quantify the frequency of screening for each woman, nor the time between 2 screenings.

In order to estimates these elements, we aimed to examine CSS pathways among women who had undergone a screening test (opportunistic or organised programme), based on real-life data over a 7-year period.

## 2. Methods

### 2.1. Data sources

This study used data from the French national health care database (SNDS) which covers almost 100 % of the French population of around 66 million inhabitants. This database compiles all reimbursements from hospital stays and outpatient care for public and private hospitals (Tuppin et al., 2017), and contains a record of biological or anatomo-pathological procedures carried out on an outpatient basis, but not the test results. All of these data are linked with a unique pseudonymised patient identifier which makes it possible to visualize screening pathways.

Data from 2015 to 2021 were extracted.

### 2.2. Data collection

All procedures related to CCS, cytological examinations of cervical smears or detection of human papillomavirus DNA, for persons aged from 25 to 65 were extracted. The procedure code indicates whether they consisted of an opportunistic or invitation-based test, a primary test, or a control test (supplementary 1). For each screening test, the date, age, home post code and community-level deprivation index (FDep) quintile were collected.

FDep considers the median household income, the percentage of high school graduates in the population aged 15 years and older, the percentage of blue-collar workers in the active population, and the unemployment rate. Quintiles of this index, computed using the French general population as a reference, range from least deprived (Q1) to most deprived (Q5) (Rey et al., 2009). FDEP is not defined for overseas territories.

The different screening tests for each woman were sequenced over time. The interval between two consecutive screenings was calculated to assess the number of screenings per woman, the interval to the next screening, and screening pathway for women screened in 2021. In order not to distort the intervals with follow-up tests following an initial result that needed to be verified, screening tests performed within 120 days after the previous one were not considered.

The screening test frequency changed in 2020 (every 5 years instead of every 3 years previously). However, as the first HPV test must be performed 3 years after the last cytology test, CCS screening coverage was still calculated over 3-year period. The interval between 2 screenings was expected to be between 31 and 42 months. An interval under 31 months corresponds to over-screening, and an interval over 42 months corresponds to under-screening.

### 2.3. Statistical analyses

Activity was described in terms of number of procedures, and number of persons with at least one procedure according to the different areas: period, age groups, FDep, and opportunistic/invitation-based test.

Survival analyses using the Kaplan-Meier method were performed to visualise the interval to the next screening after an index screening. The failure time variable is calculated from the index screening up to the next screening, 65th birthday, conisation, cervical removal, death, point date, whichever came first. 1-S(t) is the probability that a screening test occurred before t.

As this study was conducted in the overall population (not a sample), statistical tests for descriptive comparisons were not considered relevant.

### 2.4. Sunburst graphic

Sunburst charts show the screening pathways (including the three most recent screenings from 2021 onwards) for women who underwent screening in 2021. From centre to edge: the first circle corresponds to the interval between screening in 2021 and the last one, the second circle corresponds to interval between the last and penultimate screening and the third circle corresponds to the interval between penultimate and ante-penultimate screening.

The interval in split into 5 different color classes: 4–14 months between two screenings (over-screening), 15–30 months between two screenings (over-screening), 31–42 months between two screenings (recommended interval), 43–60 months between two screenings (under-screening) and $>$ 60 months between two screenings (under-screening).

When no screening was found since 01/01/2015.

A specific color was used when age was under 25 3 years before the previous screening of the 2015–2021 period to indicate that previous screenings were not sought because they were outside the target age group.

### Ethical approval

This study falls within the remit of French Data Protection Authority (CNIL – Commission nationale informatique et liberté) authorisation by French Decree no. 2016–1871 of 26 December 2016.

## 3. Results

The mean number of all screenings recorded each year is around 4,659,000, the minimum was recorded in 2020 (4,200,479 screenings) and the maximum in 2021 (4,987,168 screenings).

Over a 3-year period, the recommended screening interval,

approximately 9,827,000 women were screened, the minimum was recorded in 2018–2020 (9,529,764 women), and the maximum in 2015–2017 (10,100,077 women) (Fig. 1).

More than one quarter (27 %) of women who were at least 25 years old in 2015 and up to 65 years old in 2021 were not screened over the 2015–2021 period. Compared to women who had undergone screening at least once, women who were not screened were older (36 % vs. 23 % in the 50–59 years age group in 2015) and lived in the most deprived urban areas (21 % vs 16 % in FDep 5) (Table 1).

The rest of the results relate only to women who have undergone at least one screening test over the 2015–2021 period.

### 3.1. Number of screenings per woman over the period

Among women who underwent one screening in 2015 and were up to 65 years old in 2021, nearly one third underwent three screenings over the 7-year period (2015–2021), and one quarter underwent two. Thirteen percent underwent only one screening, and 29.5 % underwent more than three (Table 2). This breakdown was somewhat the same for each age group, but varied according to deprivation index, particularly for under- and over-screening. We observed a social gradient in terms of screening within the recommended intervals per woman screened in 2015, with a higher proportion of appropriate screening among women living in less deprived areas (Table 2).

### 3.2. Time to next screening

Among women who underwent at least one screening in the period, nearly one in two women were rescreened within 30 months of a previous screening (excluding screenings within 120 days).

Around one in five women were screened a second time between 31 and 42 months after the previous screening, i.e. 70 % of women were rescreened within 42 months of a previous screening (Table 3).

Another 10 % were screened between 43 and 60 months after the previous screening. Hence, 20 % of women were rescreened more than 5 years after a previous screening.

This breakdown was almost the same by year of initial screening or age, but varied according to the FDep of the women's residence. The

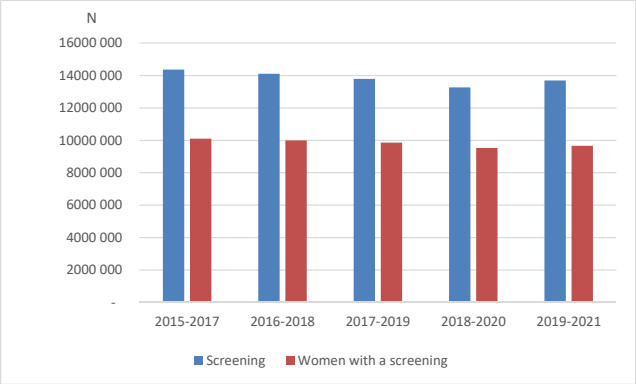


**Fig. 1.** Screening pathways since 2015 for women screened in 2021 2a Women undergoing opportunistic screening in 2021 in France From centre to edge: 1st circle: interval between screening in 2021 and last screening 2nd circle: interval between last and penultimate screening 3rd circle: interval between penultimate and ante-penultimate screening Light orange: 4–14 months between two screenings (over-screening) Dark orange: 15–30 months between two screenings (over-screening) Green: 31–42 months between two screenings (recommended interval) Pink: 43–60 months between two screenings (under-screening) Purple: >60 months between two screenings (under-screening) Grey: age < 25 3 years before first screening of the 2015–2021 period White: no screening since 01/01/2015 2b Women undergoing invitation-based screening in 2021. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

**Table 1**
Age and deprivation index (Fdep) for women with or without* screening from 2015 to 2021 in France.

| | No screening N (%) | At least one screening N (%) |
|---|---|---|
| Age at screening | | |
| 25-29y | 446 836 (11.0) | 1 373 904 (12.7) |
| 30-39y | 967 394 (23.8) | 3 492 373 (32.2) |
| 40-49y | 1 177 496 (29.0) | 3 422 287 (31.6) |
| 50-59y | 1 469 515 (36.2) | 2 545 014 (23.5) |
| *Total* | *4 061 241 (100)* | *10 833 578 (100)* |
| FDep at screening | | |
| 1 (less deprived) | 757 346 (18.7) | 2 324 950 (21.5) |
| 2 | 711 815 (17.5) | 2 243 727 (20.7) |
| 3 | 750 206 (18.5) | 2 109 669 (19.5) |
| 4 | 770 733 (19.0) | 1 999 190 (18.4) |
| 5(most deprived) | 8 587 89 (21.1) | 1 768 764 (16.3) |
| Missing** | 21 252 (5.2) | 387 278 (3.6) |
| *Total* | *4 061 241 (100)* | *10 833 578 (100)* |

*women without screening must be eligible for screening during the whole period: > 25 years old in 2015 and < 65 years old in 2021 and no conization/cervical removal between 2015 and 2021.
** FDEP is not defined for overseas.

percentage of women rescreened was 53 % for category 1 (less deprived) and 43 % for category 5 (most deprived) at 30 months, 72 % for category 1 and 64 % for category 5 at 42 months, and 83 % for category 1 and 78 % for category 5 at 60 months.

### 3.3. Screening pathway for women screened in 2021

In 2021, 10.6 % of screenings were invitation-based.

Compared to women who underwent opportunistic screening, the women who were invited were older (20 % vs. 11 % in the 60–65 years age group), but the FDep did not differ (Table 4).

Sunburst charts show the screening pathways (including the three most recent screenings from 2021 onwards) for women who underwent screening in 2021: opportunistic screening (Fig. 2a), and invitation-based screening (Fig. 2b).

Opportunistic screening in 2021 was the only screening procedure for the 2015–2021 period for 19 % of women, of whom 7 % were aged under 25 in 2018. In most cases, screenings were less than 30 months apart.

Invitation-based screening in 2021 was the only screening procedure for the 2015–2021 period for 31 % of women, of whom 10 % were aged under 25 in 2018. In most cases, screenings were more than 42 months apart.

## 4. Discussion

This study reports on CCS practices among women aged 25–65 years specifically using national reimbursement data.

Our analysis is based on a high-quality nationwide population. In addition, our findings were based on national reimbursement data, and represent the entire French population. This study provides details on the real-life effectiveness of the CCS programme and screening pathways, over a long period of time, and add to the literature previously assessing the efficacy of CCS programme implementation from the perspective of targeted populations. The insights appear to be relevant for other developed countries with the same approach (invitation method, CCS charges, targeted population, etc.).

### 4.1. Main findings

For women screened in 2015, three screenings were expected over the 2015–2021 period. Two screenings could be considered, if the next test was performed slightly more than three years after the first one. We

**Table 2**
Number of screenings per woman* during the 2015–2021 period among women who underwent screening in 2015 in France.

| | 1<br>N (%) | 2<br>N (%) | 3<br>N (%) | 4<br>N (%) | 5<br>N (%) | 6<br>N (%) | >6<br>N (%) |
|---|---|---|---|---|---|---|---|
| Total | 499 626 (13.1) | 977 031 (25.6) | 121 232 (31.8) | 636 917 (16.7) | 274,165 (7.2) | 139,773 (3.7) | 77,071 (2.0) |
| Age at screening | | | | | | | |
| 25-29y | 69 972 (13.9) | 142 295 (28.3) | 158 828 (31.6) | 78 808 (15.7) | 31 739 (6.3) | 13 606 (2.7) | 7 656 (1.5) |
| 30-39y | 141 894 (12.2) | 306 622 (26.3) | 379 171 (32.6) | 193 957 (16.7) | 82 368 (7.1) | 38 522 (3.3) | 21 298 (1.8) |
| 40-49y | 152 435 (12.4) | 298 060 (24.3) | 389 460 (31.7) | 213 151 (17.4) | 5 297 (7.8) | 51 424 (4.2) | 28 225 (2.3) |
| 50-59y | 135 307 (14.6) | 230 054 (24.8) | 289 173 (31.2) | 151 002 (16.3) | 64 761 (7.0) | 36 221 (3.9) | 19 892 (2.1) |
| FDep at screening | | | | | | | |
| 1 (less deprived) | 102 494 (12.0) | 196 290 (22.9) | 265 891 (31.0) | 161 923 (18.9) | 74 304 (8.7) | 37 227 (4.3) | 18 501 (2.2) |
| 2 | 96 066 (11.7) | 201 127 (24.4) | 266 740 (32.4) | 142 089 (17.3) | 63 730 (7.7) | 33 860 (4.1) | 19 306 (2.3) |
| 3 | 90 547 (12.3) | 188 028 (25.5) | 238 949 (32.4) | 123 432 (16.7) | 53 232 (7.2) | 27 270 (3.7) | 15 685 (3.2) |
| 4 | 90 704 (13.6) | 180 284 (27.0) | 216 928 (32.5) | 103 824 (15.6) | 41 914 (6.3) | 21 095 (3.2) | 11 976 (1.8) |
| 5(most deprived) | 90 911 (15.6) | 165 397 (28.4) | 181 414 (31.2) | 84 373 (14.5) | 33 239 (5.7) | 16 695 (2.9) | 9 744 (1.7) |
| Missing** | 28 904 (18.5) | 45 905 (29.4) | 46 710 (29.9) | 21 276 (13.6) | 7 746 (5.0) | 3 626 (2.3) | 1 859 (1.2) |

* women performed a screening in 2015 and were at least 25 years old in 2015 and up to 65 years old in 2021.
** FDEP is not defined for overseas.

**Table 3**
Time to next screening (Survival analysis) according to year of index screening, age at index screening or deprivation index (Fdep).

| | | **time** | **n at risk** | **n event** | **S(t)** | **lower95% CI** | **upper95% CI** | **1-S(t) %** |
|---|---|---|---|---|---|---|---|---|
| Year of index screening | 2015 | 30 | 2 111 381 | 601 803 | 0,484 | 0,484 | 0,485 | 52 |
| | 2016 | 30 | 2 191 079 | 590 836 | 0,510 | 0,510 | 0,511 | 49 |
| | 2017 | 30 | 2 242 816 | 530 270 | 0,538 | 0,537 | 0,538 | 46 |
| | 2018 | 30 | 2 307 792 | 513 884 | 0,573 | 0,572 | 0,573 | 43 |
| | 2019 | 30 | 1 432 586 | 591 997 | 0,532 | 0,531 | 0,532 | 47 |
| | 2015 | 42 | 1 272 382 | 341 750 | 0,299 | 0,299 | 0,300 | 70 |
| | 2016 | 42 | 1 336 402 | 339 742 | 0,320 | 0,320 | 0,321 | 68 |
| | 2017 | 42 | 1 450 635 | 357 993 | 0,352 | 0,352 | 0,353 | 65 |
| | 2018 | 42 | 867 980 | 463 497 | 0,315 | 0,315 | 0,316 | 69 |
| | 2015 | 60 | 791 721 | 221 322 | 0,196 | 0,196 | 0,197 | 80 |
| | 2016 | 60 | 829 411 | 266 850 | 0,207 | 0,207 | 0,208 | 79 |
| | 2017 | 60 | 109 357 | 290 935 | 0,162 | 0,161 | 0,162 | 84 |
| Age at screening | 25–29 | 30 | 1 270 554 | 281 891 | 0,541 | 0,540 | 0,541 | 46 |
| | 30–39 | 30 | 2 950 181 | 749 813 | 0,532 | 0,531 | 0,532 | 47 |
| | 40–49 | 30 | 2 927 548 | 852 521 | 0,501 | 0,501 | 0,502 | 50 |
| | 50–59 | 30 | 2 516 995 | 746 118 | 0,512 | 0,512 | 0,513 | 49 |
| | 60–65 | 30 | 640 376 | 198 447 | 0,541 | 0,540 | 0,541 | 46 |
| | 25–29 | 42 | 659 661 | 172 743 | 0,344 | 0,344 | 0,345 | 66 |
| | 30–39 | 42 | 1 435 314 | 430 710 | 0,318 | 0,318 | 0,319 | 68 |
| | 40–49 | 42 | 1 384 686 | 439 688 | 0,292 | 0,292 | 0,293 | 71 |
| | 50–59 | 42 | 1 233 622 | 383 861 | 0,306 | 0,305 | 0,306 | 69 |
| | 60–65 | 42 | 24 113 | 76 078 | 0,321 | 0,320 | 0,322 | 68 |
| | 25–29 | 60 | 244 661 | 108 372 | 0,207 | 0,206 | 0,208 | 79 |
| | 30–39 | 60 | 502 920 | 241 040 | 0,184 | 0,184 | 0,185 | 82 |
| | 40–49 | 60 | 500 714 | 221 293 | 0,174 | 0,174 | 0,174 | 83 |
| | 50–59 | 60 | 459 016 | 192 156 | 0,186 | 0,186 | 0,186 | 81 |
| | 60–65 | 60 | 23 178 | 17 911 | 0,194 | 0,193 | 0,195 | 81 |
| Fdep at screening | 1 (less deprived) | 30 | 2 119 208 | 672 631 | 0,469 | 0,469 | 0,470 | 53 |
| | 2 | 30 | 2 112 717 | 614 550 | 0,505 | 0,505 | 0,506 | 49 |
| | 3 | 30 | 1 998 459 | 545 245 | 0,520 | 0,520 | 0,521 | 48 |
| | 4 | 30 | 1 909 492 | 497 754 | 0,546 | 0,546 | 0,547 | 45 |
| | 5 (most deprived) | 30 | 1 725 867 | 407 391 | 0,569 | 0,569 | 0,570 | 43 |
| | Missing** | 30 | 419 911 | 91 219 | 0,593 | 0,592 | 0,594 | 41 |
| | 1 | 42 | 999 760 | 300 586 | 0,278 | 0,278 | 0,279 | 72 |
| | 2 | 42 | 978 314 | 323 308 | 0,291 | 0,201 | 0,292 | 71 |
| | 3 | 42 | 942 923 | 299 971 | 0,307 | 0,306 | 0,307 | 69 |
| | 4 | 42 | 917 372 | 282 895 | 0,327 | 0,327 | 0,328 | 67 |
| | 5 | 42 | 867 005 | 235 034 | 0,359 | 0,358 | 0,360 | 64 |
| | Missing** | 42 | 222 025 | 61 286 | 0,383 | 0,382 | 0,384 | 62 |
| | 1 | 60 | 353 347 | 160 206 | 0,165 | 0,165 | 0,166 | 83 |
| | 2 | 60 | 335 337 | 162 117 | 0,167 | 0,167 | 0,167 | 83 |
| | 3 | 60 | 324 814 | 150 452 | 0,180 | 0,179 | 0,180 | 82 |
| | 4 | 60 | 320 071 | 145 667 | 0,194 | 0,193 | 0,194 | 81 |
| | 5 | 60 | 312 963 | 129 856 | 0,222 | 0,222 | 0,223 | 78 |
| | Missing** | 60 | 83 957 | 32 474 | 0,242 | 0,241 | 0,243 | 76 |

** FDEP is not defined for overseas.

concluded that 57 % of women were screened within recommended intervals, 13 % of women were under-screened, and 30 % were over-screened. An overview of screening uptake was conducted in 2010 in France before the implementation of the CCS programme Limmer et al., 2014. 51.6 % of women were screened infrequently (under-screening situation), and 40.6 % of women were screened too frequently (over-

**Table 4**
Age and deprivation index (Fdep) for women who performed opportunistic and invitation-based screenings in 2021.

| | Opportunistic N (%) | Invited-based N (%) |
|---|---|---|
| Age at screening | | |
| 25-29y | 391 201 (11.4) | 53 113 (11.9) |
| 30-39y | 896 503 (26.0) | 95 364 (21.4) |
| 40-49y | 950 598 (27.6) | 97 715 (22.0) |
| 50-59y | 827 307 (24.0) | 111 611 (25.1) |
| 60-65y | 377 720 (11.0) | 87 057 (19.6) |
| *Total* | *3 443 329 (100)* | *44 44 860 (100)* |
| FDep at screening | | |
| 1 (less deprived) | 785 198 (22.8) | 85 774 (19.3) |
| 2 | 740 222 (21.5) | 93 977 (21.1) |
| 3 | 677 801 (19.7) | 88 547 (19.9) |
| 4 | 621 151 (18.0) | 88 253 (19.8) |
| 5 (most deprived) | 530 180 (15.4) | 69 637 (15.7) |
| Missing** | 88 777 (2.6) | 18 672 (4.2) |
| *Total* | *3 443 329 (100)* | *4 444 860 (100)* |

** FDEP is not defined for overseas.

screening situation). Only 7.8 % of women were screened within recommended intervals.

The comparison of the findings over these two periods suggest that screening practices are improving, which may reflect the effectiveness of the CCS programme.

### 4.2. Related factors

Our findings were in line with the literature: older women and women living in deprived areas were less likely to be screened opportunistically (Menvielle et al., 2014; Limmer et al., 2014; Luque et al., 2018; Barré et al., 2017), and also in the organised CCS programme (Audiger et al., 2021 Dec).

Among women who were not screened during the 2015–2021 period, the proportion of women living in the most deprived areas was higher compared to the other groups which is in line with the literature (Hamers and Jezeweski-Serra, 2019; Menvielle et al., 2014; Limmer et al., 2014; Luque et al., 2018). Although the town's social deprivation indicator cannot be considered to represent women's socio-economic status, we observed that women who were living in the most deprived urban areas were less likely to be screened, under either opportunistic screening or invitation-based screening. Combatting inequalities is one of the expected benefits of an organised cancer screening programme (Palencia et al., 2010). The programme has seemed to target vulnerable women, but this approach could be stepped up. The women invited to take part in the organised CCS programme are those who were not screened within the recommended interval; these women thus had been out of contact with the healthcare system for a long time, and a mere screening invitation in the post may not be enough to re-integrate them in the CCS process. Moreover, during the COVID-19 pandemic, lockdowns interrupted various strategies to reach vulnerable women. It is essential to take social inequalities into account in the implementation of public health programmes, to ensure that no one is left behind, as well

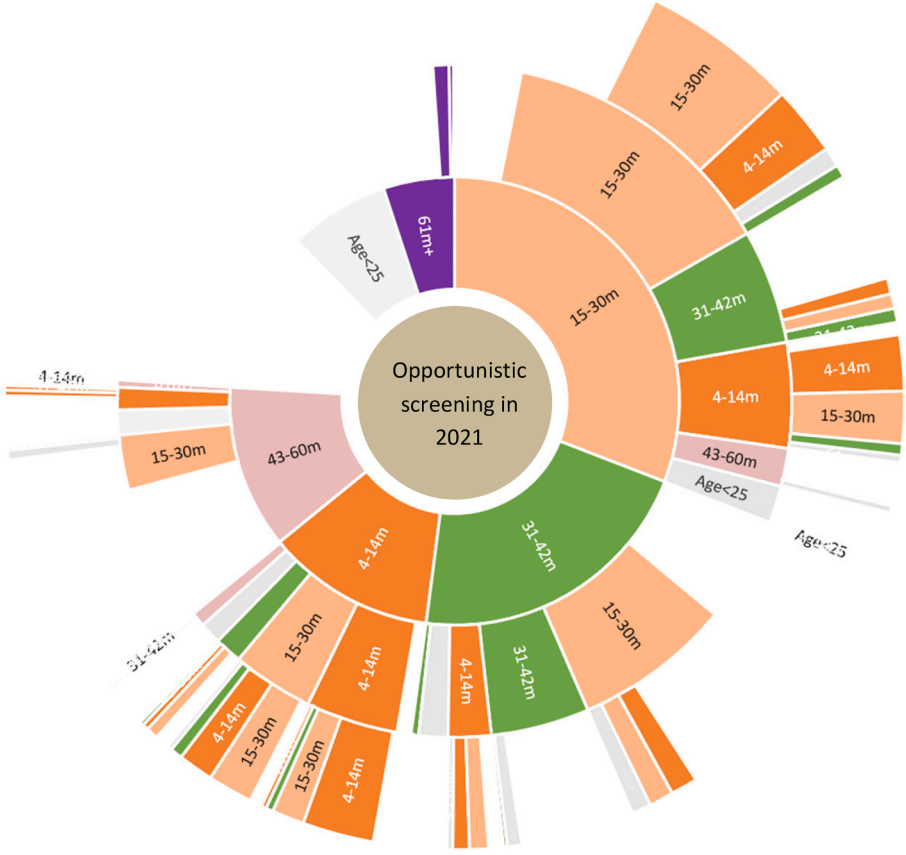


**Fig. 2.** Screening pathways since 2015 for women screened in 2021. 2a Women undergoing opportunistic screening in 2021 in France From centre to edge: 1st circle: interval between screening in 2021 and last screening 2nd circle: interval between last and penultimate screening Light orange: 4–14 months between two screenings (over-screening) Dark orange: 15–30 months between two screenings (over-screening) Green: 31–42 months between two screenings (recommended interval) Pink: 43–60 months between two screenings (under-screening) Purple: >60 months between two screenings (under-screening) Grey: age < 25 3 years before first screening of the 2015–2021 period White: no screening since 01/01/2015. 2b Women undergoing invitation-based screening in 2021. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

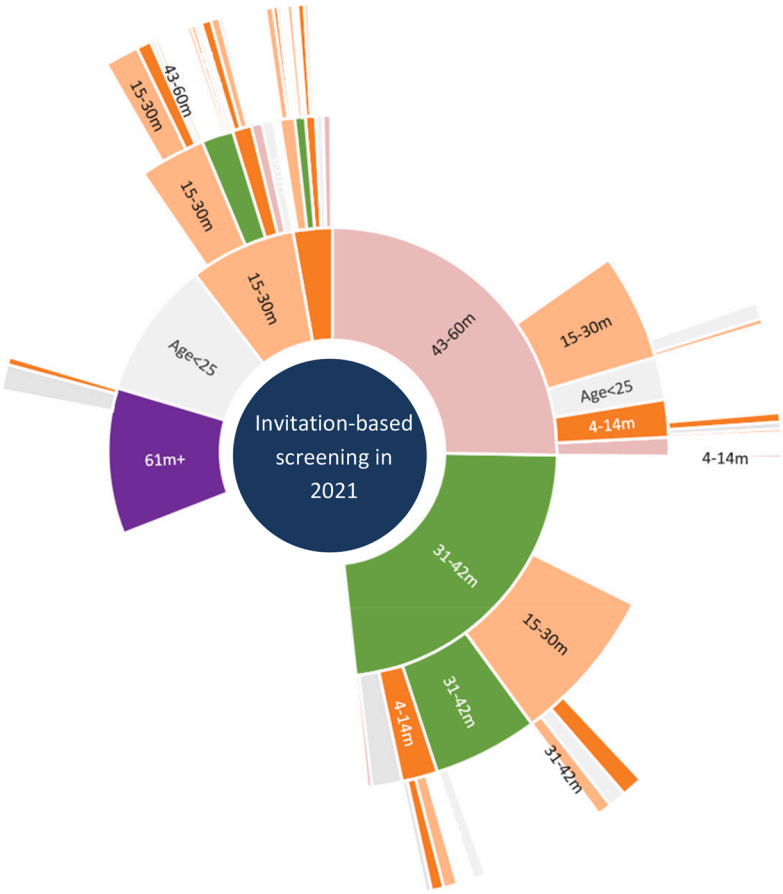


**Fig. 2.** (*continued*).

as to monitor and assess the effectiveness of approaches. To move forward in reducing inequalities, the programme could include more specific interventions to reach vulnerable women and to promote women's empowerment. Bringing CCS directly to women either with mobile facilities (Guillaume et al., 2017), or through urine or vaginal self-sampling (DesMarais et al., 2018; Lefeuvre et al., 2020) might be other options.

To better understand the role of healthcare in organized CCS programme uptake, it would be of interest to explore CCS care pathways (who had a smear test and where). However, this information was unavailable. We may nevertheless presume that, based on their socio-economic status (Lorant et al., 2002) and mobility (Traore et al., 2020; Vallee and Chauvin, 2012), women visit different type of health professionals in various places.

More specifically, socioeconomically privileged women are more likely to undergo screening by a gynaecologist outside their place of residence, whereas vulnerable women more often use municipal centres close to their place of residence (Vallee and Chauvin, 2012). Most of the time, women are required to pay for the cost of the medical consultation before being refunded by health insurance providers, and gynaecologists charge out-of-pocket fees in France. This process can be a barrier to vulnerable women. Moreover, it is important to bear in mind that throughout France the medical demographic is in decline. Diversifying the healthcare professional offering should be a priority.

### 4.3. Does the CCS programme include the targeted women?

Women undergoing opportunistic screening in 2021 were more likely to have a test within the recommended intervals over the 7-year period, compared to women undergoing invitation-based screening in 2021. However, a small proportion of the women undergoing invitation-based screening in 2021 were screened within the recommended interval over the 7-year period. This finding could be explained by the fact that some RCSCCs chose to invite the entire eligible population.

These findings prove that the design and the implementation of the programme are effective.

### 4.4. Limits

In this study, we did not collect the screening test results. To eliminate tests who were not screening-related issues, we excluded tests performed 4 months after the first one. We assumed that these prior tests were performed in the context of medical following-up.

Finally, we used a social deprivation indicator based on the French deprivation index (FDep). This indicator was designed for cities, yet it partly reflects women's socio-economic status (Schuurman et al., 2007). It would have been preferable to assess the socio-economic status using an ecological index on a smaller geographical unit but such an indicator was not available in this database.

The observation period includes 2020, the year of the COVID-19 pandemic. During this year, to contain and mitigate the spread and infection rate of the virus, the government guidelines were to provide only emergency healthcare. Prevention was delayed. Although the total number of tests and the women screened over a 3-year period remained stable, given the COVID-19 pandemic had huge consequences on health systems and on prevention in particular, the improvement in screening practices could have been better.

## 5. Conclusion

Overall, our study identified that the organised programme targeted women who were less likely to be screened within the recommended

interval over the 7-year period. These analyses need to be continued over time to assess whether the programme helps reintegrate women into the screening process.

Moreover, HPV self-sampling strategies targeting the most vulnerable population should be considered, as the majority of women testing negative would be given 5 years of reassurance, which is in lines with France's 2021–2030 ten-year cancer control strategy.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The authors do not have permission to share data.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2023.102429.

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