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Original Research

Resilience of the Dutch HPV-based cervical screening programme during the COVID-19 pandemic

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ABSTRACT

Objectives: Organisation of a screening programme influences programme resilience to a disruption as COVID-19. Due to COVID-19, the Dutch human papillomavirus–based cervical screening programme was temporarily suspended. Afterwards, multiple measures have been taken to catch-up participation. This study aimed to investigate programme resilience by examining the effect of COVID-19 and programme measures taken on participation in cervical screening.

Study design: Observational cohort study.

Methods: Data from the national screening registry and Dutch nationwide pathology databank (Palga) were used on invitations and follow-up in 2018/2019 (pre-COVID) and 2020 (COVID). Sending invitations, reminders and self-sampling kits were suspended from March to July 2020. Main outcome measures include distribution of participant characteristics (age, region and screening history), participation rates by age and region, time between invitation and participation (i.e. response time) and self-sampling use per month.

Results: Participation rate was significantly lower in 2020 (49.8%) compared to 2018/19 (56.8%, $P < 0.001$), in all ages and regions. Compared to 2018/19, participation rates decreased most in women invited from January to March 2020 (−6.7%, −9.1% and −10.4%, respectively). From August, participation rates started to recover (difference between −0.8% and −2.7%). Median response time was longer in February and March (2020: 143 and 173 days; 2018/19: 53 and 55 days) and comparable from July onwards (median difference 0–6 days). Self-sampling use was higher in 2020 (16.3%) compared to 2018/19 (7.6%).

Conclusions: The pandemic impacted participation rates in the Dutch cervical screening programme, especially of women invited before the programme pause. Implementation of self-sampling in national cervical screening programmes could increase participation rates and could serve as an alternative screening method in times of exceptional health care circumstances, such as a pandemic. Due to the well-organised programme and measures taken to catch-up participation, the impact of COVID-19 on the screening programme remained small.

Introduction

The COVID-19 pandemic has had a major impact on cancer screening programmes worldwide.[1,2] The organisation of a screening programme can influence the programme resilience to a disruption as COVID-19 and the implementation of recovery strategies.[3] The Netherlands has a well-organised,[4] primary high-risk human papillomavirus (hrHPV)–based cervical screening programme, with the possibility of using self-sampling.[5] During the pandemic, due to a three-month reservation of polymerase chain reaction test capacity for COVID-19 diagnostics and constraints on healthcare services, the Dutch government temporarily stopped the organised cervical screening programme in March 2020. These measures included a pause in sending invitations, reminders and self-sampling kits to women (further referred to as the 'programme pause'). In July 2020, there was a progressive resumption of the

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programme. In October and November 2020, additional measures were taken to catch up invitations and participation, including sending out 120% of the usual monthly invitations and subsequently, as participation rates were still low because women did not want or were not able to go to the general practitioner (GP), more prominently offering self-sampling.

Since the start of the hrHPV-based screening programme in 2017, participation in the programme has hovered around 57%.[6] The most recent monitoring data from the Dutch cervical screening programme showed that, despite efforts to increase participation following the programme pause, the participation rate dropped below 50% in the first COVID-19 year (2020).[7]

As all screening programme activities in the Netherlands are recorded in a centralised, dedicated IT system ('ScreenIT'), it is possible to evaluate in detail the impact of the COVID-19 pandemic on the screening programme.[3] We aimed to investigate the effect of the COVID-19 pandemic (including the different measures taken in that period) on participant characteristics (i.e. age, region and screening history), participation rates by age and region, response times and use of self-sampling. These short-term indicators of screening effectiveness can eventually be used to estimate the long-term impact of COVID-19 on screening outcomes and cervical cancer burden,[4] thereby showing the resilience of a well-organised screening programme during a crisis, such as the COVID-19 pandemic.

Methods

Setting

This study was conducted within the Dutch cervical screening programme. Women aged 30–60 years are invited every five years to participate in cervical screening. Annually, approximately 750,000 women are invited to attend the screening programme. Since January 2017, all cervical samples have been tested primarily for the presence of hrHPV, and women can either be sampled by their GP or request a self-sampling kit. Self-sampling is offered to all women eligible for screening. Following a hrHPV-positive screen, reflex cytology is performed on clinician-collected samples, and women with a hrHPV-positive self-sample are requested to make an appointment with their GP for an additional cervical cytology test. If cervical cytology is positive (atypical squamous cells of undetermined significance or higher [ASC-US+)], women are referred for colposcopy. If cervical cytology is negative, then women are invited after 6 months for repeat cytology. If the repeat cytology test finds ASC-US+, women are referred for colposcopy (see Flowchart Fig. S1). A reminder letter is sent to non-responders after 16 weeks.

Data source

We used data from the national information system for cervical cancer screening (ScreenIT, Topicus, Deventer, the Netherlands) for this study. ScreenIT contains information about all invitations and reminders sent in the national screening programme, as well as requests for self-sampling kits and the date and results of primary screening. We received data on all invitations (including their follow-up) sent for screening in 2018, 2019 and 2020. Since ScreenIT did not contain information before 2017, we linked the data from ScreenIT to the Dutch nationwide pathology databank (Palga) in order to obtain information about the screening histories of women who participated in the screening programme.

We received permission from the data protection officer from Bevolkingsonderzoek Nederland for processing of the data for this study. All data were pseudonymised, and potentially identifying information was provided in a non-identifiable format (e.g. age groups were provided instead of single year of age, intervals in days between key screening moments were provided instead of dates). For each invitation year, the follow-up was 15 months from the start of the invitation year.

Data and indicator definitions

COVID-19 measures included a stop in sending invitations, reminders and self-sampling kits (March 2020), the restart of the programme (July 2020), sending invitations at 110% (October 2020), then up to 120% and the broader offer of self-sampling by a revision of the invitation letter (November 2020). Table S1 shows the different measures. When invitations increased to 110%, the additional 10% was prioritized to those that should have been invited in March, followed by April, May and June, respectively, to minimize the delay time. A screening episode starts with the primary screening test, followed by any (cytology or histology) follow-up tests and/or treatment, and is completed once a woman is advised to return to regular screening. We used the date of the most valid hrHPV test result as a proxy for date of participation to define the beginning of a screening episode. This indicates that in case of more than one hrHPV sample, the date of the most 'valid' result was used according to the following order: positive, negative, inadequate and unable to analyse. Participation rates for each year were defined as the total number of women screened within 15 months of the start of the year divided by the total number of invitations sent in that calendar year (Fig. S2).

Response time was calculated as the number of days between the invitation and participation. Age categories include 30–34, 35–39, 40–44, 45–49, 50–54, 55–59 and 60–64 years. In the Netherlands, there are five regional screening organisations, which are responsible for the implementation of the screening programme in practice, including sending invitations to eligible women and communicating results with them. Regions were defined as 1 to 5. Screening history was defined as the number of previous primary cytology tests (from screening or medical indication) from 1 January 2008 onwards and categorised as 0 or $\geq$1. Sampling method included clinician-sampling or self-sampling.

Data analysis

In order to analyse the overall impact of COVID-19 on the screening programme, descriptive analyses of age, screening region and screening history of women participated in 2018/19 and 2020 were performed. Also, the median response time and distribution of sampling method were analysed in both periods. Differences between invitation years were analysed using the chi-squared test for categorical variables or the Mann–Whitney U test for continuous variables (which have a non-normal distribution). Participation rates were calculated per age category and screening region. Differences in average participation rates between 2020 and 2018/2019 were analysed using the independent sample *t*-test. Regarding the COVID-19 measures taken, the effect of the stop in sending invitations and reminders on participation was analysed using monthly participation rates and monthly response times as a proxy. In order to investigate the effect of a broader offer of self-sampling since November 2020 on the use of self-sampling, self-sampling use by month was analysed. For the latter analysis, follow-up data until August 2021 was used, to ensure enough follow-up time to evaluate the effect of introducing this measure from November 2020. All analyses were performed in IBM SPSS Statistics for Windows Version 25.0 (Armonk, NY: IBM Corp). A *P*-value of 0.05 was considered to be statistically significant.

Results

Overall impact of COVID-19 on participation

In total, 297,076 women participated in the Dutch cervical screening programme in 2020, compared to 907,945 in 2018/19 (Table 1). The participation rate was significantly lower in 2020 (49.8%) than in 2018/19 (56.8%, $P < 0.001$; Fig. 1). A slightly higher proportion of women without a screening history participated in 2020 compared to 2018/19 (Table 1). The median response time between invitation and participation slightly decreased from 2018/19 to 2020 (50 vs 46 days). The use of self-sampling was significantly higher in 2020 (16.3% of all participants) compared to 2018/19 (7.6%, $P < 0.001$). Participation rates were significantly lower for every age category and screening region in 2020 compared to 2018/19 (Table S2). With the largest difference in participation rate in age 40–44 years (−8.4%) and the smallest in age 30–34 years (−5.5%). For region, the difference in rate was most prominent in region 2 (−8.4%) and least prominent in region 1 (−6.6%).

Impact of COVID-19 measures on participation and self-sampling use

Participation rates after primary invitation and reminder were significantly lower in every month of invitation in 2020 compared to 2018/19 ($P < 0.001$; Fig. 1). Participation after reminder was higher in women invited in February and March 2020 compared to 2018/2019. The lower total participation rate in 2020 is mainly seen in the first three months of 2020 (−6.7% in January, −9.1% in February and −10.4% in March; Figs. 1 and 2). After the restart of the programme in July, differences in participation rates became smaller compared with 2018/19 (difference between −0.8% and −2.7%; Fig. 1). In January and February, time between primary invitation and participation was similar across all three years, but the response time after reminder was longer in 2020 compared to 2018/19, related to the pause in sending reminders between March and July (Fig. 3). In February and March 2020, compared to February and March 2018/19, median response time increased (up to 90 and 118 days longer, respectively). From July onwards, response times recovered and were comparable to the previous two years (median difference varying from 0 to 6 days). The use of self-sampling per participation month strongly increased as of December 2020, which can be related to the broader offer of self-sampling implemented in November 2020 (Fig. 4).

Discussion

Participation rates were lower in 2020 compared to the two years before the pandemic, in every age category and region. The largest decrease in participation was seen in women who were invited in the first three months of 2020, the period between the start of the pandemic and the programme pause. Those women may have 'missed' the opportunity to be screened shortly after their invitation due to the programme pause. Also, response times were longer for women who were invited in February and March 2020 compared to 2018/19. However, participation rates and response times caught up quickly following the restart of the programme in July 2020. We found broadening the offer of self-sampling resulted in a steep increase in use, which might have helped restore participation rates.

In concordance with our study, in England, cervical screening coverage decreased from 70.9% to 68.3% in women aged 25–49 years and from 76.4% to 75.3% in women aged 50–64 years from March to September 2020.[8,9] Lower cervical screening test volumes were observed in programmes in Scotland, Slovenia, Canada and the USA. In Scotland, from November 2019 to October 2020, 43% of the total annual screening tests were carried out of the year prior.[10] In Slovenia, test volume decreased by 23% from March to September 2020 compared to the previous 3-year average.[11] In Canada, the average monthly number of tests decreased by 63.8% from March to August 2020 compared to 2019.[12] In the National Breast and Cervical Cancer Early Detection Program of the United States, cervical screening tests were lower compared to 5-year averages from previous years in the period April–June 2020.[13] Although lower test volumes might be due to screening stoppages, these may also be a result of lower participation rates due to

Table 1
Descriptives of women who participated in screening in 2018/19 and 2020.

	2018/19 (n = 907,945 (%))	2020 (n = 297,071 (%))	*P*-value
Age, years			<0.001
30-34	106,280 (11.7)	35,828 (12.1)	
35-39	108,789 (12.0)	36,213 (12.2)	
40-44	121,716 (13.4)	39,133 (13.2)	
45-49	131,963 (14.5)	40,425 (13.6)	
50-54	157,517 (17.3)	51,822 (17.4)	
55-59	150,168 (16.5)	49,788 (16.8)	
60-64	131,512 (14.5)	43,862 (14.8)	
Region			<0.001
1	243,349 (26.8)	79,733 (26.8)	
2	89,296 (9.8)	29,801 (10.0)	
3	176,733 (19.5)	59,619 (20.1)	
4	197,592 (21.8)	68,032 (22.9)	
5	200,204 (22.1)	59,788 (20.1)	
Unknown	771 (0.1)	98 (0.0)	
Screening history[a]			<0.001
0 screens	132,044 (14.6)	47,638 (16.1)	
≥1 screens	774,691 (85.4)	248,912 (83,9)	
Time between invitation and participation (days; median (IQR))	50 (28–112)	46 (26–124)	<0.001
Sampling method			<0.001
Clinician sampling	838,560 (92,4)	248,766 (83.7)	
Self-sampling	69,385 (7.6)	48,305 (16.3)	

IQR = interquartile range.
[a] Include only cases that could be linked with Palga (2018/19: n = 906,735; 2020: n = 296,550).

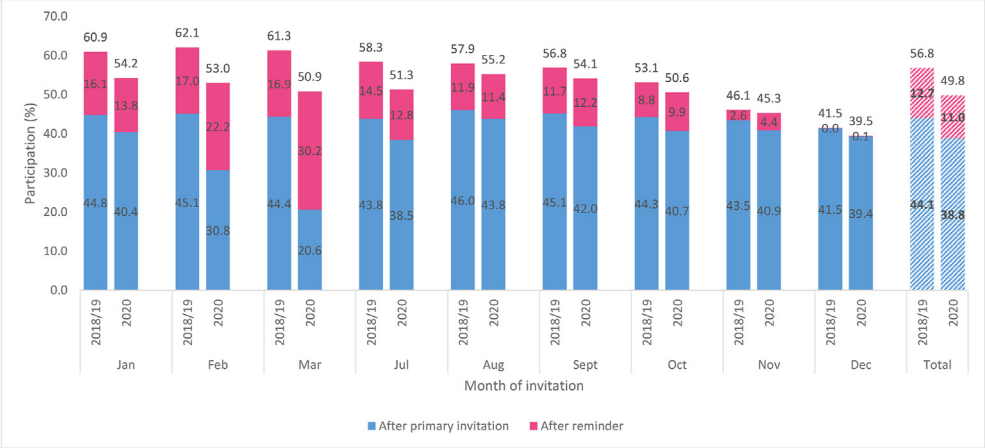

Fig. 1. Participation after primary invitation and reminder for each month of invitation. All differences were statistically significant ($P < 0.05$) between 2020 and 2018/2019 following the results of the independent sample *t*-test. There is a gap in data between March and July because of the stop in sending invitations, reminders and self-sampling kits in those months (i.e. programme pause).

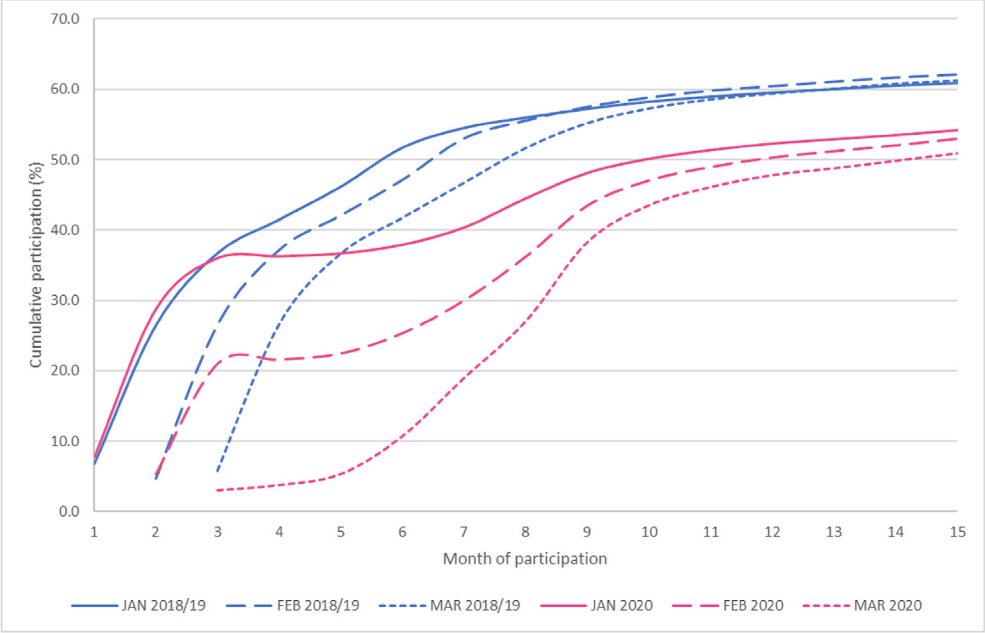

Fig. 2. Cumulative proportion participation of women invited between January and March for the cohorts of 2018/19 and 2020 and their month of participation.

the pandemic. Currently, there are no studies available reporting annual participation rates in cervical screening during the pandemic. Also, such a fast recovery as has been observed in the Dutch cervical screening programme has not been reported elsewhere.

In many countries, the introduction of human papillomavirus (HPV)–based screening has overlapped with the pandemic.[14] In the Netherlands, which was one of the first countries to introduce primary HPV-based screening in 2017, lower participation rates were already found in the new programme compared to the old cytology-based programme prior to the pandemic.[5] Therefore, for those other countries, it might be difficult to determine what has driven lower participation (pandemic or implementation of HPV screening).

Similar to our study, lower participation rates were seen in the Dutch colorectal cancer screening programme before and during the programme's suspension from March to June 2020.[15] After resumption of the programme in July, these rates were comparable to 2018/19, whereas we found a slight decrease in participation over the year. This difference in participation rates might be a result of the way of offering the test. For cervical screening, an appointment needs to be made at the GP for cytology or a self-sampling kit needs to be requested, whereas the faecal immunochemical test is sent together with the screening invitation, which may remove barriers for participation (especially during the pandemic).

Participation rates by age and screening region were analysed in order to explore reasons for the lower total participation rate in 2020 compared to 2018/19. For example, certain age groups might be more hesitant to undergo screening due to the pandemic, or changes in participation rates could be attributable to one or more (regional) screening organisations in particular (e.g. due to lack of capacity). Participation rates were lower in all age groups and screening regions in 2020, but we did not find any remarkable differences between age groups or screening regions.

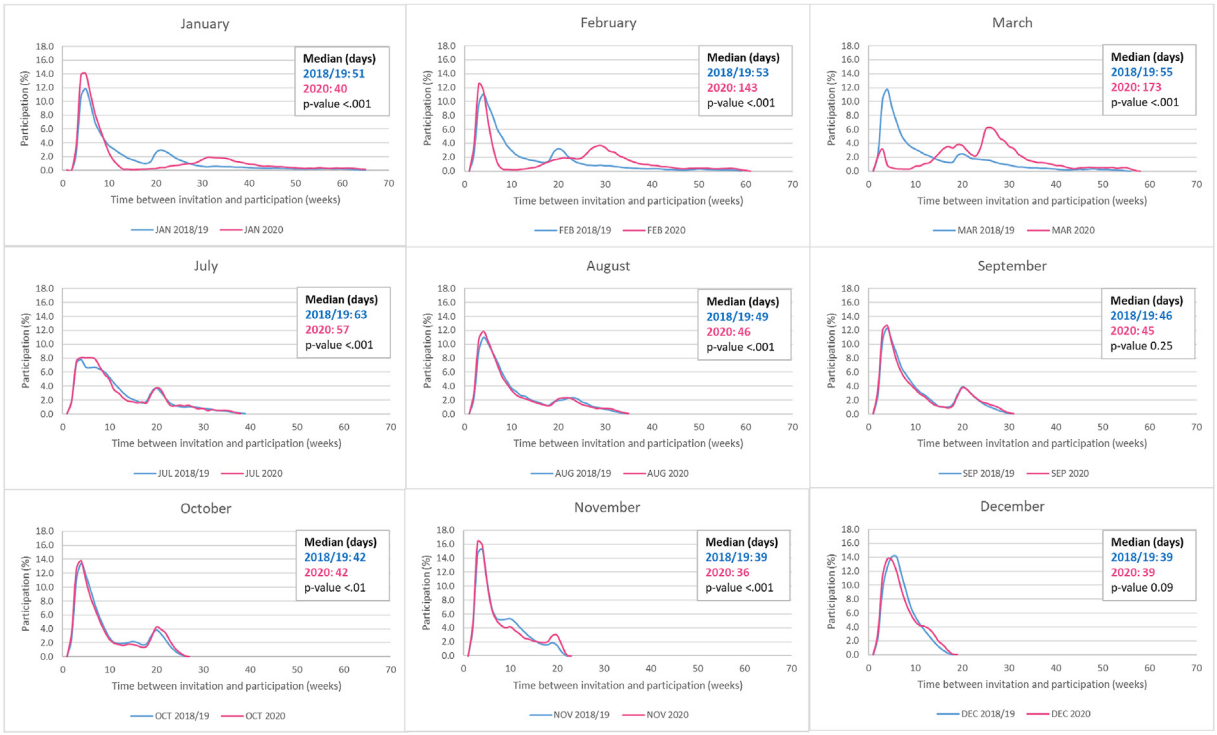

Fig. 3. Response times (weeks) between invitation and participation per invitation month in 2018/19 and 2020. In April, May and June 2020, there was a programme pause (no graphs). The second peak is largely related to the reminder, which is usually sent at 16 weeks after invitation to non-responders.

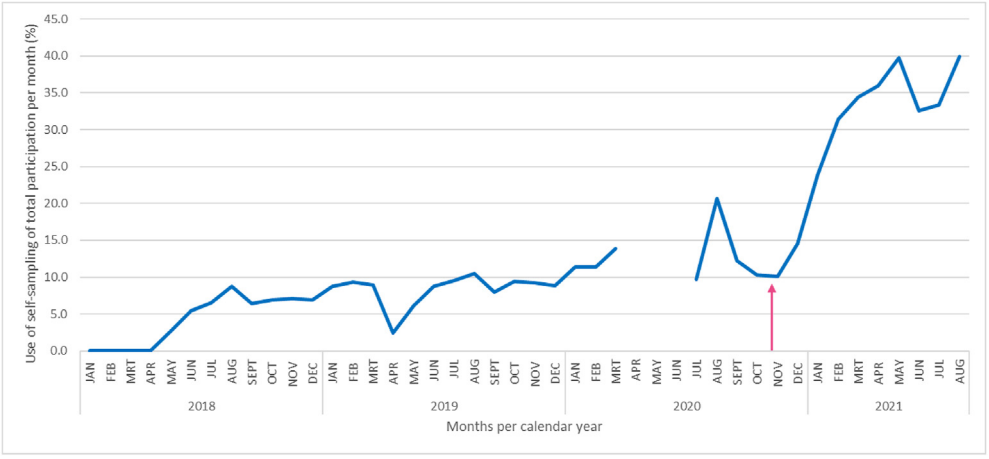

Fig. 4. The use of self-sampling per month of participation relative to the total participation per month for the calendar years 2018, 2019, 2020 and 2021. Programme pause from March 2020 (self-sampling from April) to July 2020. There was a delay of 4 months in sending self-sampling kits from the start of 2018 and 2019. Extra follow-up time until August 2021 was used to be able to evaluate the effect of the more prominent offer of self-sampling in November 2020 (indicated with the arrow). The gap in data between March and July 2020 was due to the stop in screening (i.e. 'programme pause').

As shown in our study, offering self-sampling more prominently doubled the use of self-sampling compared to previous years. It appears that this policy measure removed barriers for participation. Self-sampling was initially introduced to increase participation amongst underscreened women. Concerns were raised regarding switchers because of the potential higher loss of follow-up amongst self-samplers and the reduction in effectiveness of the programme due to different test characteristics.[16,17] Recently, the Health Council of the Netherlands has advised that both self- and clinician-sampling should be offered as equal primary collection method.[18] Moreover, they advised to immediately send the self-sampling kit along with the invitation. Although studies have shown that the performance of self-sampling is equal to clinician-sampling,[19,20] a Dutch study found a slightly lower sensitivity of hrHPV testing on self-collected samples compared to clinician-collected samples.[21] So, the long-term effects of self-sampling use on cervical intra-epithelial neoplasia (CIN) detection rates and interval cancers should be investigated and closely monitored. Regardless of these potential limitations, our study indicated that self-sampling might have contributed to catching up on lower participation rates due to the pandemic.[22] This indicates that the implementation of self-sampling could, in general, be used in national screening programmes to increase participation rates. In addition, self-sampling could serve as an alternative screening method during times of

crisis, such as a pandemic, and improve the resilience of a screening programme.

Compared to other countries, the Netherlands has a relatively long interval between two screening rounds (5 and 10 years, depending on age and screening history), so the long-term impact of missing one screening round on future cervical cancer burden might be relatively large. The long-term effects of the described decrease in participation should therefore be closely monitored whenever data become available. Modelling studies, however, have already shown that rapid catch-up of missed screens, as we have observed, will minimise the impact of COVID-19 on cervical cancer incidence.[23]

The Dutch cervical screening programme is a well-organised programme with nationwide coverage. Data are collected per screening round on individual level, which enables insights into individual screening behaviour. This data infrastructure is a strength compared to other studies, which only reported the number of screening tests performed. Detailed information about participation in screening, especially in a dynamic situation as a pandemic, is useful for informing additional policy changes to minimise the impact of COVID-19 stoppages on the long term.

Our study also has limitations. We used a 15-month period from the start of the invitation year (i.e. January 1st) as a definition for participation; therefore, women invited later in the year have a shorter period (and less opportunity) to participate. This may result in lower participation rates of women invited in these months. As a consequence, differences in participation across the three years might be different if a longer inclusion period was used. Also, in 2020, more women were invited later in the year due to the programme pause from March to July. As a result, a higher proportion of women had a shorter period to participate compared to 2018/19, which might have decreased the average total participation rate of 2020. Moreover, we were unable to report on referral and detection rates, treatments or long-term effects on the cervical cancer screening burden of COVID-19 due to limited follow-up time from 2020.

Conclusion

The COVID-19 pandemic has impacted participation rates in the Dutch cervical screening programme, especially of those women invited in the first three months of 2020. A more prominent offer of self-sampling contributed to catching up lower participation rates. In general, implementation of self-sampling in national cervical screening programmes could increase participation rates and could serve as an alternative screening method, especially in times of exceptional healthcare circumstances such as a pandemic. Due to the measures taken to catch up on participation, the impact of COVID-19 appears to be minor, showing the resilience of a well-organised HPV-based cervical screening programme. The longer-term impact on cervical cancer incidence and mortality, however, needs to be further explored. Referral and CIN detection rates, as well as interval cancer rates, should be closely monitored with regard to the sudden increase in the use of self-sampling.

Author statements

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Ethical approval

Ethical approval by a medical ethical committee was not required under Dutch law, as no patients were involved in the development of the research and only non-identifiable data were used for this study.

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Competing interests

The authors declare no conflict of interest.

Data availability

The data of this study are property of the Dutch national screening organisation Bevolkingsonderzoek Nederland and the Dutch nationwide pathology databank Palga. Data from Bevolkingsonderzoek Nederland can be requested via Wetenschappelijkonderzoek@bevolkingsonderzoeknederland.nl. Data from Palga can be requested via the Palga request system at their website (www.palga.nl).

Contribution to authorship

EMGO performed the data analysis and wrote the first draft of the article, with contributions from CAA and IMCMdK. AGS created the data set from PALGA following a review by FJvK. All authors reviewed and approved the final article for publication.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2023.11.026.

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