Social Science & Medicine 312 (2022) 115371

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Mirror, mirror on the wall, when are inequalities higher, after all? Analysis of breast and cervical cancer screening in 30 European countries

Carlota Quintal [a,b,*], Micaela Antunes [a]

[a] University of Coimbra, CeBER, Faculty of Economics, Portugal
[b] CEISUC, Portugal

ARTICLE INFO

Keywords:
Breast cancer screening
Cervical cancer screening
Inequalities
European health interview survey

ABSTRACT

Screening for breast and cervical cancer is strongly related with a reduction in cancer mortality but previous evidence has found socioeconomic inequalities in screening. Using up-to-date data from the second wave of the European Health Interview Survey (2013–2015), this study aims to analyse income-related inequalities in mammography screening and Pap smear test in 30 European countries. We propose a framework that combines age group and screening interval, identifying situations of due-, under-, and over-screening. Coverage rates, standard and generalised concentration indices are calculated. Overall, pro-rich inequalities in screening persist though there are varied combinations of prevalence of screening attendance and relative inequality across countries. Bulgaria and particularly Romania stand out with low coverage and high inequality. Some Baltic and Mediterranean countries also present less favourable figures on both accounts. In general, there are not marked differences between mammography and Pap smear test, for the recommended situation ('Due-screening'). 'Extreme under-screening' is concentrated among lower income quintiles in basically all countries analysed, for both screenings. These women, who never screened, are at risk of entering the group of 'Lost opportunity', once they reach the upper-limit age of the target group. At the same time, there are signals of 'Over-screening', within target group, due to screening more frequently than recommended. In several countries, 'Over-screening' seems to be concentrated among richer women. This is not only a waste of resources, but it can also cause harms. The inequalities found in 'Extreme under-screening' and 'Over-screening' raise concerns on whether women are making informed choices.

1. Introduction

Breast cancer is the most prevalent form of cancer in women worldwide, while cervical cancer is the fourth most common cancer in women, with about 2.1 million and 570 thousand newly diagnosed cases in 2018, respectively. Despite the lower incidence of cervical cancer compared to breast cancer, the former was responsible for 311.4 thousand deaths in 2018, which is about half of the deaths (626.7 thousand) caused by breast cancer in the same year (International Agency for Research on Cancer [IARC], 2019). Age standardised mortality rates (per 100,000), in 2018, for cervical and breast cancers, were 6.9 and 13.0, respectively (Ferlay et al., 2019).

There is evidence that screening for breast and cervical cancer is strongly related with a reduction in cancer mortality (Basu et al., 2018). In the case of breast cancer, timely and regular screening and early treatment have significantly reduced mortality rates by 20–30% in adult women (over 45 years of age) in developed countries (Massat at al. 2016). There are projections for the Nordic countries which suggest that the incidence of cervical cancer in the absence of screening would have been 3 to 5 times higher than the observed rates (Vaccarella et al., 2014). Already in 2003, the Council of the European Union recommended the implementation of population-based screening programmes for breast, cervical and colorectal cancers (von Karsa et al., 2008). The two main screening strategies are population-based programmes in which women in the defined target group are systematically tested, either on a national or regional level, and opportunistic screenings, in which the women's participation is a result of a recommendation made by a health care practitioner or of their own choice. The evidence suggests that organised programmes, compared to opportunistic, lead to better results both in terms of higher participation rates (Gianino et al., 2018) and less inequality (De Prez et al., 2021; Palència et al., 2010).

Socioeconomic inequalities in breast and cervical cancer screening

* Corresponding author. Faculty of Economics, University of Coimbra, Av. Dias da Silva, 165, 3004-512, Coimbra, Portugal.
E-mail addresses: qcarlota@fe.uc.pt (C. Quintal), micaela@fe.uc.pt (M. Antunes).

https://doi.org/10.1016/j.socscimed.2022.115371
Received 17 September 2020; Received in revised form 1 July 2022; Accepted 11 September 2022
Available online 15 September 2022

have been documented, with more deprived, less educated, women less likely to be screened (Carrieri and Wübker, 2013; Damiani et al., 2015; De Prez et al., 2021; Devaux, 2015; Mahumud et al., 2020; McKinnon et al., 2011; Palència et al., 2010; Willems and Bracke, 2018a).

Inequalities are a relevant matter given their impact on the ultimate goals of health systems. Under the framework proposed by the World Health Organization (WHO) to assess health systems, a good health system, above all, contributes to good health. But good health is both about the best attainable average level and the smallest feasible differences among individuals and groups. Within the WHO framework, access is an intermediate objective, that is, to achieve their main goals, health systems must ensure access to and coverage for effective health interventions (WHO, 2000, 2007). In the case of cancer, it has been acknowledged that health systems have an important role to play in promoting health equality by ensuring that every patient has access to high-quality cancer services throughout the care continuum from prevention and early detection to diagnosis, treatment, survivorship, and palliative care. Further, it is essential that service coverage is provided across the social gradient (Vaccarella et al., 2019). It is nonetheless important to recognise that access is a multidimensional concept involving supply-, as well as demand-, side factors. According to the well-known Andersen's (1995) model of health care utilisation, utilisation can be viewed as realised access. Access, in turn, depends on need factors (when it comes to screening persons of average risk, everyone is deemed to have the same need), on predisposing factors (like the individuals' perceptions of an illness and population-specific cultural characteristics) and on enabling factors (the means available to individuals to use health services). In the end, utilisation will depend on the interaction between features such as availability, appropriateness, and affordability of services, on the one hand, and persons' abilities, namely, to perceive that they have a need for health care as well as to seek and reach health services and to pay for health care, on the other (Levesque et al., 2013). In conclusion, in this widely consensual context, it is relevant to assess how health systems are performing both in terms of total rates of cancer screening attendance and in terms of inequalities in attendance rates across income groups, bearing in mind that attendance rates (realised access) depend on multiple factors associated with services and individuals.

The premise of the studies on income inequalities in cancer screening is that those in equal need ought to be treated equally irrespective of their income and that violations of this principle constitute empirical evidence of horizontal inequity in the utilisation of preventive health care. Usually, empirical analyses of equity in health care utilisation (e.g., of doctor visits) suffer from one limitation, that is, they look at deviations from the norm assuming that the norm represents the appropriate level of care (van Doorslaer and Masseria, 2004). Nonetheless, if there is for example overutilisation by some parts of the population, the norm might be artificially high (or the other way around if some population groups use less than needed). The norm might also vary from one country to another. In the case of screening, because there are guidelines in terms of target populations and screening intervals, it is easier to specify what an adequate level of utilisation is, and this same level might be used to compare different countries.

According to the WHO, so far, the only breast cancer screening method that has proved to be effective in organised population-based programmes is mammography screening. For asymptomatic women (at average risk) aged 50–69 years, screening every two years seems to provide the best trade-off between benefits and harms (World Health Organization, 2014). In the case of screening for cervical cancer, the screen-and-treat strategies are more varied, but the standard practice is to screen women using cytology (Pap smear test). Here, the recommendation is to screen every three years, starting between the age of 20 and 30 and until 69 years (World Health Organization, 2013). European guidelines (Arbyn et al., 2010; Perry et al., 2008) are in accordance with WHO recommendations and have been followed in most European countries. For the case of cervical cancer, as evidence on improved efficacy of human papillomavirus (HPV) primary screening became available, two Supplements to the European guidelines on cervical cancer screening were published in 2015 (Anttila et al., 2015; von Karsa et al., 2015). In this case, screening should not begin under the age of 30 and the screening interval for women with a negative HPV primary test result should be at least five years. When the data used in this study was collected, the most common test implemented by European countries was nonetheless the cytology. By July 2016, among the European countries with population-based programmes, only eight offered the two tests (conventional/liquid-based cytology and HPV) (Basu et al., 2018).

Combining the recommendations regarding the intervals of screening with those about age bands, it is possible to identify different situations in terms of due-, under-, and over-screening, as shown in Fig. 1.

Screening according to guidelines is reflected in the sum of cases from cells A and B, in Fig. 1 (women within target group, whose last screening test occurred within the recommended interval). For this reason, most studies (e.g. Burton-Jeangros et al., 2017; Carrieri and Wübker, 2013; Damiani et al., 2015; De Prez et al., 2021; Devaux, 2015; Douglas et al., 2016; Mahumud et al., 2020; McKinnon et al., 2011; Menvielle et al., 2014; Palència et al., 2010; Willems and Bracke, 2018a, 2018b) only analyse the group represented by cells A and B. In this case, the general interpretation is that the higher the percentage of the target group falling in A + B, the better. Regarding inequalities, because we are dealing with women of average risk, everyone is deemed to have the same need, hence, inequalities in utilisation are simultaneously seen as inequities – for all cells in Fig. 1, the less inequality, the better. In this work, we too analyse the target group (specifically, we analyse the cells highlighted in Fig. 1), however, our analysis is not restricted to cells A and B. By looking only at cells A and B, previous studies have implicitly assumed that the remainder situations (C and D) are equivalent. In our approach, we consider that under screening is more severe in cell D than in cell C given that, although screening is overdue for women in cell C, at least they had already the chance to detect possible abnormal situations. Also, according to Jolidon et al. (2020), who, differently from most previous studies, analysed separately 'under' and 'never-screeners' (our cells C and D, respectively), for the case of cervical cancer screening in Switzerland and Belgium, socioeconomic and demographic determinants of screening inequalities differ between these groups. These authors claim that inequalities in these groups should be addressed by

<table>
<tr><td colspan="3" rowspan="3"></td><td colspan="3">Target group</td></tr>
<tr><td rowspan="2">Yes</td><td colspan="2">No</td></tr>
<tr><td>Younger</td><td>Older</td></tr>
<tr><td rowspan="4">Last screening in recommended interval</td><td rowspan="2">Yes</td><td>< 1 year</td><td>A
(Due- / Possible over-screening)</td><td rowspan="3">E
(Over-screening)</td><td rowspan="2">G
(Over-screening)</td></tr>
<tr><td>>1 year</td><td>B
(Due-screening)</td></tr>
<tr><td rowspan="2">No</td><td>> Recom.</td><td>C
(Under-screening)</td><td>H
(Due-screening)</td></tr>
<tr><td>Never</td><td>D
(Extreme under-screening)</td><td>F
(OK)</td><td>I
(Lost opportunity)</td></tr>
</table>

Fig. 1. Matrix age group versus screening interval: due-, under-, and over-screening.

different public health strategies; thus, it seems pertinent to distinguish between cells C and D. Concerning the proportion of the target group falling in C and/or D, the lower the better. However, although this interpretation applies in general, it does not mean that the optimal scenario corresponds to empty cells for C and D. According to WHO, organised population-based screening should meet criteria such as whether women are able to make an informed decision based on the benefits and risks of screening; pursuing high attendance rates for screening in a population-based programme should never take priority over informed decisions based on evidence and individual values and preferences (World Health Organization, 2014, p. 26). Thus, non-zero figures within C and D might be acceptable and equitable if they follow from individual preferences and informed choices.

Most previous studies not only have restricted their analysis to cells A and B but also have looked at them jointly. Although both cells A and B are compatible with guidelines, in group A there are women, who, according to guidelines, screen every two years for breast cancer (or, every three years for cervical cancer), or even women who screen irregularly, but happen to have screened in the last year as well as women who screen annually. One might adopt a conservative approach, as most studies do, assuming that what matters is to monitor whether the last time women screened falls within the recommended interval, even if this means screening more frequently than recommended. However, over-screening is a waste of resources, which is becoming a worldwide cause of concern (Mafi and Parchman, 2018), and it is possibly reducing the capacity of health care systems to provide tests in a timely manner for those in clinical need. It can also cause harms such as complications from screening and follow-up tests, overtreatment of clinically unimportant cancers and psychological stress from false positive results (De Prez et al., 2020). There is evidence that over-screening is more likely in opportunistic programmes (Arbyn et al., 2009) and among women with high socioeconomic status (Willems and Bracke, 2018b). Consequently, it is pertinent to take a closer look at cell A, both in terms of the percentage of the target group falling in this situation, as well as in terms of inequalities occurring in this subgroup. To simplify the exposition, we considered that screening in cell B is in accordance with guidelines, but overuse might exist in this case for cervical cancer screening (for women screening every two years).

Over-screening in cell A is related with frequency, but over-screening might also be due to screening of women younger than the recommended age (cell E) or of women older than the recommended age (cell G). In this work, we do not analyse screening among non-target groups (cells E to I); nonetheless, these situations have increasingly raised concerns among researchers namely regarding the reasons that lead physicians to offer screening for young people (Kadivar et al., 2012). There is also evidence that few older women are informed of the risks of mammography screening and most overestimate its benefits (Cadet et al., 2021). In addition, although the recommended age bands are the reference to identify overuse in cells E and G, it is open to debate when to start screening (Silva et al., 2021) as well as when to stop (Kotwal et al., 2019). A special case within non-target groups concerns women who never screened in their lives and are already beyond the recommended age. This situation corresponds to cell I, in Fig. 1, which we labelled as 'Lost opportunity'. A study for Sweden found that geographical differences in breast cancer outcomes were mainly due to variation in survival in women not participating in screening (Tábar et al., 2021). Thus, inequalities in cell I are worrisome and unjust. The question is that they are not amenable to change anymore. It is therefore pertinent to tackle inequalities among women in the target group who never screened (cell D), and to prevent them, particularly those coming from disadvantaged backgrounds, from transitioning to cell I, given that they still have a chance of benefiting from screening.

Given this framework, our objectives are to analyse income-related inequalities in breast and cervical cancer screening attendance in a sample of 30 European countries, using the latest available data from the European Health Interview Survey (EHIS). We start with the recommended ages and intervals (cells A + B), focusing afterwards on women, within the target group, who never screened (cell D) and who screened in the shortest interval (cell A). Our results combine and present simultaneously information on inequality and level of screening attendance, two relevant dimensions under WHO framework to assess health systems, providing a more complete picture about the relative positions of European countries.

2. Methods

Data come from the second wave of the EHIS, conducted between 2013 and 2015 and implemented in all European Union Member-States at the time, Iceland, and Norway (30 countries). The EHIS data are available from Eurostat upon request (access to the data used in this study was granted under the research project with reference RPP 391-2019-EHIS). The countries included in the analysis and their respective codes are as follows: Austria (AT); Belgium (BE); Bulgaria (BG); Croatia (HR); Cyprus (CY); Czechia (CZ); Denmark (DK); Estonia (EE); Finland (FI); France (FR); Germany (DE); Greece (EL); Hungary (HU); Iceland (IS); Ireland (IE); Italy (IT); Latvia (LV); Lithuania (LT); Luxembourg (LU); Malta (MT); Norway (NO); Poland (PL); Portugal (PT); Romania (RO); Slovakia (SK); Slovenia (SI); Spain (ES); Sweden (SE); The Netherlands (NL); and United Kingdom (UK).

The variables of interest for our analysis are self-reported mammogram and Pap smear, obtained from two questions from the EHIS on preventive services. More specifically, women were asked when was the last time they had undergone a mammography (breast X-ray) (variable PA7) and about when was the last time they had a cervical smear test (variable PA8). The answer options were: (i) within the past 12 months; (ii) one to less than two years; (iii) two to less than three years; (iv) three years or more and (v) never. The categories for Sweden are slightly different (regarding categories (ii) one to less than three years; (iii) three to less than five years; (iv) more than five years) and thus outcomes are not always directly comparable.

To analyse inequality in screening attendance, we adopt the methodology of concentration indices (CI). Concentration indices measure relative inequality in one variable (in our case, screening attendance) over the distribution of another variable (in our case, income) and are often used to measure socioeconomic-related health inequality. The (standard) concentration index is defined with reference to the concentration curve. The concentration curve is the bivariate analogue of the Lorenz curve. Income-related inequality in screening attendance can be assessed by plotting the cumulative proportion of screening attendance across women ranked from poorest to richest. Unlike the Lorenz curve, the concentration curve may lie above the 45° line (line of equality) if screening is disproportionately concentrated among those with lower incomes. The convention is that the index takes a negative value when the concentration curve lies above the line of equality, indicating disproportionate concentration of the variable among the poor, and a positive value when it lies below the line of equality. In the case in which there is no socioeconomic-related inequality (in screening attendance), the concentration index is zero. The index is bounded between −1 and 1 (O'Donnell et al., 2008). It has been argued that inequality, namely in cancer screening attendance, must be interpreted with regards to the level of screening attendance (Devaux, 2015) and that it matters not only relative inequality (CI) but also absolute inequality (OECD, 2019). Absolute inequality is given by the generalised concentration index (GCI). The GCI is derived from the standard CI by multiplying it with the mean of the variable of interest. As a result, for instance, if two countries have the same level of relative inequality in cancer screening attendance, the inequality between rich and poor will be deemed higher in the country with the higher prevalence of screening attendance because in that case there are more people affected by the disproportionate distribution of screening attendance across income (OECD, 2019).

For each screening test, we have estimated standard CIs for the target group in different screening intervals (cells A + B, A and D, in Fig. 1), using the *conindex* STATA command written by O'Donnell et al. (2016). Target groups are women between 50 and 69 years for breast cancer screening and women between 20 and 69 years for cervical cancer screening. Net monthly equivalised income of the household (quintile) has been used as the ranking variable (in EHIS, variable HHINCOME). We have also computed the screening coverage for the recommended age/interval (cells A + B, in Fig. 1) as well as the proportion of women, within target group, who never screened (cell D, in Fig. 1). In the case of cell A, in Fig. 1, we have also identified countries with likely over-screening, adopting the same assumption as De Prez et al. (2020). Assuming an even distribution of breast (cervical) cancer screening over the two (three) years of the recommended interval, if women who screened in last year (cell A) corresponds to more than 50% (33%) of women who screened in recommended interval (cells A + B), then there is over-screening at the country level. The CI for cell A also provides a clue on this potential over-screening. If over-screening is more likely among women with high socioeconomic status (Willems and Bracke, 2018b), then, positive CIs for cell A of greater magnitude than positive CIs, if any, for A + B, might be an indication of over-screening. Sample weights provided in the database have been used (these weights are intended to overcome issues related to potential non-response bias and the demographic distribution across countries). Methodological details of the EHIS can be found in the Eurostat quality report (Santourian and Kitromilidou, 2018).

In terms of absolute inequalities, a country with a small degree of (relative) inequality and high screening attendance may count as much as a country with large (relative) inequality and low screening attendance. But these are very different situations. Hence, we show the position of countries in two-dimensional diagrams, with the prevalence of screening attendance (for cells A and B) or the proportion of women who never screened (for cell D) in the Y-axis and the standard CI in the X-axis.

3. Results

3.1. Breast cancer screening

3.1.1. Screening within last two years and recommended age group

Fig. 2 shows results for the recommended situation (cells A + B, in Fig. 1) for mammography. The average coverage is 65.3%, ranging from 6.6% in Romania to 86.9% in France (Sweden shows a prevalence of attendance of 90.5% but for screening within last three years). In addition to Romania, there are four other countries with a screening coverage below 50% (Bulgaria, Estonia, Lithuania, and Latvia). Prevalence of attendance in Malta, Greece, Slovakia, The UK, Slovenia, and Poland are above 50% but below the sample average. There are six countries with a coverage above 80% (France, Finland, Portugal, Denmark, Luxembourg, and The Netherlands).

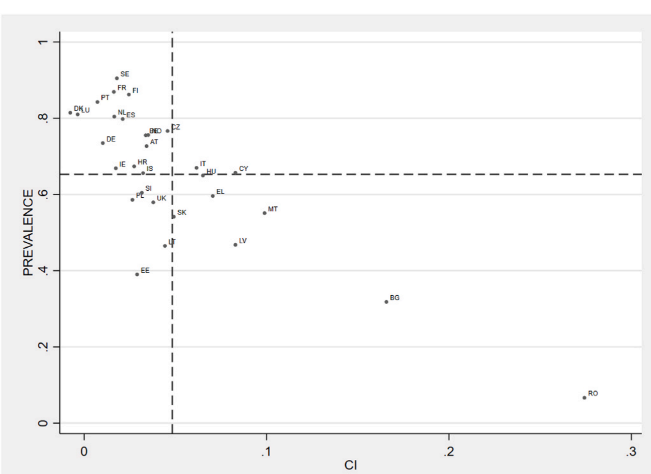
Concerning relative inequalities, there are only two countries (Denmark and Luxembourg) with a negative CI, though not statistically significant. In Portugal and Estonia, CIs are positive but not statistically significant as well. In the remainder countries, it seems to exist pro-rich inequalities as shown by positive values of CIs in Fig. 2.

Concerning absolute inequalities, the lowest values (in terms of magnitude) emerge in the cases of Luxembourg, Portugal, and Denmark, combining low (not significant) CIs with high prevalence of attendance, leading to GCIs, not statistically significant, of −0.0029, 0.0061 and −0.0062, respectively (GCIs are provided in the supplementary material - Table 1). But low values of GCIs might result from not so favourable performances. For example, Estonia presents a GCI lower than many other countries in Table 1 but this stems from its much lower screening coverage (as seen in Fig. 2). Looking at Fig. 2 and Table 1, it is possible to confirm that similar levels of absolute inequalities can derive from quite different situations. Lithuania and Finland, for instance, have similar GCIs (0.0206 and 0.0211, respectively), nonetheless, Finland has a much wider coverage than Lithuania as well as lower relative inequality. Bulgaria does not stand out in terms of the CGI, presenting a level like Malta and Cyprus, however, Fig. 2 shows that Bulgaria clearly performs worse with lower coverage and greater inequality. Absolute inequality in Romania is among the lowest in Table 1 despite its huge relative inequality. This happens because prevalence of attendance there is so low. Thus, in the end, most women are in the same situation - not screened.

3.1.2. Never screened within recommended age group

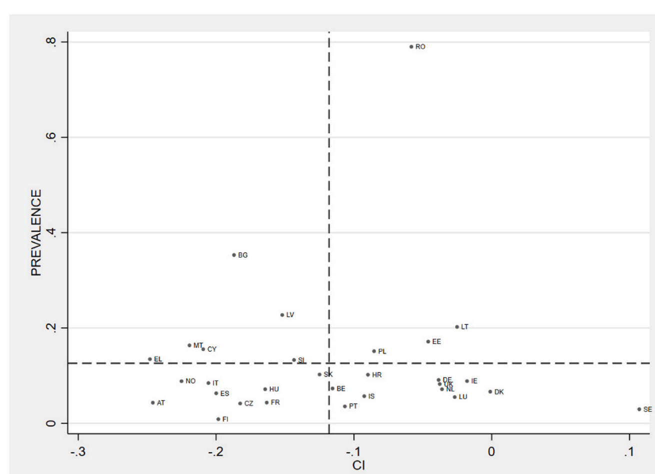
Fig. 3 shows results for the case of extreme under-screening (cell D, in Fig. 1).

In line with the results from Fig. 2, Romania presents the highest percentage of women not screened. Bulgaria has the second highest percentage representing less than half the proportion in Romania. Finland has the lowest rate of never screening with only 0.8%. For those countries below the sample average, in Fig. 3, the proportions of women who never screened vary between 0.8 and 10%. CIs are negative basically across the whole sample, indicating that the cases of never screening are concentrated among the poorest women. Sweden shows a



Notes: in the case of Sweden results are for mammography within last three years; dashed lines represent the average prevalence and CI

Fig. 2. Prevalence and relative inequality in coverage of mammography screening within last two years by women aged 50–69 years (due-screening).



Note: dashed lines represent the average prevalence of absence of screening and CI

Fig. 3. Prevalence and relative inequality among women aged 50–69 years who never screened for breast cancer (extreme under-screening).

relatively high and positive CI, nonetheless, it is not significant, and it combines with the second lowest proportion of women who never screened. The largest CIs (about −0.25) are observed for Greece and Austria, nonetheless, these countries are in different situations given that prevalence of never screening is higher in Greece, meaning that absolute inequality is also higher in this country compared to Austria. It should be noted that CIs are not statistically significant in 13 countries. Hence, in these countries one cannot rule out a proportional distribution of women who never screened for breast cancer, within target group, across income quintiles.

3.1.3. Screening within last 12 months and recommended age group

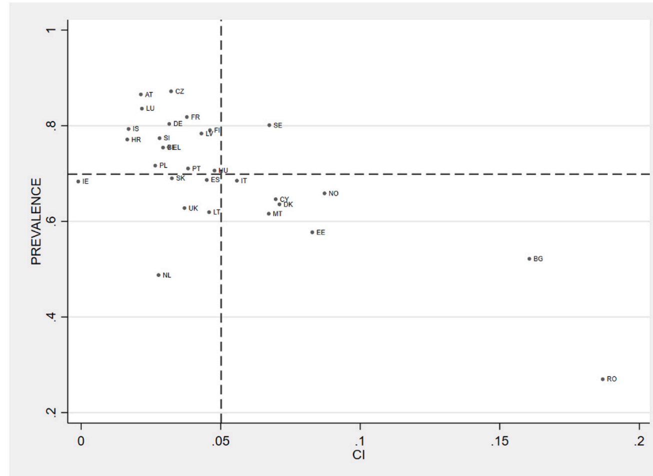
In this section we analyse the situation corresponding to cell A in Fig. 1, where there might be over-screening. We start by showing (Fig. 4) the breakdown of women in the target group who screened within the last two years by screening intervals.

There are some nuances across countries but, in the majority, the proportion of women who screened within the last 12 months is between 50 and 60%. Based on the criteria defined in the methods (proportion of women screening in last year greater than 50%), most countries exhibit likely over-screening. In Greece this proportion is the highest reaching 67.94%, followed by Luxemburg (64.48%) and Austria (63.72%). The results for relative inequality in screening in this shortest interval can be found in the supplementary material - Fig. S.1. In many countries, CIs continue to show positive values and of greater magnitude compared to Fig. 2 (that is, CIs for cell A are greater than CIs for A + B), suggesting stronger concentration of mammography, in shortest interval, among the richest women. Still, caution is required in the assessment of these values as CIs are not statistically significant in half of the countries. Considering only countries with significant CIs, Cyprus is the country with the widest absolute difference between CI in Fig. 2 and CI in Fig. S.1 (0.0829 and 0.1695, respectively), followed by Portugal and Croatia. There are nonetheless some countries such as Austria, Hungary, The Netherlands, Poland, Slovenia, Slovakia, and The UK where relative inequality is smaller in the shortest interval.

3.2. Cervical cancer screening

3.2.1. Screening within last three years and recommended age group

The case of recommended target group and screening interval (cells A + B, in Fig. 1) for Pap smear test is represented in Fig. 5. The average coverage is 69.86% (the lowest value is observed for Romania – 26.99% and the highest for Czechia – 87.21%, followed by Austria – 86.56%). There are only two countries with screening coverage below 50% (Romania and The Netherlands) and most countries present attendance prevalences above 60%. CIs are positive and statistically significant, except for Ireland (CI negative and not significant). The average CI is 0.0502 and values range from −0.001 in Ireland to 0.1869 in Romania. Again, it seems to exist pro-rich inequalities. GCIs in Table 1 (supplementary material) show that absolute inequalities are lower (|GCIs| < 0.02) in Ireland (GCI not significant), Croatia, Iceland, Luxembourg, Austria, Poland, and The Netherlands. In the latter country the low value of GCI nonetheless comes at the cost of lower coverage.



Notes: in the case of Sweden results are for Pap smear test within last five years; dashed lines represent the average prevalence and CI

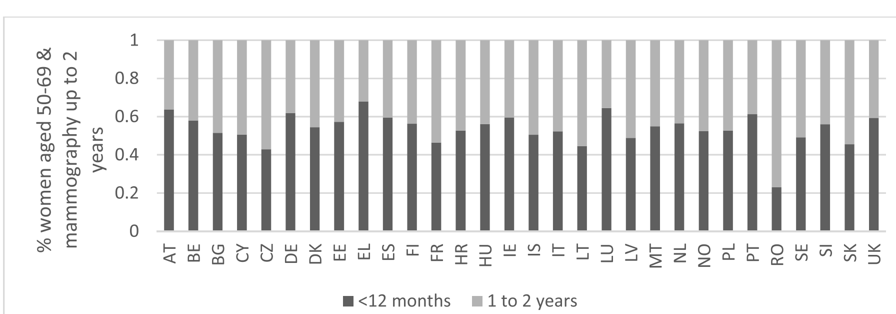
Fig. 5. Prevalence and relative inequality in Pap smear test within last three years by women aged 20–69 years (due-screening).

3.2.2. Never screened within recommended age group

Fig. 6 shows the proportion, and relative inequality, regarding women aged 20–69 years, who never did a Pap smear test (cell D, in Fig. 1).

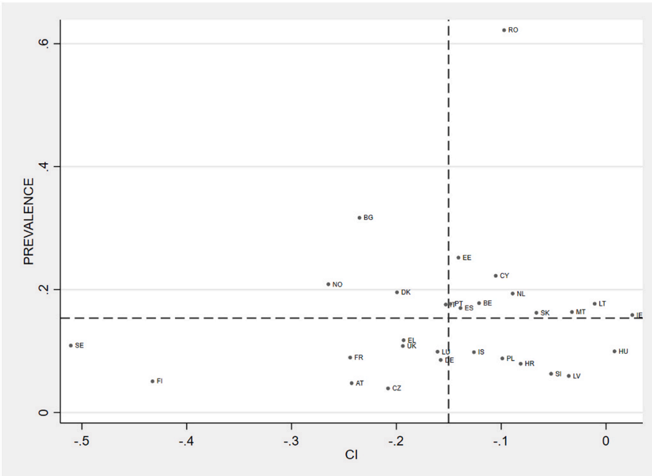
Romania shows the highest percentage of women (in target group) who never screened (62.21%), followed by Bulgaria (31.68%). Czechia is the country in the most favourable position regarding extreme under-screening given that only 3.92% of women in target group never did a Pap smear test. In 23 out of 30 countries, between 6 and 20% of women in recommended age never screened. Except for Hungary and Ireland (with positive CIs - not statistically significant), CIs are negative suggesting the concentration of never screening among poorest women. Among countries with negative CIs, only in Croatia, Latvia, Lithuania, Malta, and Slovenia the hypothesis of proportional distribution of never-screeners across income groups cannot be ruled out.

Compared with mammography, the range of prevalence rates of never screening is smaller in Fig. 6 than in Fig. 3 but, on average, the proportion of never-screeners is higher for Pap smear test.



Note: In the case of Sweden the intervals are: <12 months; 1 to 3 years

Fig. 4. Breakdown of women aged 50–69 years who did a mammography within last two years by screening intervals.



Note: dashed lines represent the average prevalence and CI

Fig. 6. Prevalence and relative inequality among women aged 20–69 years who never screened for cervical cancer (extreme under-screening).

3.2.3. Screening within last 12 months and recommended age group

As in the case of mammography, we present the breakdown of women in the target group who did a Pap smear test within last three years by screening intervals (Fig. 7).

There are signals of over-screening in basically all countries (28 out of 30). Results are striking for the cases of Austria, Germany, and Luxembourg, where more than 70% of targeted women did the test within the last 12 months. In Greece and Czechia this percentage is also high (above 60%) and in some other countries, such as Croatia, Hungary, Malta, Latvia, and Portugal, it is well above the reference level of 33%. The countries with a distribution of screened women across the three screening intervals closer to an even distribution are The UK and Ireland.

Regarding inequalities in screening for cervical cancer within last 12 months (Fig. S.2 – supplementary material), in most countries, CIs are positive (and statistically significant). Comparing with Fig. 6, in general, pro-rich inequalities are greater (CIs for cell A greater than CIs for A + B) and, as in mammography, Cyprus again is the country with the wider absolute difference between CIs (0.1489 within last 12 months and 0.0697 up to three years). Bulgaria also shows a strong absolute difference between screening intervals (0.2215 within last 12 months and 0.1605 up to three years). In the case of Greece, the absolute difference is lower but the CI for screening within last 12 months is 2.66 times higher than the CI for screening up to three years (0.0835 and 0.0313, respectively).

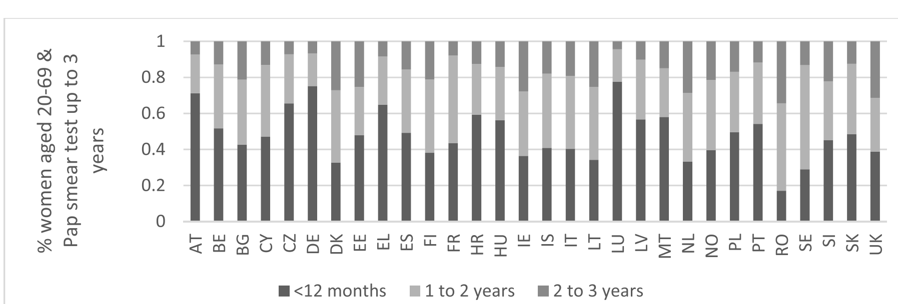
4. Discussion

The main objective of this study is to analyse income-related inequalities in breast and cervical cancer screening attendance in a set of European countries. In line with previous studies, our results suggest, with few exceptions, the existence of pro-rich inequalities in the situation which we identified as 'Due-screening', for both cancers. There is nonetheless great variability between countries.

In both cancers, Bulgaria and particularly Romania emerge with strong relative inequality. These countries further have quite low levels of coverage. There, prevalence rates of screening attendance are a bit higher for Pap smear test than for mammography, eventually, because cervical cancer screening was previously included in annual medical examinations in many institutions and factories during the Soviet era (Palència et al., 2010). Still, coverage is clearly short of needs and when prevalence rates of attendance are excessively low, as they are in these cases, measuring inequality may seem somewhat futile (as noted by McKinnon et al., 2011). Thus, while not completely losing sight of inequality, efforts in these countries should concentrate on augmenting levels of screening attendance (cells A + B). To a lesser extent, this also applies to some Baltic countries (Estonia, Latvia, and Lithuania) which present prevalence rates of attendance lower than most of other countries, especially, for breast cancer screening. Some Mediterranean countries (Greece, Malta, Cyprus, and Italy) show a level of relative inequality above the average and prevalence of attendance at, or below, average in the case of breast cancer screening as well. In the case of cervical cancer screening, surprisingly, Norway and Denmark appear in the group of countries with a coverage level below the sample average and relative inequality above the sample average.

Comparing our results for the two screening tests analysed, on average, relative inequality for the recommended situation ('Due-screening') is similar and this also happens in a few countries. In other countries, relative inequality is higher for Pap smear test than for mammography while in others it is the opposite. Differences are stronger (more relative inequality in Pap smear) in Denmark, Luxembourg, Portugal, Sweden, Germany, and Estonia. Some studies (Damiani et al., 2015; Douglas et al., 2016; Menvielle et al., 2014) found a weaker association between socioeconomic status and screening for breast cancer than for cervical cancer. We did not obtain so clear-cut results probably due to the expansion of coverage in cervical cancer screening in the meantime. Nonetheless, we must note that the hypothesis of equal utilisation could not be ruled out (due to nonsignificant indices) in more countries in the case of breast cancer screening than in the case of cervical cancer screening.

Previous studies have restricted their analyses to recommended age groups and screening intervals (cells A + B, in Fig. 1). We acknowledge that, in terms of equity concerns, this is the most relevant approach and we too started by analysing it. However, available data in EHIS allows a deeper investigation of patterns of utilisation.



Note: In the case of Sweden the intervals are: <12 months; 1 to 3 years; 3 to 5 years

Fig. 7. Breakdown of women aged 20–69 years who did a Pap smear test within last three years by screening intervals.

Regarding women who never screened (situation identified in cell D, in Fig. 1), the results are very clear concerning the concentration among the poorest women demonstrated by negative CIs in basically all countries. It should nonetheless be acknowledged that CIs were not statistically significant in 12 countries, in the case of mammography, and in seven countries, in the case of Pap smear test. Moreover, in countries where the proportion of never screened women is very low, results regarding relative inequality should be interpreted with caution. Combining prevalence of never screening and relative inequality, and apart from Romania and Bulgaria, greater inequalities appear to exist in Malta, Latvia, Greece, and Cyprus, in the case of mammography, and in Norway, Denmark and Estonia, in the case of Pap smear test. These are situations that beg for close attention, particularly for those women nearer the upper-limit age eligible for screening, who are therefore at a greater risk of entering the 'Lost opportunity' cell in Fig. 1.

As stressed in the Introduction, women not screening (cell D, in Fig. 1) might be an acceptable situation. Lower screening uptake, irrespective of the characteristics of the unscreened group, should be respected as the result of an informed choice (Douglas et al., 2016; World Health Organization, 2014). In a study in the Paris metropolitan area, the main reason given most often for never having had a cervical cancer screening test was the feeling that this test is not necessary or needed and/or that everything was alright (Grillo et al., 2012). Notwithstanding these (reasonable) perspectives, it seems unlikely that preferences for not screening are concentrated among the poorest women. In fact, there is evidence that passive nonparticipants tend to be more socially deprived than active nonparticipants (Harder et al., 2018). Active nonparticipants actively decline attendance, while passive nonparticipants fail to attend without actively declining. Thus, the disproportionate concentration of never screeners among women of lower income should be a cause of policy concern.

In the other extreme, we explored situations of likely over-screening. For mammography, there are countries such as Austria, Luxembourg, and Greece, where there seems to exist generalised over-screening but not necessarily concentrated among richer women. That is, these countries show a high proportion of women screening in last 12 months but the CIs for this shortest interval (cell A, in Fig. 1) do not differ, substantially, from the CI for the whole target group (A + B, in Fig. 1). The countries where those indices show larger differences are Portugal, Croatia, France, and Cyprus, meaning that, in these countries, over-screening might be a phenomenon specific to richer women. Regarding the Pap smear test, across all countries, the proportion of women screening in last year is well above the threshold of 33% and again Austria and Luxembourg stand out, as well as Germany. Our results suggest that there is more over-screening (related with frequency higher than recommended) in Pap smear test than in mammography. This issue has been studied for the case of USA, where new recommendations called for longer intervals between cervical cancer screening tests (Bartley et al., 2020). While their shorter intervals might be a question of slow adjustment to new guidelines, in the European Union, there is no such 'excuse'. Based on results of inequality for cell A, Cyprus consistently appears in both screenings with signals of over-screening among richer women. Naturally, screening annually might be justified by medical reasons, but it is unlikely that CIs for cell A are greater than CIs for cells A + B because need for annual screening is concentrated among richer women. It has been estimated that mammograms, for example, following symptoms, account for only 5% of all mammograms (cf. Menvielle et al., 2014). It has also been concluded that, while women with a history of (breast) cancer consume sensibly more resources, they are not significantly poorer or richer than other women (Carrieri and Wübker, 2013).

Although with considerable variation across European countries, our results indicate that important inequalities persist in breast and cervical cancer screening, to the disadvantage of poorer women. In 2003, when the Council of the European Union published recommendations on cancer screening it was understandable the focus on coverage but now it is time to give more attention to recommendation (22): *Action should be taken to ensure equal access to screening taking due account of the possible need to target particular socioeconomic groups* (von Karsa et al., 2008, p.220).

4.1. Limitations

Some limitations apply to our study. Episodes of screening might be justified on medical grounds, meaning that women who are not of average risk should not be included in the analysis but due to data limitations it was not possible to exclude women with specific risks. Our results are based on self-reported data which might be subject to recall bias and to an overestimation of utilisation. There is indeed evidence that women tend to over-report their participation in Pap smear tests and mammography screening in a given timeframe, compared to medical record (Howard et al., 2009). Another study specifically evaluated the impact of using self-reported data in inequality analysis, concluding that the use of self-reported cancer screening data did not impact the magnitude of social differences in the screening attendance for the case of breast cancer but led to an overestimation of social differences in screening attendance for the case of cervical cancer (Aranda et al., 2021). However, relying on self-reported data is the common procedure in research about these topics due to the difficulty in obtaining identifiable registry data to link to participant responses (Brown et al., 2019). Another limitation is related with the fact that our discussion and comparisons across countries are based on screening attendance rates but there is lack of information on the quality of the services provided in the different countries. Thus, there might be cases where prevalence rates of attendance are lower, but the outputs of screening are of higher quality. Additionally, our study focusses on screening alone but there are other important features such as timeliness and appropriateness of diagnosis, treatment, and follow-up according to guidelines, which may be equally important to prevent the occurrence of cancer and related mortality, namely, in lower socioeconomic groups (Spadea et al., 2010).

In this study we analyse income-related inequalities in screening, however, some of the observed differences might be caused by inequalities besides income itself. Existing evidence suggests that education is a significant contribution factor for income-related inequalities in screening for breast cancer (Carrieri and Wübker, 2013). Educated women tend to possess higher health literacy, a more future-oriented attitude and better risk perception which might incentivise greater use of preventive health care. Differently, there is evidence that lower levels of income generally increase the likelihood of negative health behaviours (Murfin et al., 2020). In the case of Romania, for instance, because most Roma people lives in poor conditions, income-related inequalities in screening might be partly explained by issues related with ethnicity (Andreassen et al., 2017). All these aspects are in accordance with the view that the use of health care, regarded as realised access, depends on the interaction of diverse factors associated both with health services and individuals. Another remark is that, in some cases, national screening programmes are implemented regionally; consequently, regional inequalities might be a greater preoccupation than income-related inequalities.

5. Conclusions

Although with considerable variation across European countries, our results indicate that important pro-rich inequalities persist in breast and cervical cancer screening. The second wave of the EHIS includes many more countries than the previous wave and results show different realities. In some countries, screening coverage is still low, hence, in these cases significant effort should be put into the expansion of coverage. However, in countries with screening attendance between 70 and 80% of the target groups, attention should be especially given to inequalities, eventually considering recruiting strategies which have proved to be more successful in tackling socioeconomic differences in the uptake of screening tests. In the case of 'Extreme under-screening', the results clearly point to its concentration among the poorest women. At the same time, our results suggest that there might be over-screening due to screening more frequently than recommended. Besides the waste of scarce resources that it represents, there is the issue of ensuring that women are making informed choices, adequately balancing benefits, and harms of screening. Future studies should also analyse over-screening related with screening outside target groups. The near future might bring new discussions namely on innovative screening strategies and the adoption of cancer prevention measures like the HPV vaccination reducing the need for screening itself.

Credit author statement

Both authors (CQ and MA) contributed to the conceptualisation of the study, to the formal analysis, to the interpretation of results and writing of the paper. Both approved the final version of the revised manuscript.

Disclaimer

The responsibility for all conclusions drawn from the data lies entirely with the authors.

Data availability

The authors do not have permission to share data.

Acknowledgements

This work has been funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., Project UIDB/05037/2020.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2022.115371.

References

Andersen, R.M., 1995. Revisiting the behavioral model and access to medical care: does it matter? J. Health Soc. Behav. 36, 1–10.

Andreassen, T., Weiderpass, E., Nicula, F., Suteu, O., Itu, A., Bumbu, M., Tincu, A., Ursin, G., Moen, K., 2017. Controversies about cervical cancer screening: a qualitative study of Roma women's (non) participation in cervical cancer screening in Romania. Soc. Sci. Med. 183, 48–55.

Anttila, A., Arbyn, M., Vuyst, H.D., Dillner, J., Dillner, L., Franceschi, S., Patnick, J., Ronco, G., Segnan, N., Suonio, E., Törnberg, S., von Karsa, L., 2015. European Guidelines for Quality Assurance in Cervical Cancer Screening- Second Edition-Supplements. European Commission, Luxembourg.

Aranda, E., Franck, J.E., Ringa, V., Sassenou, J., Coeuret-Pellicer, M., Rigal, L., Menvielle, G., 2021. Social inequalities in participation in cancer screening: does the mode of data collection matter? The CONSTANCES cohort. Eur. J. Publ. Health 31 (3), 602–608.

Arbyn, M., Anttila, A., Jordan, J., Ronco, G., Schenck, U., Segnan, N., Wiener, H., Herbert, A., Von Karsa, L., 2010. European guidelines for quality assurance in cervical cancer screening - summary Document. Ann. Oncol. 21 (3), 448–458. https://doi.org/10.1093/annonc/mdp471.

Arbyn, M., Rebolj, M., De Kok, I.M., Fender, M., Becker, N., O'Reilly, M., Andrae, B., 2009. The challenges of organising cervical screening programmes in the 15 old member states of the European Union. Eur. J. Cancer 45 (15), 2671–2678. https://doi.org/10.1016/j.ejca.2009.07.016.

Bartley, S.J., Benard, V., Tai, E., Rockwell, T., Kenney, K., Richardson, L.C., 2020. Are uninsured women in a national screening program having longer intervals between cervical cancer screening tests? Prev. Med. 135, 106078.

Basu, P., Ponti, A., Anttila, A., Ronco, G., Senore, C., Vale, D.B., Segnan, N., Tomatis, M., Soerjomataram, I., Zakelj, M., Dillner, J., Elfstrom, K., Lonnberg, S., Sankaranarayanan, R., 2018. Status of implementation and organization of cancer screening in the European Union Member States—summary results from the second European screening report. Int. J. Cancer 142 (1), 44–56. https://doi.org/10.1002/ijc.31043.

Brown, R.F., Muller, T.R., Olsen, A., 2019. Australian women's cervical cancer screening attendance as a function of screening barriers and facilitators. Soc. Sci. Med. 220, 396–402. https://doi.org/10.1016/j.socscimed.2018.11.038.

Burton-Jeangros, C., Cullati, S., Manor, O., Courvoisier, D.S., Bouchardy, C., Guessous, I., 2017. Cervical cancer screening in Switzerland: cross-sectional trends (1992–2012) in social inequalities. Eur. J. Publ. Health 27 (1), 167–173.

Cadet, T., Aliberti, G., Karamourtopoulos, M., Jacobson, A., Siska, M., Schonberg, M.A., 2021. Modifying a mammography decision aid for older adult women with risk factors for low health literacy. Health Lit. Res. Pract. 5 (2), e78–e90.

Carrieri, V., Wübker, A., 2013. Assessing inequalities in preventive care use in Europe. Health Pol. 113 (3), 247–257. https://doi.org/10.1016/j.healthpol.2013.09.014.

Damiani, G., Basso, D., Acampora, A., Bianchi, C.B., Silvestrini, G., Frisicale, E.M., Sassi, F., Ricciardi, W., 2015. The impact of level of education on adherence to breast and cervical cancer screening: evidence from a systematic review and meta-analysis. Prev. Med. 81, 281–289. https://doi.org/10.1016/j.ypmed.2015.09.011.

De Prez, V., Jolidon, V., Willems, B., Cullati, S., Burton-Jeangros, C., Bracke, P., 2021. Cervical cancer screening programs and their context-dependent effect on inequalities in screening uptake: a dynamic interplay between public health policy and welfare state redistribution. Int. J. Equity Health 20 (1), 1–14.

De Prez, V., Jolidon, V., Willems, B., Cullati, S., Burton-Jeangros, C., Bracke, P., 2020. Cervical cancer (over) screening in Belgium and Switzerland: trends and social inequalities. Eur. J. Publ. Health 30 (3), 552–557.

Devaux, M., 2015. Income-related inequalities and inequities in health care services utilisation in 18 selected OECD countries. Eur. J. Health Econ. 16 (1), 21–33. https://doi.org/10.1007/s10198-013-0546-4.

Douglas, E., Waller, J., Duffy, S.W., Wardle, J., 2016. Socioeconomic inequalities in breast and cervical screening coverage in England: are we closing the gap? J. Med. Screen 23 (2), 98–103. https://doi.org/10.1177/0969141315600192.

Ferlay, J., Colombet, M., Soerjomataram, I., Mathers, C., Parkin, D.M., Piñeros, M., Znaor, A., Bray, F., 2019. Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods. Int. J. Cancer 144 (8), 1941–1953. https://doi.org/10.1002/ijc.31937.

Gianino, M.M., Lenzi, J., Bonaudo, M., Fantini, M.P., Siliquini, R., Ricciardi, W., Damiani, G., 2018. Organized screening programmes for breast and cervical cancer in 17 EU countries: trajectories of attendance rates. BMC Publ. Health 18 (1), 1236. https://doi.org/10.1186/s12889-018-6155-5.

Grillo, F., Vallée, J., Chauvin, P., 2012. Inequalities in cervical cancer screening for women with or without a regular consulting in primary care for gynaecological health, in Paris, France. Prev. Med. 54 (3–4), 259–265. https://doi.org/10.1016/j.ypmed.2012.01.013.

Harder, E., Juul, K.E., Jensen, S.M., Thomsen, L.T., Frederiksen, K., Kjaer, S.K., 2018. Factors associated with non-participation in cervical cancer screening–a nationwide study of nearly half a million women in Denmark. Prev. Med. 111, 94–100. https://doi.org/10.1016/j.ypmed.2018.02.035.

Howard, M., Agarwal, G., Lytwyn, A., 2009. Accuracy of self-reports of Pap and mammography screening compared to medical record: a meta-analysis. Cancer Causes Control 20 (1), 1. https://doi.org/10.1007/s10552-008-9228-4.

International Agency for Research on Cancer [IARC], 2019. World fact sheets. Available at: https://gco.iarc.fr/today/data/factsheets/populations/900-world-fact-sheets.pdf. Accessed 22 July 2020.

Jolidon, V., De Prez, V., Willems, B., Bracke, P., Cullati, S., Burton-Jeangros, C., 2020. Never and under cervical cancer screening in Switzerland and Belgium: trends and inequalities. BMC Publ. Health 20 (1), 1–11.

Kotwal, A., Walter, L.C., Lee, S.J., Dale, W., 2019. Are we choosing wisely? Older adults' cancer screening intentions and recalled discussions with physicians about stopping. J. Gen. Intern. Med. 34 (8), 1538–1545.

Levesque, J.F., Harris, M.F., Russell, G., 2013. Patient centred access to health care: conceptualising access at the interface of health systems and populations. Int. J. Equity Health 12, 18.

Mafi, J.N., Parchman, M., 2018. Low-value care: an intractable global problem with no quick fix. BMJ Qual. Saf. 27 (5), 333–336.

Mahumud, R.A., Keramat, S.A., Ormsby, G.M., Sultana, M., Rawal, L.B., Alam, K., Gow, J., Renzaho, A.M., 2020. Wealth-related inequalities of women's knowledge of cervical cancer screening and service utilisation in 18 resource-constrained countries: evidence from a pooled decomposition analysis. Int. J. Equity Health 19 (1), 42. https://doi.org/10.1186/s12939-020-01159-7.

Massat, N.J., Dibden, A., Parmar, D., Cuzick, J., Sasieni, P.D., Duffy, S.W., 2016. Impact of screening on breast cancer mortality: the UK program 20 years on. Cancer Epidemiol. Biomarkers Prev. 25, 455–463. https://doi.org/10.1158/1055-9965.EPI-15-0803.

McKinnon, B., Harper, S., Moore, S., 2011. Decomposing income-related inequality in cervical screening in 67 countries. Int. J. Publ. Health 56 (2), 139–152. https://doi.org/10.1007/s00038-010-0224-6.

Menvielle, G., Richard, J.B., Ringa, V., Dray-Spira, R., Beck, F., 2014. To what extent is women's economic situation associated with cancer screening uptake when nationwide screening exists? A study of breast and cervical cancer screening in France in 2010. Cancer Causes Control 25 (8), 977–983. https://doi.org/10.1007/s10552-014-0397-z.

Murfin, J., Irvine, F., Meechan-Rogers, R., Swift, A., 2020. Education, income and occupation and their influence on the uptake of cervical cancer prevention strategies: a systematic review. J. Clin. Nurs. 29 (3–4), 393–415.

O'Donnell, O., O'Neill, S., Van Ourti, T., Walsh, B., 2016. conindex: estimation of concentration indices. STATA J. 16 (1), 112–138.

O'Donnell, O., van Doorslaer, E., Wagstaff, A., Lindelow, M., 2008. Analyzing Health Equity Using Survey Data: A Guide to Techniques and Their Implementation. The World Bank, Washington, DC.

OECD, 2019. Health for everyone?. In: Social Inequalities in Health and Health Systems, OECD Health Policy Studies. OECD Publishing, Paris. https://doi.org/10.1787/3c8385d0-en.

Palència, L., Espelt, A., Rodríguez-Sanz, M., Puigpinós, R., Pons-Vigués, M., Pasarín, M.I., Spadea, T., Kunst, A., Borrell, C., 2010. Socio-economic inequalities in breast and cervical cancer screening practices in Europe: influence of the type of screening program. Int. J. Epidemiol. 39 (3), 757–765. https://doi.org/10.1093/ije/dyq003.
Perry, N., Broeders, M., de Wolf, C., Törnberg, S., Holland, R., von Karsa, L., 2008. European guidelines for quality assurance in breast cancer screening and diagnosis - summary Document. Oncol. Clin. Pract. 4 (2), 74–86.
Santourian, A., Kitromilidou, S., 2018. Quality Report of the Second Wave of the European Health Interview Survey. Publications Office of the European Union, Luxembourg.
Silva, C.F., Abreu, E.M., Marques, J.C., Pool, K.L., 2021. Annual breast cancer screening beginning at age 40: why should Portugal choose wisely? Acta Med. Port. 34 (11), 717–720.
Spadea, T., Bellini, S., Kunst, A., Stirbu, I., Costa, G., 2010. The impact of interventions to improve attendance in female cancer screening among lower socioeconomic groups: a review. Prev. Med. 50 (4), 159–164. https://doi.org/10.1016/j.ypmed.2010.01.007.
Vaccarella, S., Lortet-Tieulent, J., Saracci, R., Conway, D.I., Straif, K., Wild, C.P., 2019. Reducing Social Inequalities in Cancer: Evidence and Priorities for Research, vol. 168. IARC Scientific Publications, Lyon (IARC).
Vaccarella, S., Franceschi, S., Engholm, G., Lonnberg, S., Khan, S., Bray, F., 2014. 50 years of screening in the Nordic countries: quantifying the effects on cervical cancer incidence. Br. J. Cancer 111 (5), 965–969. https://doi.org/10.1038/bjc.2014.362.
van Doorslaer, E., Masseria, C., 2004. Income-related Inequality in the Use of Medical Care in 21 OECD Countries. OECD Publishing, Paris.
von Karsa, L., Arbyn, M., De Vuyst, H., Dillner, J., Dillner, L., Franceschi, S., Patnick, J., Ronco, G., Segnan, N., Suonio, F., Törnberg, S., Anttila, A., 2015. European guidelines for quality assurance in cervical cancer screening. Summary of the supplements on HPV screening and vaccination. Papillomavirus Res. 1, 22–31. https://doi.org/10.1016/j.pvr.2015.06.006.
von Karsa, L., Ronc, G., Ponti, A., Malila, N., Arbyn, M., Segnan, N., Castillo-Beltran, M., Boniol, M., Ferlay, J., Hery, C., Sauvaget, C., Voti, L., 2008. Cancer screening in the European union - cancer screening in the European union. In: Report on the Implementation of the Council Recommendation on Cancer Screening – First Report. Luxembourg. European Commission.
World Health Organization, 2014. WHO Position Paper on Mammography Screening. WHO, Geneva.
World Health Organization, 2013. WHO Guidelines for Screening and Treatment of Precancerous Lesions for Cervical Cancer Prevention. WHO, Geneva.
World Health Organization, 2007. Everybody's Business: Strengthening Health Systems to Improve Health Outcomes: WHO's Framework for Action. WHO, Geneva.
World Health Organization, 2000. The World Health Report 2000: Health Systems: Improving Performance. WHO, Geneva.
Willems, B., Bracke, P., 2018a. Education gradient in cancer screening participation: a consistent phenomenon across Europe? Int. J. Publ. Health 63 (1), 93–103. https://doi.org/10.1007/s00038-017-1045-7.
Willems, B., Bracke, P., 2018b. The impact of regional screening policies on the diffusion of cancer screening participation in Belgium: time trends in educational inequalities in Flanders and Wallonia. BMC Health Serv. Res. 18 (1), 943. https://doi.org/10.1186/s12913-018-3746-x.