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The importance of mammography in the prevention of breast cancer in women in

Norway

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Abstract

Introduction. Breast cancer in women in the world is the dominant cancer and the main cause of death in this population. In the last decade, the number of new cases of this cancer has increased significantly, especially among women over 50 years of age. In Norway, however,

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positive epidemiological trends can be observed in the form of high relative five-year survival rates and a decrease in mortality due to breast cancer.

The aim of the study is to present the recommendations and effects of the mammography program in women in Norway for the prevention of breast cancer.

Material and methods. The study uses the method of review and analysis of literature from databases of scientific journals - mainly PubMed. The search used the following keywords: "breast cancer", "Norway", "mammography", "women". In addition, Norwegian statistical registers on demographic data were also analysed.

Results. It should be emphasized that women in Norway are very interested in mammography screening, which means that breast cancer in this country is most often diagnosed at an early stage of development. The Norwegian Research Council found that mammography has reduced women's mortality from breast cancer by more than 20%. In 2023, the five-year survival rate for women with breast cancer in Norway was high, at 92.7%. There was also a decrease in mortality from 694 deaths in 2005 to 619 in 2022.

Conclusions. National and international cooperation should be continued, sharing experiences in health-promoting activities aimed at improving epidemiological indicators and quality of life of women with breast cancer, and conducting scientific research in this area.

Keywords: mammography, breast cancer, women, Norway

Introduction

Cancer continues to be the main cause of morbidity and death in the world's population and shows a steady upward trend [1]. A similar situation also applies to Norway [2]. In 2023 -38,094 of the Norwegian population developed malignant neoplasms, including 20,386 men and 17,708 women, with the total population of Norway numbering 5,550,203 people, including 2,754,485 women, as of 1 January 2024. According to the 2024 Dødsårsaker and Norge Folkehelseinstituttet Report, malignant tumors in women and men are still the dominant health problem in the Norwegian community. However, for some cancers in Norway, there is a slight downward trend in the form of a reduction in mortality rates. For the first time since 2018, there has been a slight decrease in cancer deaths in 2023. Comparing this year with 2022, it was found that the number of deaths decreased by 262 cases (i.e. 11027 deaths were registered in 2023 and 11289 in 2022) [3].

Breast cancer in women in Norway in 2023 was the most commonly diagnosed malignant tumor and the main cause of death for this population. The number of new cases has increased significantly in the last decade, especially in women over 50, but it can also be seen that the demographic curve of incidence is moving towards an increasingly younger age group. Unfavourable epidemiological trends combined with environmental threats, i.e. exposure to carcinogenic factors and improper lifestyle, are observed in all Scandinavian and European countries [2,4,5].

In 2013 - 3220 women in Norway developed breast cancer, and in 2023 4061 [4, 6]. This increase in incidence may be the result of greater awareness of women manifested in regular breast self-examination, the use of medical examinations and imaging tests, including mammography and ultrasonography, as well as the improvement of imaging techniques.

In the secondary prevention of breast cancer, screening tests are very important, addressed to groups particularly vulnerable to specific cancers that do not yet have symptoms and are aimed at detecting the disease in its early phase [7]. Of significant importance in this respect was the introduction of a prevention program addressed to the population most at risk of breast cancer and the implementation of this program as part of primary and coordinated health care. The effect of prophylactic mammography was the diagnosis of breast cancer at an early stage of the disease, the rapid implementation of treatment that was as little burdensome as possible, i.e. having a lower risk of complications in the early and late period, and more effective.

Mammography is currently the only recommended screening diagnostic method to reduce breast cancer mortality among women in Norway, although it does not provide complete certainty as to the objectivity of the diagnosis of the disease [8,9,10]. As a screening test, it is recommended by the World Health Organization (WHO – World Health Organization) as the basic and most effective diagnostic method for breast cancer [7]. The main objective of the program is to diagnose breast cancer at an early stage, and thus reduce the number of deaths of women due to this cancer.

The five-year survival rates of women with cancer were the first in 2023 at 92.7% and there was a decrease in mortality from 694 female deaths in 2005 to 619 in 2022 [11,12].

Objective

The aim of the publication is to present the effects of women's participation in the mammography screening program in Norway and the importance of this examination in the diagnosis of breast cancer.

Material and methods

The study used the method of reviewing and analyzing literature from the online database of scientific journals, mainly PubMed. The terms: "breast cancer", "Norway", "mammography", "woman" were used as keywords. The articles on the incidence of breast cancer in women in Norway and the implementation of mammography screening in recent years were analyzed. Data from the medical statistical registers Kreftregisteret Cancer in Norway from 2005-2023 and the Ministry of Health and Social Welfare Helse - og omsorgsdepartamentet, Nasjonalt kvalitetsregister for Brystkreft Årsrapport from 2021-2023, Helsedirektoratet Brystkreft - handlingsprogram from 2022-2023 and Helsenorge -Brystkreft from 2021-2023 were also reviewed. Information on the demographic situation was obtained from the website of the Norwegian Statistical Office - Statistisk Sentralbyrå. The criteria for the selection of scientific sources were: substantive value, timeliness, originality, methodology used, scientific reliability, clarity of data presentation and the possibility of practical implications. The materials came from sources presented or published in Norway, mainly in Norwegian. The analysis and selection of sources made it possible to choose the content necessary to achieve the research objective. To assess the scale of the problem, measures of disease incidence and consequences, i.e. morbidity and mortality rates and five-year survival rates, were used.

Results

Currently, positive epidemiological trends in breast cancer can be observed in Norway. According to the Nasjonalt kvalitetsregister for brystkreft, Årsrapport, 484 cases of diagnosis of this cancer in 2023 were pre-invasive breast cancer [11]. According to epidemiological data from *Kreftregisteret Cancer in Norway*, in 2019-2023, a total of 86,560 new cases of malignant cancer were diagnosed in women in Norway, with breast cancer being the most common (22.6%). Analyzing the incidence by age, i.e. in the ranges of 25 - 49 years, 50 - 69 years and 70 years and above, it can be stated that in each of these age groups, breast cancer was the most frequently diagnosed malignant tumor in Norway. The highest incidence of breast

cancer compared to the incidence of malignant neoplasms in general was recorded among the youngest women, i.e. aged 25 - 49 years (35.1%) (Fig. 1) [13].





Kreftregisteret Cancer in Norway 2019 - 2023 https://www.kreftregisteret.no/Temasider/om-kreft/ [13]

Norway, as a country with a large ethnic diversity, offers mammography to all women aged 50-69, including those without Norwegian citizenship [10]. As previously reported, as of January 1, 2024, there were 2,754,485 women living in Norway, including 671,414 women aged 50 - 69 years old under mammography screening. The criteria for inclusion in the screening are: female gender, age, residence in Norway and having health insurance. The test is performed every two years. The Norwegian Research Council, based on the evaluation of the

programme, confirmed that mammography contributed to a 20% reduction in female mortality from breast cancer [14].

According to the Norwegian Breast Cancer Screening Program, despite the participation of women in the program, mammography does not give complete certainty of breast cancer diagnosis, because the reliability of the test is not 100%, but less, because this disease can appear between one test and another. Therefore, it is recommended to perform mammography every two years and regular breast self-examination. It is also recommended to visit a specialist if a woman notices symptoms or ailments that cause concern [15]. High attendance of women in screening programs is not only a reduction in mortality, but also socio-economic benefits for the country.

The preventive mammography program in Norway is dedicated to women aged 50 - 69. Recommendations to lower the age of preventive mammography in Norway have been postulated by the Norwegian Department of Health Helsedirektoratet since 2019. The extension of the time in which women can benefit from the program is argued by the occurrence of breast cancer in an increasingly younger age group and in older women.

Epidemiological data on breast cancer and the implementation of the preventive mammography program in Norway are documented in the National Cancer Registry Kreftregisteret [16]. The main assumption of the Norwegian state's health policy in 2024, aimed at preventing cancer in women through the implementation of a mammography program in Norway, is to screen a total of about 680,000 women, i.e. the entire population of women aged 50 - 69 years in the next 2 years. Of this group, 11,900 women are projected to decline an invitation in 2024, 14,800 to declare a temporary reservation for the test, 330,000 to accept the invitation, and eventually 250,000 women to have a mammogram, representing 75% of the study population. It is assumed that in 2024, 1500 women will be diagnosed with pre-invasive and invasive cancer based on preventive mammography. An additional 250,000 study will be performed by 8,000 women, which will make up 3% of this population. The forecasts are based on the analysis of statistical data from recent years, which show that the number of women who had a mammogram: in 2023 – amounted to 252,395 people, in previous years, i.e. in 2022 – 247,260 people, and in 2021 – 248,228 people [17].

The procedure of informing about the possibility of women's participation in preventive mammography in Norway takes place on the basis of invitations sent in paper or electronic form. Invitations are sent to all women in the programme, along with an information brochure on the nature of the study itself. Reminder information, as an additional form of notification, is sent to women who did not come for the test. The second invitation can be used by women up to 3 months after receiving it. After the test, the woman receives information about the result of the mammography test within two to four weeks [18].

The upward trend in breast cancer incidence in Norway has been maintained for a long time, and the incidence rates are determined by the high number of women reporting for preventive examinations in this country, which is 76%, i.e. more than 3/4 of the population covered by the program. These data refer to the average attendance of women in the screening program over the last 25 years, i.e. the period from 1996 to 2021. Over a 25-year period, 90,000 women received an average of 10 invitations and more than 50% of them took part in all studies. Between 1996 and 2021 - 25,400 cases of breast cancer were detected on the basis of mammography, including 4,600 in the pre-invasive stage (DCIS) – which corresponds to 5 - 6 cases of this cancer per 1,000 women diagnosed. In the years 1996 – 2019, 7,100 patients developed breast cancer in women who underwent mammography, despite the fact that the examination did not show pathological changes, which gives a percentage value of about 22% of new breast cancer cases in this population [19].

Analyzing the expected results of the mammography program in Norway every year, it is assumed that statistically out of 1,000 women who undergo this examination, 970 of them receive information that they do not have breast cancer and these women will receive a new invitation in 2 years. Out of 970 women who have a statistically negative result, 2 will develop breast cancer in the next 2 years. Out of 1000 women, 30 of them will be called again for additional tests, i.e. another mammogram, breast ultrasound and some women for a biopsy with histopathological examination. From this group, 18 women will receive information that they have not been diagnosed with breast cancer on the basis of mammography and ultrasound, and 12 women will also have a breast biopsy. Ultimately, 24 women will not be diagnosed with breast cancer and will again be recommended to have a mammogram in 2 years. Out of a group of 12 women after a diagnostic biopsy, 6 will be diagnosed with breast cancer, while one of these women will receive the so-called "overdiagnosed" status (Fig.2) [10,15,20]. Some authors point out that prophylactic mammography results in the detection of pathological proliferative lesions of a benign nature, which would not have been detected if it had not been for mammography screening, and with which women could live without consequences for their health [21,22]. However, the benefits of preventive mammography are much higher than such reservations.



Fig. 2. Expected results of the mammography program per 1000 surveyed women in the general population in Norway

Kreftregisteret sist oppdatert: 25.10.2023 r. https://www.kreftregisteret.no/screening/mammografiprogrammet/fordeler-og-ulemper/ [15]

The biggest benefit of mammography is the reduction in breast cancer deaths in the general female population. It is assumed that for every 1,000 women who do not take part in a mammography program, 23 of them will die before they reach the age of 80. If these women had had a mammogram, the statistical number of deaths would be reduced to 19 (Fig.3) [15,23].



Fig. 3. Benefits of mammography tests in women up to 80 years of age per 1000 women in the population in Norway

Kreftregisteret sist oppdatert: 25.10.2023 r. https://www.kreftregisteret.no/screening/mammografiprogrammet/fordeler-og-ulemper/[15]

[Dibden A, Offman J, Duffy SW, Gabe R. Worldwide Review and Meta-Analysis of Cohort Studies Measuring the Effect of Mammography Screening Programmes on Incidence-Based Breast Cancer Mortality. Cancers (Basel). 2020 Apr 15;12(4):976. doi: 10.3390/cancers12040976. PMID: 32326646; PMCID: PMC7226343] [23] In 2023, breast cancer in women in Norway was most often diagnosed at stage I (48.3%), followed by stage II (40.8%), which had an impact on the prognosis and significantly increased the chances of survival. Significantly fewer diagnoses of breast cancer were made in stage III and IV cancer - 7.2% and 3.7%, respectively (Tab.1) [4].

Lp.	Stage of breast cancer	Percentage indicator
1.	Ι	48,3%
2.	II	40,8%
3.	III	7,1%
4.	IV	3,7%

Tab. 1. Diagnosis of Breast Cancer in Women in Norway by Mammography in 2023

Cancer in Norway 2023 ble publisert 7. mai 2024.

https://www.kreftregisteret.no/Generelt/Rapporter/Cancer-in-Norway/cancer-in-norway-2023 [4]

It can be concluded that the screening program has brought measurable health benefits, because in women who had a prophylactic mammogram in 2023 (n=1254), 64% of women who had stage I breast cancer were diagnosed, and in 23% of them were diagnosed with stage II breast cancer, while in women who went to the doctor due to alarming symptoms (n=2793), only 32% of them were diagnosed with stage I cancer, and grade II in 41% (Fig.4) [11].



Fig. 4. Breast Cancer Diagnosis in Women in Norway in 2023 based on mammography and symptoms, taking into account the clinical stage of the disease Nasjonalt kvalitetsregister for brystkreft, Årsrapport 2023, z dnia 7.05.2024 r., https://www.kreftregisteret.no/kreftformer/Brystkreft/2023 [11]

Women taking part in prophylactic mammography have a much better chance of a better prognosis and full recovery. According to the report, the effect of mammography performed in women in Norway is m.in: more frequent diagnosis of breast cancer at its early stage (48.3%), achieving an average relative 5-year survival rate of 92.7% and a significant decrease in mortality due to this cancer by over 20% compared to previous years [11,24].

Coordination of mammography activities in Norway is carried out in 17 main Breast Cancer Diagnostic Centres, i.e. Brystsentrene, 4 mobile centres and 26 stationary centres [25]. According to the standardized breast cancer incidence rate, the highest number of diagnoses was recorded in the regions of Oslo (144.3) and Rogaland (143.6), and the lowest in Troms og Finnmark (122.8) with a national average of 133.6 diagnoses per 100,000 women (Tab.2) [26].

	Forekomst per 100 000 personår
Viken	138,8
Innlandet	124,8
Oslo	144,3
Vestfold og Telemark	127,7
Agder	129,8
Rogaland	143,6
Vestland	127,9
Trøndelag	126,6
Nordland	127,8
Møre og Romsdal	138,9
Troms og Finnmark	122,8
Norge	133,6

Tab. 2. Prevalence of breast cancer in women in the general population in Norway in 2018 - 2022 by region of the country in relation to 100,000 female population

Etterundersøkelser, deteksjon av brystkreft og positiv prediktiv verdi av etterundersøkelser på grunn av mammografifunn.Kreftregisteret.Minirapport 2023-2 [26]

Based on the number of mammography tests performed in 2020-2022 at 17 Breast Cancer Diagnostic Centers in Norway, divided into two periods, i.e. spring (Vår) and autumn (Høst), it appears that a total of 667,701 tests were performed (Tab.3) [26].

Brystsenter	2020		2021		2022		Total
	Vår	Høst	Vår	Høst	Vår	Høst	
Rogaland	4 552	7 323	8 573	7 446	8 520	7 228	43 642
Hordaland	5 558	7 756	9 939	10 653	10 035	10 830	54 771
Oslo	7 216	8 394	12 159	10 090	12 582	11 270	61 711
Telemark	2 771	4 012	5 280	4 336	4 804	3 365	24 568
Agder	4 122	7 608	8 306	7 413	8 107	6 478	42 034
Troms og F	4 088	5 646	7 334	5 671	7 148	5 956	35 843
Østfold	4 403	7 336	9 557	7 091	8 737	7 267	44 391
Nordland	4 089	5 475	7 077	5 554	5 893	5 140	33 228
Trøndelag	6 122	7 496	11 611	10 137	13 062	9 033	57 461
Oppland	2 483	4 321	5 426	5 003	5 291	4 690	27 214
Møre og R	3 316	5 400	6 576	5 937	7 391	5 254	33 874
Sogn og F	1 386	2 047	2 906	2 555	3 076	2 479	14 449
Vestfold	4 060	5 890	6 793	5 862	6 485	5 965	35 055
Hedmark	2 306	4 178	4 352	3 883	4 579	4 315	23 613
Akershus Ø	5 425	7 608	12 064	11 225	11 843	10 229	58 394
Vestre Viken	6 805	8 415	10 847	10 806	13 356	9 360	59 589
Fonna	1 772	2 835	3 363	2 402	3 859	3 633	17 864
Total	70 474	101 740	132 163	116 064	134 768	112 492	667 701

Tab. 3. Number of mammography tests performed in 2020 - 2022 at Breast Cancer Diagnostic Centers in Norway divided into two periods, i.e. spring (Vår) and autumn (Høst)

Etterundersøkelser, deteksjon av brystkreft og positiv prediktiv verdi av etterundersøkelser på grunn av mammografifunn. Kreftregisteret.Minirapport 2023-2 [26]

Around 23% of breast cancer cases diagnosed by women on the basis of mammography between 2018 and 2020 were cancers diagnosed between examinations (the rate ranged from 15% to 32%). The rate of breast cancer diagnoses between screenings was 1.88 for 1,000 women and was higher than in previous years. In 2022, on the basis of mammography, 24% of breast cancer cases were diagnosed in women under 55 years of age, 22% in women aged 55-59, 23% in women aged 60-64, and 31% in women aged 65 and over [26].

In most highly developed countries, a decrease in mortality due to breast cancer in women participating in screening studies was observed, ranging from 20 to 50% [27, 28]. In mammography, as in other diagnostic methods, there may be a false interpretation of test results or overdiagnosis, but the benefits of performing this test are much higher than the risk of errors in interpreting the results. In Norway, digital mammography and tomosynthesis, which are more sensitive than classic mammography, are currently not expected to be screened. Tomosynthesis compared to digital mammography gives fewer false positive results, and thus improves the detection of breast cancer [29].

The literature cites arguments indicating greater sensitivity and accuracy of digital mammography over classical mammography and 3D mammography with tomosynthesis over these two methods of breast imaging [29,30,31,32].

In 2023 - 252,395 women reported for mammography tests in Norway, which is close to the expected result. One of the centres in Northern Norway that deals with the diagnosis and treatment of breast cancer is Nordladsyykehuset in Bodø. The reporting rate for mammography screening of women under the care of this clinical center is 80%, which is higher than the national average (76%) and demonstrates the high quality of preventive care aimed at preventing breast cancer in women in the northern region of Norway. In Nordladsyykehuset in Bodø, 13,654 invitations were sent to women in 2023, which were used by 11,118 women, which accounted for 81.4% of the population covered by the screening. Of this group, 252 women were recommended to repeat the study. On the basis of mammography, 190 women were diagnosed with breast cancer, including 166 invasive breast cancer and 24 pre-invasive breast cancer (DCIS). The number of breast cancer cases diagnosed on the basis of mammography in Northern Norway compared to detected cases of this cancer in the whole country was 35%. In 2022, compared to 2023, the reporting of women for mammography was slightly lower (80.3% v.s. 81.4%) and the percentage share of breast cancer cases diagnosed in Northern Norway compared to the whole country was also lower and amounted to 28% (Tab.4) [11].

Lp.	Criterion	Year 2022	Year 2023
1.	Number of women invited	13 773	13 654
2.	Number of women who have benefited from the program / percentage of eligible applicants	11 057 (80,3%)	11 118 (81,4%)
3.	Number of women who had to repeat the study	234	252
4.	Number of breast cancer cases detected	218 (201 invasiv, 17 DCIS)	190 (166 invasiv, 24 DCIS)
5.	Percentage of diagnosed breast cancer cases based on mammography in relation to the whole country	28 %	35 %

Tab. 4. Mammography program at Nordlandssykehuset Bodø Norway in 2022 a	nd 2023
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Nasjonalt kvalitetsregister for brystkreft, Årsrapport 2023, z dnia 7.05.2024 r. https://www.kreftregisteret.no/kreftformer/Brystkreft/2023 [11]

The number of applicants for screening tests as part of preventive mammography in women in Norway is quite high, but the results of studies presented in the literature indicate that it could be higher if foreign women improved their participation in the screening program [33,34,35,36.37]. Poles are one of the largest groups of foreigners in Norway, constituting, according to Statistisk sentralbyrå data, about 100,000 inhabitants in 2023 [38]. Women of Polish origin, despite invitations for mammography tests and an electronic offer in Polish via the Kreftregisteret website, are reluctant to use the screening program. It should be emphasized that the share of Polish women in mammography was much lower when they lived in Poland (37%), but higher after moving abroad (51%). The same was true for visits to the general practitioner [39]. The difference of 14% in the number of women of Polish origin for mammography tests in Norway compared to Polish may indicate easier access to a general practitioner and the possibility of being covered by the "pakerforloop" package in justified cases [40].

Women's reporting for preventive examinations is closely related to satisfaction and quality of life, as evidenced by the results of retrospective studies conducted in Norway. These studies show that the quality of life of women in whom breast cancer was detected during screening tests, i.e. prophylactic mammography, was significantly higher than in women in whom it was diagnosed only on the basis of clinical symptoms and amounted to 70 points and 60 points, respectively. Women in the so-called control group who had never been diagnosed with breast cancer declared a higher quality of life at the level of 80 points on a scale of 100 possible to obtain in relation to women who developed cancer at a certain stage of life. The study also confirmed that the detection of breast cancer during screening contributed to the use of milder treatment methods, i.e. less physically and mentally taxing. Women who participated in mammography regularly also had greater health awareness and more often led a health-promoting lifestyle compared to women who did not participate in these studies [41].

The subject of research in Norway is also the problem of the dangers resulting from the emission of X-rays and their adverse effects on the body during mammography. X-rays undoubtedly increase the risk of cancer, but this risk is very small in the case of routine participation of women in mammography. The benefits of the population dimension of mammography tests are much higher than the risks associated with their performance [42, 43].

Due to the differences in the structure of breast tissue in women, some breast tumors may be clearly visible during mammography, i.e. especially those that are detected in a large mammary gland rich in adipose tissue, while other cancers may be hidden in dense glandular tissue and not visible in the radiological image [44,45,46,47], hence the need to use other methods in diagnostics, including magnetic resonance imaging of the breast. Further diagnostics of pathological changes found on the basis of imaging tests should be carried out in

specialized breast cancer centers that operate on the basis of the recommendations of the European Society of Breast Imaging (EUSOBI) [48].

It should be emphasized that the standards for diagnosing breast cancer in women in Norway are based on the recommendations of the European Society of Breast Imaging (EUSOBI), which also recommend individualization of diagnostic procedures in special situations, taking into account the presence of risk factors.

Conclusions:

- In women in Norway, the number of new breast cancer diagnoses has recently increased, but about 25% of these cancers have been diagnosed at the pre-invasive stage, which may indicate a properly implemented state health policy, including the efficient functioning of primary and coordinated health care.
- 2. Women's high interest in screening mammography probably translated into positive epidemiological trends in the form of high relative survival rates and a decrease in mortality due to this cancer.
- 3. A significantly lower participation rate of foreign women living in Norway in the mammography program was found, therefore special attention should be paid to health education of this group in the field of primary and secondary prevention of breast cancer.
- 4. National and international cooperation should be continued, sharing experiences with highlighting strengths and weaknesses in health-promoting activities aimed at improving epidemiological indicators and quality of life of women with breast cancer, and conducting scientific research in this area.

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