Aim of the study: Breast cancer is the most frequent malignancy affecting women. Some reports suggest the influence of socioeconomic status, including education, on survival rates for cancer patients. This report analyzes the effect of patients' education level on their survival.

Material and methods: A retrospective analysis of the group of 810 breast cancer patients treated in single center in Poland was performed. The analyzed group included women with elementary education (24%), vocational training (19%), secondary (38%) or higher education (16%). Overall, recurrence-free and metastasis free survival times were analyzed.

Results: The actuarial 5-year overall survival was 72% (median 4.7 years), 5-year local recurrence-free survival was 84%, whereas metastasis-free survival 76%. Multivariate Cox model has shown that lower education had independent significantly negative influence on local recurrence-free survival time ($p = 0.024$). The highest risk of recurrence was found for patients with elementary education ($p = 0.009$). The same was confirmed for distant metastasis-free survival ($p = 0.001$), with the highest risk of metastases in patients with vocational education and stage IIIB breast cancer ($p < 0.001$). Education level had significant impact on overall survival. The patients with higher-level education lived longer ($p = 0.042$).

Conclusions: Shorter recurrence-free survival time among women attaining lowest education level and longer overall survival time for women with higher education level suggest the necessity for intensified cancer awareness educational effort and screening among less-educated healthy Polish women.

Key words: breast cancer, survival, education, occupation, domicile, socioeconomic status.

Impact of educational differences as measure of socioeconomic status on survival for breast cancer patients

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Introduction

Breast cancer is the most frequent neoplasm among women, making up almost one third of all cases [1]. There were nearly 16 000 new cases registered and nearly 5 200 deaths in Poland due to breast cancer in 2009 [2]. One of the strongest prognostic factors is disease stage at the time of diagnosis, especially the presence of metastases to axillary lymph nodes. Some authors indicate a relationship between breast cancer morbidity and socioeconomic status (SES). SES is most commonly measured by place of residence and level of education [3]. More deaths have been noted among breast cancer patients with lower SES, as compared with patients with higher SES [4–6]. Some authors have suggested that differences in education increase the differences in mortality, especially among high-income women [7–9]. It was noted that patients with lower SES usually report for treatment at a more advanced stage of the disease, which may affect survival in this group [10]. Further studies on the impact of SES on breast cancer patient survival may be of substantial importance in planning the intensity of screening studies, as well as educational actions among particular groups of healthy women in different countries.

Still, the reports of a direct impact of SES on patient survival are inconsistent [10, 11]. In recent years numerous reports have stressed race and SES related inhomogeneities of medical care quality, and this was related to differences in the treatment outcome in US breast cancer patients [12–14]. Studies concerning this problem most often were epidemiological in nature and were carried out on the basis of official death certificates. The cases were included when breast cancer was listed as the cause of death. Observational studies have indicated differences in breast cancer patients' survival between African-American and white American women, even after correction for SES [14], with a 1.19-fold increase of relative risk for African-American women.

As the Polish population is racially quite uniform and health insurance is common and mandatory, these factors should not have any significant impact on the availability of oncological treatment. That allows for direct analysis of the impact of educational level differences on breast cancer patients' survival.

The present report analyzes the influence of education level on breast cancer patient survival in a rather homogeneous population living in the highly urbanized region of Upper Silesia in southern Poland.

Material and methods

A retrospective analysis was performed on the data concerning breast cancer patients who had been treated in 2001–2002 at the Clinical and Experimental Oncology Department, MSC Memorial Cancer Center in Gliwice.

Clinical data were retrieved from patient records. There were 810 consecutive women included, with a median age of 53 years (range 28–82). The age interval represented mostly was that of 51–65 years (362 patients, 45%). Eight percent of all patients were under 40 years old. In all patients breast cancer diagnosis

was based on microscopic examination of fine needle biopsy material or histopathology specimens.

Clinical tumor stage was assessed based on physical examination as well as imaging tests (mammography, ultrasound, CT, X-ray) and restaged for this analysis using 2002 TNM staging criteria.

The most frequent clinical stages were IIIB (25%), I (21%) and IIA (18%). In 40% of patients there were previously detected and treated malignancies in first-degree relatives (parents, siblings, children). Breast cancers were one-fifth of these malignancies.

In the analyzed group 24% of patients had elementary education, 19% vocational training, 38% secondary and 16% higher education. Elementary education was defined as one lasting no longer than 8 years, while vocational training lasted no longer than 11 years. Patients with secondary education studied for at least 12 years and patients with higher education (college) were educated for a minimum time of education of 16 years. According to a Polish Education Department report (http://www.funduszestrukturalne.gov.pl) in 2002 in the whole Polish population the proportions of education were: 35.4% of people with elementary education, 23.2% with vocational training, 31.5% with secondary and 9.9% with higher education.

At the time of diagnosis 259 patients (32%) were occupationally active, whereas 551 (68%) were retired or remained jobless. The majority of patients originated from the Upper Silesia region. In that period of Polish economic history women's retirement age was about 50-55 years. Additionally, in Upper Silesia almost all wives of miners traditionally did not work professionally (mines were the main place of work for Silesians). Nowadays these rates have probably changed. Many of our patients work.

Most of them, 664 (82%), listed a city or borough as the place of residence. Inhabitation density and a rather prevalent urban type of housing make Upper Silesia an agglomeration with only pockets of rural type housing areas.

In 411 patients (51%) treatment started with surgery, including breast-conserving therapy (BCT) in 131 women, whereas in 394 patients (48.6%) it started with systemic treatment, including hormone therapy in 16 patients. After neoadjuvant systemic therapy 256 patients underwent surgery, including BCT in 31 women. The high percentage of patients with no surgery derived from the primary high clinical stage. The post-surgical treatment in the majority of patients involved chemotherapy. The most frequently used chemotherapeutics were anthracyclines, which were applied to 55% of chemotherapy-treated patients.

Conventional radiation therapy was applied to 490 patients (60%). Median total dose was 50 Gy and fraction dose was 2 Gy.

Hormonal therapy was applied to 419 patients (52%). Among 17% of women who started hormonal therapy with tamoxifen a switch to aromatase inhibitors was necessary due to side effects. The most frequent side effect was endometrial hyperplasia requiring abrasion and thrombophlebitis. Skin rash and pruritus were noted less frequently.

Cancer relapse occurred in 243 patients (30%), including 217 women with distant metastases, and 109 with local recurrence. Seven patients developed both local recurrence and distant metastases. Liver (54%) and bones (33%) were the most frequent sites of metastasis.

Sixty-five patients (8%) developed an independent second neoplasm. Cancer of the contralateral breast was diagnosed in 38 of them (5%), eight developed endometrial cancer and six thyroid cancer. We do not know any data about independent second neoplasm in breast cancer patients in other parts of Poland.

Results

The actuarial overall survivals at 1, 2, 5 and 10 years were 98%, 90%, 72% and 40%, respectively. Median overall survival was 4.7 years. The actuarial local recurrence-free survival at 1, 2, 5 and 10 years were 91%, 88%, 84% and 82%, respectively, whereas distant metastasis-free survival was 94%, 88%, 87% and 84%, respectively.

Vocational training and secondary education had a negative influence on metastasis-free survival (MFS) time ($p = 0.037$) (Fig. 3). The longest average MFS was observed for the group of patients with higher education (8.2 years), while the shortest was in patients with vocational training (6.5 years). A significantly worse 5-year MFS was found in patients with vocational training (65.9%) and secondary education (70.1%) (Fig. 3).

The median time from the first cancer symptom to seeing the physician was longer than 1 month for 71% of patients with lower education and 53% of patients with higher education. Locally advanced breast cancer was diagnosed in 38% of patients with lower education and in 23% of patients with higher education ($p = 0.019$).

Radical surgery was not feasible in 22% of patients with lower education and in 6% of those with higher education. Breast-conserving therapy was performed more often in patients with higher than with lower educational status (23% vs. 8%). For 63% of patients with lower, and for 35% with higher education, the microscopic examination of post-operative material revealed metastases to axillary lymph nodes. Positive steroid receptors in tumor cells were found in 58% of patients with higher educational status and in 45% with lower education. Interestingly, the distribution according to histological types was similar for all patients.

Surgery was feasible more often among patients holding employment, 92% vs. 84% for those without employment. Overall survival time for patients holding employment was longer ($p = 0.012$) (Fig. 3).

Based on multivariate analysis it was shown that the educational status had an independent significant influence on local recurrence-free survival ($p = 0.024$). The highest recurrence risk was found for patients with elementary education ($p = 0.009$; $RR = 2.8$).

The multivariate analysis also showed that a lower level of education had a significant independent negative influence on MFS ($p = 0.001$). The risk appeared to be the highest for patients with vocational training ($HR = 0.41$; $p = 0.009$). A particularly increased risk of metastases concerned patients with vocational training with IIIB breast cancer stage ($p < 0.001$; $HR = 14$).
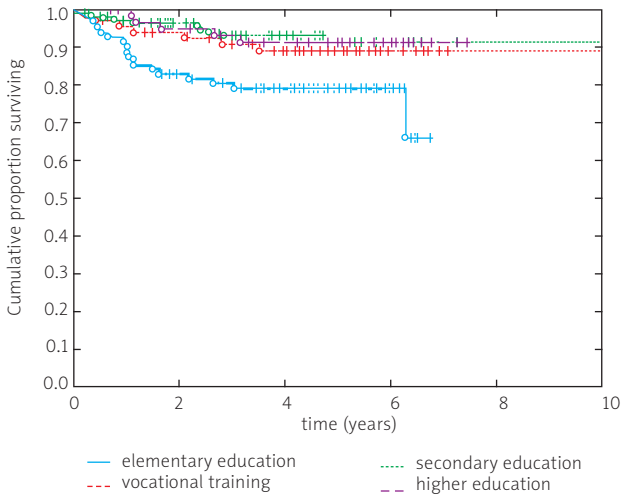
Fig. 1. Local reccurence free survival time according to education level
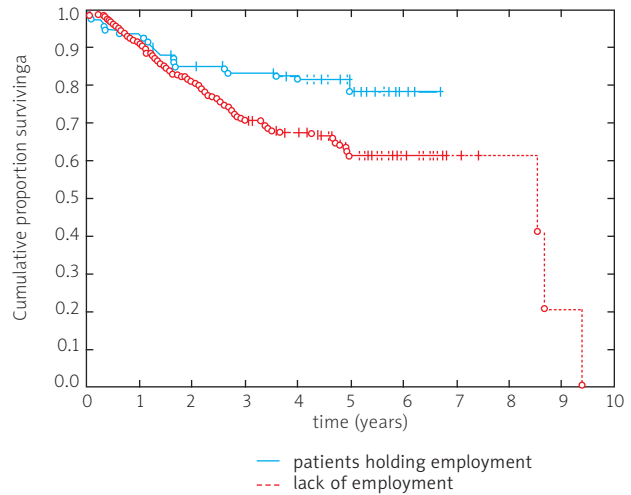

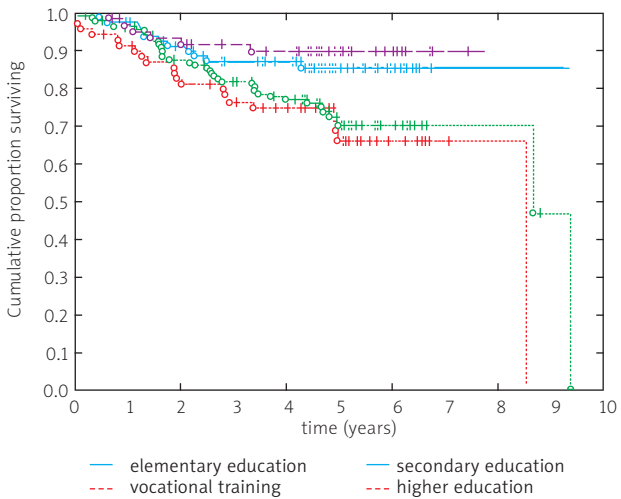**Fig. 2.** Metastasis free survival time according to occupational activity

Fig. 3. Metastasis free survival time according to education level
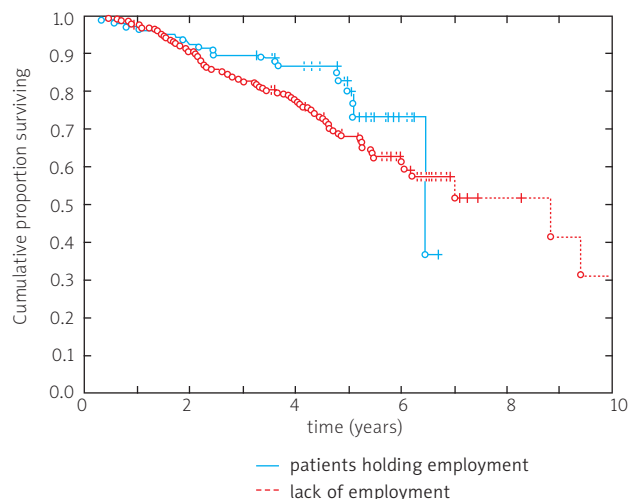

Fig. 4. Overall survival according to employment

The multivariate analysis also showed that the level of education has a significant influence on overall survival. Patients with the highest educational status also lived longer ($p = 0.042$; $RR = 2$). Five-year overall survival time for them was 84%, and for those with elementary education 62%.

This analysis has confirmed that educational status has a significant influence on survival regardless of disease stage.

Discussion

An ever increasing number of recently published reports have suggested that mortality caused by malignant neoplasms may depend on such tumor-independent variables as race [16], body mass index, place of residence [17] or educational level [18]. The socioeconomic status of patients remains linked, directly or indirectly, to many of those features [3].

A European study including data from Norway, Spain, France, Switzerland, Sweden, Italy, Belgium and Finland has demonstrated that men with lower SES (definition most often based on type of residential neighborhood and education-
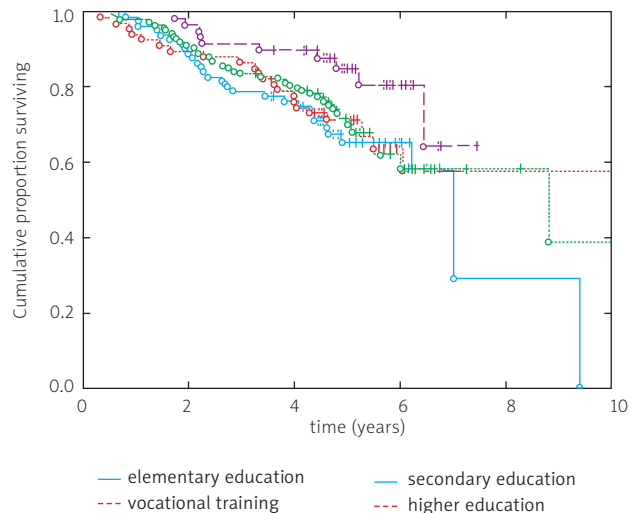

Fig. 5. Overall survival according to employment

al status) show higher mortality due to neoplasms than men with higher SES [19]. Another study did not support such a relationship [20].

The impact of race and ethnic differences on cancer patients' survival was studied in the US [17]. There were analyzed data of nearly 5000 patients included in the Breast, Colon and Prostate Cancer Data Quality and Patterns of Care Study database from the National Program of Cancer Registries. This analysis revealed that Hispanic Americans and African-Americans have a higher risk of death from cancer than non-Hispanic white Americans. The authors suggested that SES might be one of the causes. White Americans of non-Hispanic origin have, on average, higher SES than those of Hispanic origin or African-Americans, which may affect access to different treatment options. Breast cancer patients with lower SES underwent radical mastectomy more often, while patients with higher SES preponderantly underwent breast-conserving therapy, followed by radiotherapy ($p < 0.01$), chemotherapy ($p = 0.16$) or hormonal therapy ($p = 0.08$). A higher death risk due to cancer was linked to lower SES (HR = 1.33) and remained even after eliminating the impact of concomitant diseases, age or tumor stage [17]. In another large population study regarding the effect of education and race on overall survival of patients with various malignant neoplasms (mainly lung, breast, prostate and colon cancers), it was shown that breast cancer patients with higher educational status lived longer [18]. Multivariate analysis of data from Japan (33 000 patients), aimed at finding a relationship between educational level and mortality due to the most common types of cancer, did not reveal significant differences concerning age, body mass index, smoking or place of residence. Among men with lower education level there were, however, more deaths due to liver and prostate cancers, while among less educated women more deaths were attributed to lung cancer [16].

The results of various analyses involving SES may differ depending on the country in which the study was conducted. This may be caused by different systems of health care organization, various degrees of SES differences depending on the country, as well as by differences in the psychosocial attitude, which affect different approaches to the issues of health and disease.

The present study was based on detailed analysis of patients' full medical records, from diagnosis to all stages of treatment and control. Information concerning educational status and occupational activity were contained in medical files. However, data concerning income of patients, or their relatives, living conditions or eating habits were limited and were not included in this report.

The present analysis showed that lower educational status had a significantly negative impact on local recurrence-free survival time ($p = 0.0079$) (Fig. 1). Other authors suggest that lower survival of breast cancer patients with lower SES is caused by disease at more advanced stages when compared to patients with higher SES [21]. It is equally probable that these patients may have undergone suboptimal treatments. Our own observations are similar. We report here a significantly higher frequency of locally advanced breast cancer in the group of worse-educated patients as compared to better-educated patients, 38% vs. 23% ($p = 0.019$). These differences can-

not be explained by reduced access to medical care for patients with poorer educational status as health insurance remains mandatory and popular in Poland. So far however, no final explanation has been offered why the patients with lower educational level or SES have more advanced breast cancers than those with higher education level or SES. If the reason is late referral to a physician, then medical care of such individuals should be improved systematically to enable early breast cancer detection. If, however, after eliminating the impact of higher disease stage, the survival of patients with lower SES still remains worse, then this might mean that the disease affecting them is more aggressive and that these patients require an intensified treatment scheme [17].

In the present study both vocational training and secondary education had a negative influence on distant metastasis-free survival time ($p = 0.037$) (Fig. 3). We cannot explain these findings. Education span shorter than 16 years had a negative influence on overall survival time ($p = 0.05$) (Fig. 5).

Women with lower education level more often had experienced local recurrence, probably due to a higher local stage at the time of diagnosis. It remains interesting that patients with lower education level also had distant metastases less frequently. Patients with higher education level had the longest overall survival. Some authors believe that in patients with higher SES tumors may be less aggressive due to genetic differences caused by better lifestyles in this group of women [22]. This suggestion has been corroborated by a US study concerning survival differences depending on ethnicity: it was observed that shorter survivals resulted not only from tumor progression but also from differences in histological types [15, 23]. In the present study patients with higher educational status were more often steroid receptor-positive (58%) than those with lower educational status (45%). Patients who attained higher education level had less frequent metastases to axillary lymph nodes than those with lower education level (35% vs. 63%). It is worth emphasizing that the distribution of histological types was similar, irrespective of educational status.

It is also interesting that patients residing in rural settings reported to the doctor more often with higher locally advanced cancer, so they underwent surgery less frequently and more often experienced local recurrence. Place of residence played no significant role in survival times. This might result from the small number of patients actually dwelling in the rural setting, similar environmental pollution exposure irrespective of residence type, and similar ways of life among Upper Silesian inhabitants.

Higher mortality due to breast cancer among women with lower educational status could have resulted from cultural factors, tradition and prejudice, which might have influenced their late visit to a physician. Additionally, income and awareness of available treatment options, both of which have been frequently linked to educational status, might have been important. This suggests that more intense efforts have to be undertaken by the Polish education system and which should target the less educated healthy women of the population. Nonetheless, significant differences observed in breast cancer biological characteristics (such as steroid receptor status) among patients with higher and lower education are worthy of further scrutiny.

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