Socioeconomic inequalities in metastasis, recurrence, stage and grade of breast cancer: a hospital-based retrospective cohort study

M. TAHери1, M. TAVAKOЛ2, M.E. AKBARИ3, A.A. ANOSHIRVANI4, R. AGHABOZORGI5, A. ALMASI-HASHIANI6, M. ABBASI7

1 Medical Ethics and Law Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran; 2 Sociology Department, School of Social Sciences, University of Tehran, Tehran, Iran; 3 Cancer Research Center (CRC), Shahid Beheshti University of Medical Sciences, Tehran, Iran; 4 Department of Hematology and Medical Oncology, School of Medicine, Arak University of Medical Sciences, Arak, Iran; 5 Department of Hematology and Medical Oncology, School of Medicine, Arak University of Medical Sciences, Arak, Iran; 6 Department of Epidemiology, School of Health, Arak University of Medical Sciences, Arak, Iran; 7 Medical Ethics and Law Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Keywords
Socio-Economic Status • Inequality • Concentration Index • Breast Cancer

Summary

Introduction. This study aims to estimate the Socio-Economic Status (SES) inequality on the metastasis, recurrence, stage and grade in Breast Cancer (BC).

Methods. This retrospective cohort study conducted on 411 BC patients in Arak, Iran. Asset-based questionnaire used to estimate the household SES. For calculate of SES inequality was used from Concentration Index (C). Moreover for investigate the association between recurrence and metastasis with other variables were used from multilevel logistic regression and analysis of variance were used to investigate the relationship between SES and other variables. The data were analyzed with Stata (v.13) software.

Results. Results of analysis of variance showed statistical significant relationship between SES with, insurance, surgery, grade, stage, recurrence and metastasis (p-value < 0.05). Moreover the Odds Ratio (OR) were significant of recurrence with age, academic level of education, supplementary insurance history of BC in first-degree relatives, stage and grade, also, metastasis with age of > 80 years, insurance, supplementary insurance, history of BC in first-degree relatives, chemotherapy, radiotherapy, stage and grade four. The total C index obtained 0.015 (0.002, 0.026), 0.011 (0.003, 0.031), −0.014 (−0.034, −0.001) and −0.042 (−0.061, −0.002) for metastasis, recurrence, stage and grade of BC respectively.

Conclusions. Our results showed evidence of inequality in the metastasis, recurrence, stage and grade in BC patients.

Introduction

Breast cancer (BC) accounts for about one-third of all cancers in women. This cancer is the second most common cancer after lung cancer and the most common cause of cancer deaths among women [1]. BC with nearly 1.7 million cases was considered as the most prevalent cancer among women in 2016 [2]. Breast cancer has led to 535,000 deaths and 15.1 million DALYs [2]. The incidence and mortality rate of BC has increased in recent years in Asian countries as well as Iran [2-4].

Some factors such as age, estrogen receptor status and lymph node involvement as factors influencing recurrence [5]. One of the most important problems in this cancer was the metastasis of cancer cells to other organs, which was, in fact, one of the main causes of failure in the treatment [6]. The metastasis was seen among the 5-10% of patients [7]. Also, the factors affecting the metastasis was identified, such as the initial size of the tumor, lymph node involvement, disease grade, estrogen receptor status, and the interval between surgery, and local recurrence [8]. Moreover, the tumor stage, access to health-care services, comorbidity, cigarette smoking, Body Mass Index (BMI), stress, and social support were associated with the prognosis and the risk of death of BC. The SES was related to hormone therapy, smoking, and access to health-care and affects metastasis, recurrence, stage, and grade of diagnosis [9]. The SES and the level of education lead to a difference in the stage and subsequently survival of BC [10, 11]. Early diagnosis with treatment was an appropriate strategy for improving prognosis. Population-based screening programs reduce the incidence and death of cancer, due to extensive population coverage and improved follow-up and control. The SES was referred to socio-economic factors such as education level, income and occupation, which can affect a person’s or group’s situation in the community [12]. However, the role of SES inequality in outcomes of BC cancer remains uncertain. Despite the many efforts in different periods to reduce the difference between the poor and the rich, through the redistribution of wealth to create an equal society, social inequalities have not disappeared and even seems increased globally. Health inequality is one of the most important indexes of inequality. It has been shown in various studies, that the overall incidence and mortality...
rates in poorer economic groups are higher, due to an increase in inequality index in particular areas [13]. The relation between inequality and health is an important issue. Inequality is an issue at the social level that imposes a lot of costs on society. Health is one of the most important indicators of human capital. Therefore, inequality has the greatest effect on health [14]. Income inequality affects people’s health in many ways. The high level of inequality undermines social capital, also, caused stress among individuals in the community, which set these behaviors affects general health [15]. At the individual level, the person’s income increases the health, but community-based studies do not endorse this theory. Because there are countries that, although lower income than high-income countries have high health status, because they have less inequality [16]. The BC is curable and also can be prevented with early detection and if does not metastasize to other tissues. Achieving health care and screening services can lead to early diagnosis and prevention of disease severity. SES inequality can also play an important role in people’s health. To date, no study has been performed yet, that can identify the role of SES inequality in recurrence, metastasis, grade and stage of BC. This gap was addressed in this study.

Methods

STUDY DESIGN AND SAMPLING

This retrospective cohort study conducted on 411 BC patients referred to hospitals of Arak University of Medical Sciences. The sampling method is accessible (non-randomized). In this study, we analyzed all cases during the study period.

INSTRUMENT

Two questionnaires were used to data collection in this study: 1) the demographic and disease information questionnaire includes age, marital status, education, job, insurance, supplementary insurance, history of BC in first-degree relatives, chemotherapy, radiotherapy, surgery, stage and grade of BC patients; 2) a questionnaire designed by Gorramoodi et al. was used to measure the SES. This questionnaire includes questions about the level of women’s education, the education of her husband, the area of the infrastructure, the cost of home, the number of rooms and the facilities and amenities (personal car, personal computer, more than one TV, refrigerator, washing machine, dishwasher, mobile phone and traveling abroad. The correlation of these factors with a score reliability was obtained 0.87 and validity was obtained 0.88 respectively [17].

STATISTICAL ANALYSIS

To investigate the relationship between recurrence and metastasis with other variables, binary logistic regression was used because these two variables were dichotomous. Using this method, the OR for each variable is calculated with constant considering effect of other variables. Moreover to evaluate the relationship between SES with other variables, analysis of variance was used. All statistical analyzes were performed using Stata (v.13) software.

MEASUREMENT OF SES AND INEQUALITY

In this study, a new variable was created as an SES, using the Principal Component Analysis (PCA) method. The PCA method identifies the variables that have the greatest effect on the variance of the total variables, and then constructs the new variable. The first component derived from the analysis, explains the most variance in the variables and gives each family a score that is considered as an indicator of its SES [18, 19].

The Concentration index (C) was used to determine the inequality in this study. The value of this index varies between +1 to -1. When the line of equality and the C curve fit together, the C index will be zero, which means that there is no inequality. The C index is defined by the area under the C curve multiplication in two. With the greater interval between the C curve of the inequality line the amount of inequality also increases. When the C curve is above the equality line, the C index will be negative, which means that, the concentration of the investigated factor (in this study: metastasis, recurrence, stage and grade of BC is more in lower SES. Also when the C curve is under the equality line, the C index will be positive, which means that the concentration of the investigated factor is more in highest SES [20, 21].

The C index is a common inequity measure in health outcomes and has been used continually in recent studies [20, 22]. The C was calculated by the Kakwani et al. formula [20] (formula 1).

\[ C = 2 \sum_{t=1}^{T} f_t \mu_t R_t - 1 \]

In this formula, \( \mu \) is the mean in studied patients with cancer and \( \mu_t \) is that for the \( t \)th group. In addition, \( f_t \) is the group share of patients. Also, \( R_t \) is the relative rank of the \( t \)th educational level of the participating patients, which was obtained through formula 2:

\[ R_t = \sum_{t=1}^{T} f_{t'} - \frac{1}{2} f_{t} \]

Therefore, \( R_t \) indicates the cumulative proportion up to the midpoint of each SES group interval. The correspondence confidence interval for C is calculated based on Wagstaff and Van Doorslaer method [20, 23].
This method has been used in other studies [24-29] and is as given below.

\[
Var(C) = \frac{1}{n} \sum_{i=1}^{T} f_i \sigma^2_i + \frac{1}{n \mu^2} \sum_{i=1}^{T} f_i (2R_i - 1 - C)^2
\]

In this formula \( \sigma^2_i \) is the variance of \( \mu_i \),

\[ a_t = \frac{\mu_i}{\mu} (2R_i - 1 - C) + 2q_{t-1} - q_t \] and \( q_t = \frac{1}{n} \sum_{i=1}^{T} \mu_i f_i \) which is the ordinate of \( L(P) \), \( q_0 = 0 \) and \( p_t = \sum_{r=1}^{T} f_r R_r \).

**Results**

In total, 411 women with mean age of 20-87 participated in this study. Mean score of SES was 0.29 ± 0.94 (–2.71, 2.2). Of all patients, 19.7% had a good SES, 71.04% had a middle and 9.26% had a poor SES.

The crude and adjusted OR of relationship between the recurrence and other variables showed in Table I. According to these results, the OR was significant for relationship between recurrence and supplementary insurance, history of radiotherapy, stage 4 and grade 3 of BC patients. The crude and adjusted OR of relationship between the metastasis and other variables showed in Table II. According to these results, the OR was significant for relationship between the metastasis and history of surgery, stage 4, grade 2, and grade 3 of BC patients. Differences in mean of subgroups of variables in this study by SES showed in Table III. These results shown significant relationship between SES with supplementary insurance and grade of BC (p-value < 0.05). C index obtained – 0.0025 (–0.0153, 0.0103) and – 0.00001 (–0.01623, 0.01620) for recurrence and metastasis respectively. Also for stage and grade of BC, C index obtained 0.0013 (-0.009, 0.011) and – 0.004 (–0.0145, 0.0059) respectively, that showed there was not concentration of metastasis, recurrence, stage and grade by SES levels (Tab. IV). In addition, the concentration curve for recurrence and metastasis showed that there was no concentration of these outcomes by SES level (Figs. 1, 2).

**Tab. I.** The crude and adjusted OR of recurrence with other variables.

| Variables                      | Subgroups                | Crude (OR 95% CI) | Adjusted* (OR 95% CI) |
|--------------------------------|--------------------------|-------------------|-----------------------|
| Age                            | < 40                     | Reference          | Reference              |
|                                | 40-60                    | 2.91 (0.36, 25.27) | 4.28 (0.48, 37.84)     |
|                                | > 60                     | 3.54 (0.45, 28.94) | 2.91 (0.26, 32.25)     |
| Marital status                 | Single                   | Reference          | Reference              |
|                                | Married                  | 1.65 (0.20, 13.65) | 2.29 (0.26, 19.71)     |
|                                | Widow/divorced           | 0.94 (0.09, 9.53)  | 1.39 (0.12, 15.60)     |
| Education                      | Illiterate               | Reference          | Reference              |
|                                | Primary                  | 0.33 (0.12, 0.87)  | 0.27 (0.08, 0.89)      |
|                                | Diploma                  | 0.85 (0.31, 2.52)  | 1.06 (0.3, 3.57)       |
|                                | Academic                 | 0.27 (0.05, 1.27)  | 0.43 (0.05, 3.69)      |
| Job                            | Housewife                | Reference          | Reference              |
|                                | Retired                  | 0.31 (0.04, 4.5)   | 0.28 (0.02, 2.81)      |
|                                | Unemployment             | 2.26 (0.41, 12.28) | 2.75 (0.44, 16.81)     |
|                                | Permanent/temporary      | 0.75 (0.16, 3.49)  | 1.14 (0.18, 7.29)      |
| Insurance                      | No                       | Reference          | Reference              |
|                                | Yes                      | 0.48 (0.04, 4.80)  | 0.43 (0.02, 6.69)      |
| Supplementary insurance        | No                       | Reference          | Reference              |
|                                | Yes                      | 2.19 (1.00, 4.77)  | 2.94 (1.21, 7.14)      |
| History of BC in first-degree relatives | No | Reference | Reference |
|                                | Yes                      | 1.43 (0.66, 3.13)  | 1.12 (0.47, 2.68)      |
| Chemotherapy                   | No                       | Reference          | Reference              |
|                                | Yes                      | 2.91 (0.98, 8.71)  | 2.67 (0.82, 8.61)      |
| Radiotherapy                   | No                       | Reference          | Reference              |
|                                | Yes                      | 2.42 (1.12, 5.24)  | 2.73 (1.17, 6.34)      |
| Surgery                        | No                       | Reference          | Reference              |
|                                | Yes                      | 0.32 (0.13, 0.78)  | 0.38 (0.14, 1.05)      |
| Stage                          | One                      | Reference          | Reference              |
|                                | Two                      | 0.17 (0.01, 3.00)  | 0.15 (0.001, 2.99)     |
|                                | Three                    | 1.04 (0.12, 9.02)  | 1.09 (0.10, 10.86)     |
|                                | Four                     | 27.5 (3.05, 249.48)| 49.24 (4.06, 596.2)    |
| Grade                          | One                      | Reference          | Reference              |
|                                | Two                      | 3.42 (0.91, 12.77) | 2.95 (0.75, 11.44)     |
|                                | Three                    | 9.47 (2.52, 35.59) | 9.43 (2.34, 38.06)     |

*: adjusted for age, marital status, education level, job.
Discussion

The results of our study showed that most patients were housewives, also were in middle level of SES. Moreover, the most of patients had a primary level of education. In evaluating the status of employment, the results showed that most of the patients were housewives and other were employed, also had a middle level of income, which is consistent with our study result [30].

The results of this study showed that there was no the significant relationship between the metastasis and...
recurrence of BC with age of patients. In some studies, it has been concluded that metastasis occurs at an earlier age, which is not consistent with our findings [31]. In some studies the role of age has proven to be an important factor in causing a bad prognosis in patients with a variety of cancers [32]. Results of Bennier’s study in French showed the probability of recurrence and metastasis of BC was higher in patients older than 35 years. Also shown that patients with age of 35 years, before menopause had a better prognosis than the first group and patients over 60 years of age had a worse prognosis than the second group [33].

In our study, there was no significant relationship between education levels with metastasis and recurrence. In various studies, appropriate prevention and treatment of BC have relationship with education. Also, there is a significant relationship between knowledge of risk factors for BC and the level of education, which this knowledge can prevent the metastasis and recurrence [34]. Our results showed that there was a significant relationship between the existences of supplementary insurance in patients with recurrence. In other words, the recurrence in patients with supplementary insurance was occurred more than other patients. Having supplementary insurance helps to encourage individuals for treatment and screening and causes more diagnosis and sooner discovering the disease. Therefore, it can be concluded that SES directly affect the stage, grade, recurrence and metastasis of BC [35]. Also, in a study, the insurance status had an important role in the outcomes of BC, even with adjusting for SES [36].

Some studies had identified a number of genes that causes metastasis in various tissues in BC [37]. However, there was not association between history of BC in first degree relatives with recurrence and metastasis. Cancer patients receive different therapies after surgery that can affect the survival, recurrence and metastasis [38]. In our study, the effect of surgery on metastasis was evident. In some studies, the role of radiotherapy has been shown to reduce metastasis [39]. Also results of our study showed grade and stage of BC had a relationship with recurrence and metastasis. Other studies showed a significant correlation between tumor size with recurrence and metastasis also with staging of BC [40].

The C index for health expenditure has always been positive, stating that health costs in higher deciles is
higher than lower deciles. This can be due to the low pay ability of low income deciles or lack of access to health services. The C index is closer to zero, indicating a more equality concentration on health costs among different deciles. The C index was 0.498 at 2009 in Iran, which indicates significant inequalities in health costs. An increase in inequality could be affected by rising prices due to economic policies or discriminatory health policies. An increase in inequality, can have a more negative effect on the health expenditure of lower SES groups [41]. According to the results of this study, there was not SES inequality in recurrence, metastasis, stage and grade of BC. This was the first study in this field. Although the role of SES inequality in health has been evaluated in some studies [42-45]. In some studies, the effect of SES on the incidence of cancer is reversed. For example in a study by Tweed et al., BC had a low incidence in areas with lower SES [46]. In a study in European countries the role of SES inequality evaluated in health. The C index varied from 0.0034 in the Netherlands to 0.0218 in Portugal. Also in this study patients with high SES are more likely to use diagnostic and therapeutic test, which leads to early detection of the disease [47].

Conclusions

BC is the most common cancer among women. Many complications of this cancer can be prevented with early detection. To date no study has been performed that evaluate the role of SES inequity in recurrence, metastasis, grade, and stage of BC. Therefore, our study results can be good evident of the importance of this topic. Due to the important role of SES and the existence of insurance and supplementary insurance, in early detection and treatment of BC, it is suggested that measures be taken to allow BC diagnostic and screening services to be available at a lower cost to the public. Also, with the reduction of SES inequality and increase in screening test, BC can be detected earlier and metastasis and recurrence decrease eventually.

Ethical statement

The Research Ethics Committee of Shahid Beheshti University of Medical Sciences approved this study and participants provided written informed consent for voluntary participation in the study (Ethical Code: IR.SBMU.RETECH.REC.1396.839).

Acknowledgements

Funding/Support sources: this research has been supported by Shahid Beheshti University of Medical Sciences grant number: 11361. This study is part of PhD thesis of Dr. Majid Taheri in the field of Medical Sociology that funded by Shahid Beheshti University of Medical Sciences. The authors also gratefully acknowledge the cooperation of oncolgists, without whom this investigation would not have been possible. We would also like to thank all patients who participated in this research.

Conflict of interest statement

None declared.

Authors’ contributions

MT, MT, MEA, AAH, RA, AAA and MT contributed to project design and its development. MT, MT, AAH, RA and MA wrote the manuscript. MT, AAH, MT and MA analyzed data.

References

[1] Berek J, Novak E. Woltersk. Female Genital Disease.15th ed. LippincotWilliams&Wilkins 2012.
[2] Fitzmaurice C, Akinyemiju TF, Al Lami FH, Alam T, Alizadeh-Navaei R, Allen C, Alsharif U, Alvis-Guzman N; Global Burden of Disease Cancer Collaboration. Global, Regional, and National Cancer Incidence, Mortality, Years of Life Lost, Years Lived With Disability, and Disability-Adjusted Life-Years for 29 Cancer Groups, 1990 to 2016: a systematic analysis for the Global Burden of Disease Study. JAMA Oncol 2018;4:1553-68. doi: 10.1001/jamaoncol.2018.2706.
[3] Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. CA Cancer J Clin 2015;65:87-108. doi: 10.3322/caac.21262.
[4] GBD 2015 Eastern Mediterranean Region Cancer Collaborators. Burden of cancer in the Eastern Mediterranean Region, 2005-2015: findings from the Global Burden of Disease 2015 Study. Int J Public Health 2018;63:151-64. doi: 10.1007/s00038-017-0999-9.
[5] Dai H, van’t Veer L, Lamb J, He YD, Mao M, Fine BM, Bernards R, van de Vijver M, Deutsch P, Sachs A. A cell proliferation signature is a marker of extremely poor outcome in a subpopulation of breast cancer patients. Cancer Res 2005;65:4059-66. doi: 10.1158/0008-5472.CAN-04-3953.
[6] Rugo HS. The importance of distant metastases in hormone-sensitive breast cancer. Breast 2008;17(Suppl 1):S3-8. doi: 10.1016/S0960-9776(08)70002-X.
[7] Cardoso F, Harbeck N, Fallowfield L, Kyriakides S, Senkus E, Group E. Locally recurrent or metastatic breast cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. Ann Oncol 2012;23(Suppl 7):i11-9. doi: 10.1093/annonc/mds232.
[8] Engel J, Eckel R, Kerr J, Schmidt M, Fürstenberger G, Richter R, Sauer H, Senn H-J, Hölzel D. The process of metastasisation for breast cancer. Eur J Cancer 2003;39:1794-806. doi: 10.1016/S0959-8499(03)00422-2.
[9] Akinyemiju TF, Genkinger JM, Farhat M, Wilson A, Gary-Webb TL, Tehranifar P. Residential environment and breast cancer incidence and mortality: a systematic review and meta-analysis. BMC cancer 2015;15:191. doi: 10.1186/s12885-015-1098-z.
[10] Philips Jr BU, Belasco E, Markides KS, Gong G. Socioeconomic deprivation as a determinant of cancer mortality and the Hispanic paradox in Texas, USA. Int J Equity Health 2013;12:26. doi: 10.1186/1475-9276-12-26.
Chor JSY, Lam HCY, Chan A, Lee HM, Fok E, Griffiths S, Cheung P. Socioeconomic disparity in breast cancer detection in Hong Kong - a high income city: retrospective epidemiological study using the breast cancer registry. PloS one 2014;9:e107630. doi: 10.1371/journal.pone.0107630.

Palencía L, Espelt A, Rodríguez-Sanz M, Puigpinós R, Pons-Vigués M, Pasarín MI, Spada T, Kunst AE, Borrell C. Socioeconomic inequalities in breast and cervical cancer screening practices in Europe: influence of the type of screening program. Int J Epidemiol 2010;39:757-65. doi: 10.1093/ije/dyq003.

Tomatis L. Socioeconomic factors and human cancer. Int J Cancer 1995;62:121-5. doi: 10.1002/jic.291062020.

Lago S, Cantarero D, Rivera B, Pascual M, Blazquez-Fernandez C. Socioeconomic status, health inequalities and non-communicable diseases: a systematic review. Z Gesundwiss 2018;26:1-14. doi: 10.1007/s10389-017-0850-z.

Elgar FJ. Income inequality, trust, and population health in 33 countries. Am J Public Health 2010;100:2311-5. doi: 10.2105/ajph.2009.189134.

Wilkinson RG. Socioeconomic determinants of health: Health inequalities: relative or absolute material standards? Bmj 1997;314:591. doi: 10.1136/bmj.314.7080.591.

Garmaroudi GR, Moradi A. Socio-economic status in Iran: a study of measurement index. PAYESH 2010;9:137-44.

Filmer D, Pritchett L. Estimating wealth effects without expenditure data - or tears. Policy Research Working Paper 1980, The World 1998.

Vyas S, Kumaranyake L. Constructing socio-economic status indices: how to use principal components analysis. Health Policy Plan 2006;21:459-68. doi: 10.1093/heapolicy/ez029.

Kakwani N, Wagstaff A, Van Doorslaer E. Inequality in health: measurement, computation, and statistical inference. J Econom 1997;87-103. doi: 10.1016/S0304-4076(96)01807-6.

Kakwani Nanak C, Kakwani Nanak C. Income inequality and poverty: methods of estimation and policy applications. Oxford: Oxford University Press 1980.

Hassanzedeh J, Mohammadbeigi A, Esfahri B, Rezaianzadeh A, Rajaeefard A. Determinants of inequality in health care services utilization in Markazi Province of Iran. Iran Red Crescent Med J 2013;15:363-70. doi: 10.5812/rcmj.3525.

Wagstaff A, Van Doorslaer E. Measuring inequalities in health in the presence of multiple-category morbidity indicators. Health Econ 1994;3:281-91. doi: 10.1002/hec.4730030409.

Ayubi E, Sani M, Safiri S, Khedmati Morasae E, Almasi-Hashian A, Nazarzadeh M. Socioeconomic determinants of inequality in smoking stages: a distributional analysis on a sample of male high school students. Am J Mens Health 2017;11:1162-8. doi: 10.1177/1557859815585822.

Mohammadbeigi A, Hassanzedeh J, Esfahri B, Rezaianzadeh A. Decomposition of inequality determinants of healthcare utilization, Iran. Public Health 2013;127:661-7. doi: 10.1016/j.puhe.2013.01.001.

Mohammadbeigi A, Hassanzedeh J, Esfahri B, Rezaianzadeh A. Socioeconomic inequality in health care utilization, Iran. J Epidemiol Glob Health 2013;3:139-46. doi: 110.1016/j.jegh.2013.1003.1006.

Omani-Samani R, Almasi-Hashian A, Safiri S, Rezaeinjad M, Shokri F, Khedmati Morasae E, Maroufizadeh S, Sepidarkish M. Why caesarean is more unequally concentrated among better-off people in Tehran? A concentration index decomposition approach. J Epidemiol Community Health 2019;73:182-7. doi: 10.1136/jech-2017-201043.

Omani-Samani R, Amini Ranani M, Sepidarkish M, Khedmati Morasae E, Maroufizadeh S, Almasi-Hashiani A. Socioeconomic inequality of unintended pregnancy in the Iranian population: a decomposition approach. BMC Public Health 2018;18:607. doi: 10.1186/s12889-018-5515-5.

Omani-Samani R, Mansournia MA, Almasi-Hashian A, Sepidarkish M, Safari S, Khedmati Morasae E, Amini Ranani M. Decomposition of socioeconomic inequalities in preterm deliveries in Tehran, Iran. Int J Gynaecol Obstet 2018;140:87-92. doi: 10.1002/ijgo.12347.

Hayati P. Shahsavari A. Investigation of demographic and social inforation in women with breast cancer. Journal of Aligudarz University 2010;2:35-43.

Gohari MR, Abolghasemi J, Mohammad M. Prognostic factors of metastases in breast cancer patients using the recurrent Andersen-Gill model. Koomesh 2013;14:483-9.

Jalali M. Jasek B, Velae N. Age and type of tumorigenicity with prognosis of breast cancer patients. Feys Scientific Journal 2000;20:67-73. doi: 10.3390/cancers7020815.

Bonnier P, Romain S, Charpin C, Lejeune C, Tubiana N, Martin PM, Piana L. Age as a prognostic factor in breast cancer: relationship to pathologic and biologic features. Int J Cancer 1995;62:138-44. doi: 10.1002/jic.2910620205.

Liu Y, Zhang J, Huang R, Feng WL, Kong YN, Xu F, Zhao L, Song QK, Li J, Zhang BN, Fan HJ, Qiao XL, Xie XM, Zheng S, He JJ, Wang K. Influence of occupation and education level on breast cancer stage at diagnosis, and treatment options in China: a nationwide, multicenter 10-year epidemiological study. Medicine 2017;96:e6641. doi: 10.1097/md.0000000000006641.

Bitter MP, Carpenter CS. Health insurance mandates, mammography, and breast cancer diagnoses. Am Econ J Policy 2016;8:39-68. doi: 10.1257/pol.20120298.

Akinenyinju T, Sakhuja S, Vin-Raviv N. Racial and socioeconomic disparities in breast cancer hospitalization outcomes by insurance status. Cancer Epidemiol 2016;43:63-9. doi: 10.1016/j.canep.2015.06.011.

Bell R, Barracough R, Vasieva O. Gene expression meta-analysis of potential metastatic breast cancer markers. Current molecular medicine 2017;17:200-10. doi: 10.2174/156652401766610708464496.

Fisher S, Gao H, Yasui Y, Dabbs K, Winget M. Survival in stage I-III breast cancer patients by surgical treatment in a publicly funded health care system. Ann Oncol 2015;26:1161-9. doi: 10.1093/annonc/mdv107.

Dunst J, Steil B, Furch S, Fach A, Lautenschlager C, Diestelhorst A, Lampe D, Kolbi H, Richter C. Prognostic significance of local recurrence in breast cancer after postmastectomy radiotherapy. Strahlenther Onkol 2001;177:504-10.

Kasangian AA, Gherardi G, Biagioli E, Torri V, Moretti A. The prognostic role of tumor size in early breast cancer in the era of molecular biology. PLoS One 2017;12:e0189127. doi: 10.1371/journal.pone.0189127.

Raghfar H, Zargari N, Sangari Mohazzab K. Measuring Inequality in Households’ Health Care Expenditures in Iran. Hakim Research Journal 2013;16:89-97.

Hosseinpoor AR, Mohammad K, Majdizadeh R, Naghavi M, Abdollahi F, Sousa A, Speybroeck N, Jamshidi HR, Vega J. Socioeconomic inequality in infant mortality in Iran and across its provinces. Bull World Health Organ 2005;83:837-44. doi: 10.2105/ajph.2009.189127.

Kushel MB, Vittinghoff E, Haas JS. Factors associated with the health care utilization of homeless persons. Jama 2001;285:200-6. doi: 10.1001/jama.285.2.200.

Van de Poel E, Hosseinpoor AR, Speybroeck N, Van Ourti T, Vega J. Socioeconomic inequality in malnutrition in developing countries. Bull World Health Organ 2008;86:282-91. doi: 10.2105/BLT.07.044800.

Taheri M, Tavakol M, Akbari ME, Mohammadbeigi A, Abbasi M. Socio-Economic Status Inequality in self rated health in
patients with breast cancer. Open Access Maced J Med Sci 2019;7:152-6. doi: 10.3889/oamjms.2019.028.

[46] Tweed E, Allardice G, McLone P, Morrison D. Socioeconomic inequalities in the incidence of four common cancers: a population-based registry study. Public Health 2018;154:1-10. doi: 10.1016/j.puhe.2017.10.005.

[47] Myers ER, Moorman P, Gierisch JM, Havrilesky LJ, Grimm LJ, Ghate S, Davidson B, Montgomery RC, Crowley MJ, McCrory DC, Kendrick A, Sanders GD. Benefits and harms of breast cancer screening: a systematic review. Jama 2015;314:1615-34. doi: 10.1001/jama.2015.13183.

Received on December 28, 2018. Accepted on June 17, 2019.

Correspondence: Mohammad Tavakol, Sociology Department, School of Social Sciences, University of Tehran, Tehran, Iran - Tel. +98 21 61117938 - Fax +98 21 88012524 - E-mail: mtavakol@ut.ac.ir

How to cite this article: Taheri M, Tavakol M, Akbari ME, Anoshirvani AA, Aghabozorgi R, Almasi-Hashiani A, Abbasi M. Socioeconomic inequalities in metastasis, recurrence, stage and grade of breast cancer: a hospital-based retrospective cohort study. J Prev Med Hyg 2019;60:E262-E269. https://doi.org/10.15167/2421-4248/jpmh2019.60.3.1162

© Copyright by Pacini Editore Srl, Pisa, Italy

This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.