

## RESEARCH ARTICLE

# Relationship of Social Determinants of Health with the Three-year Survival Rate of Breast Cancer

Esmat Davoudi Monfared<sup>1\*</sup>, Maryam Mohseni<sup>2</sup>, Farzaneh Amanpour<sup>3</sup>, Alireza Mosavi Jarrahi<sup>4</sup>, Mohammad Moradi Joo<sup>5</sup>, Mohammad Ali Heidarnia<sup>4</sup>

### Abstract

**Background:** Social determinants of health are among the key factors affecting the pathogenesis of diseases. Considering the increasingly high prevalence of breast cancer and the association of social determinants of health with its occurrence, related morbidity and mortality and survival rate, this study sought to assess the relationship of three-year survival rate of breast cancer with social determinants of health. **Materials and Methods:** This cohort study was conducted on males and females presenting to the Cancer Research Center of Shohada-E-Tajrish Hospital from 2006 to 2010 with definite diagnosis of breast cancer. Data were collected via phone interviews. Kaplan-Meier and Cox regression was fitted using SPSS (version 18) and PH assumption was tested by STATA (version 11) software. **Results:** The study was performed on 797 breast cancer patients, aged 25-93 years with mean age of 54.66 (SD=11.86) years. After 3 years from diagnosing cancer 700 (87.8%) patients were alive and 97 (12.2%) patients were dead. Using log rank test, there was relationship between 3-year survivals with age, education, childhood residence, sibling, treatment type, and district were significant ( $p<0.05$ ). Using Cox PH regression, 3-year survival was related to age, level of education, municipal district of residence and childhood condition ( $p<0.05$ ). **Conclusion:** Social determinants of health such as childhood condition, city region residency, level of education and age affect the three-year survival rate of breast cancer. Future studies must focus on the effect of childhood social class on the survival rates of cancers, which have been paid less attention to.

**Keywords:** Breast cancer- survival- social determinant of health - Iran

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### Introduction

Breast cancer is the most common type of cancer in developed and developing countries (Bray et al., 2013). It is the second most prevalent cause of deaths due to cancer after lung cancer in women. According to the most recent statistics, the incidence of cancer is globally increasing at a rate of 2% per year (DeSantis et al., 2011).

In the past thirty years, the survival rate of advanced stage breast cancer has greatly improved. During 1999-2005, the five-year survival rate of women diagnosed with breast cancer was 90% in comparison to 75% during 1975-1977 (Horner et al., 2008). Improved survival rate is probably attributed to advances in treatment modalities for breast cancer and extensive screening of high-risk women for detection of cancer at an early stage (Berry et al., 2005). However, unfortunately, not all women enjoy such an increase in survival rate. Individual differences in this regard may be due to several factors; which have

been evaluated in many previous studies. Strong evidence shows that differences in the rate of survival, morbidity and mortality of cancers such as breast cancer may relate to the social determinants of health (Yu XQ et al., 2009).

Social determinants of health are among the key factors affecting the pathogenesis of diseases. Despite the advances in diagnostic and therapeutic techniques, social determinants of health still affect the prevalence of diseases and the related morbidity and mortality (Link et al., 1996). These factors include childhood conditions, social status, addiction, social support, work environment, transportation, etc. (Marmot and Wilkinson, 2000). In order to classify and descriptively assess these factors, some indices are used including the socioeconomic status, level of education, occupation, level of income, sex, race, ethnicity, religion, nationality, social class and place of residence (rural versus urban, and northern versus southern areas).

In terms of socioeconomic class, people are classified

<sup>1</sup>Department of Community Medicine, Faculty of Medicine, Baqiyatallah University of Medical Science, <sup>2</sup>Department of Social Medicine, Medical School, <sup>4</sup>Department of Community Medicine, Shahid Beheshti University of Medical Sciences, <sup>5</sup>Cancer Research Center, Shahid Beheshti University of Medical Sciences and Iran Health Insurance Organization Tehran, <sup>3</sup>Department of Epidemiology and Biostatistics, School of Public Health, Shahrood University of Medical Sciences, Shahrood, Iran. \*For Correspondence: davoudimonfared@gmail.com

based on their level of education, social class and place of residence, and their position in the social, national and global level is determined as such (Kelly et al., 2006).

Regarding breast cancer, women in poor countries with low level of education often have lower survival rates, and the rate of cancer related death is 1.39 times higher in patients with an educational level lower than high school education compared to women with university education (Sprague et al., 2011). Bouchardy and Dalton showed that breast cancer patients with low socioeconomic status had a poor prognosis (Bouchardy et al., 2006; Dalton et al., 2007). However, prevalence of breast cancer is higher in women with higher levels of education and income (Larsen et al., 2011).

Despite extensive investigations on social determinants of health related to breast cancer, some factors such as the place of residence and childhood conditions have been paid less attention to.

Considering the increasingly high prevalence of breast cancer and the association of social determinants of health with its occurrence, related morbidity and mortality and survival rate (Taghavi et al., 2012; Cheung, 2013; Heidarnia et al., 2013), this study sought to assess the correlation of social determinants of health with the three-year survival rate of breast cancer.

## Materials and Methods

This cohort study was conducted on males and females registered in the Cancer Research Center of Shohada-E-Tajrish Hospital from 2006 to 2010 with definite diagnosis of breast cancer. Sampling was census and sample size was calculated using the sample size formula for survival studies. Type one error ( $\alpha$ ) was considered as 5% with a type 2 ( $\beta$ ) error of 20%.

The inclusion criteria were definite diagnosis of breast cancer, residing within the limits of Tehran city and initiation of treatment after definite diagnosis of cancer.

To interview patients, information form was designed by the researchers. Years of education was used as an index for social class; since previous studies have shown that education is a valid and reliable index for studies on the correlation of health and social factors in Iran. Financial status was measured by the average per capita housing area (calculated by dividing the square meter of the house by the number of people residing in the house). This index was used since previous studies have shown that level of income in Iran is not a reliable measure because people often work several jobs. But, the per capita housing area (house floor area/person) serves as a valid and reliable index for this purpose in Iran (Montazeri et al., 2005). Social determinants of health were evaluated in different levels. Demographics were also evaluated including age, sex, marital status, financial status, per capita housing area, social class, place of residence, housing, level of education, occupational status, high risk behaviors such as cigarette smoking, access to health care services, health insurance status, childhood conditions, place of residence in childhood, number of siblings, medical history and family history of breast cancer.

Tehran city was divided into five geographical

districts according to the Urban HEART Study namely north (municipal districts 1,2,3 and 6), east (municipal districts 4,7,8 and 13), west (municipal districts 5,21 and 22), center (municipal districts 9,10,11 and 12) and south (municipal districts 14,15,16,17,18,19 and 20) (Fereshtehnejad et al., 2010).

First, primary information of patients were retrieved from the Shohada-E-Tajrish cancer registry center and then the patients were contacted by phone and were interviewed over the phone. Patient's current status was questioned to do a follow up and assess the three-year survival rate of patients. Other questions were then asked regarding the socioeconomic status of patients. If the patient was deceased, the closest family member was interviewed. The interviewers had university education and were instructed on how to do the interviews and ask the relevant questions. For incomplete questionnaires, the patients were contacted again to fill out the questionnaires by asking them additional questions.

### Statistical analysis

Variables in the study included: Age ( $<50, \geq 50$ ), sex (female, male), inheritance (yes, no), chronic disease (yes, no), childhood residence (urban, rural), sibling ( $\leq 4, > 4$ ), smoking (yes, no), marital status (single, married, divorced, widow), education ( $<$ high school, diploma, academic), district (north, west, east, center, south), home ownership (yes, no), home size ( $<30, 30-60, >60$ ), complete treatment (yes, no), and treatment type (incomplete, complete).

Kaplan-Meier and Cox proportional Hazard model were used to investigate the effect of possible risk factors on survival time of breast cancer patients.

In this study, Cox PH regression was applied to determine the hazard ratio of breast cancer patients in terms of demographic, socioeconomic and health care access variables. The models were applied based on time- order of variables in which demographic factors affect socioeconomic factors, which influence health care access and consequently survival time.

Survival time was defined as a period between the diagnostic of disease and death or the end of third year. A binary variable was used to indicate whether a patient was censored or died of cancer.

Variables were entered separately to the Kaplan-Meier model, and log-rank test was estimated for each variable. Furthermore, significant variables were entered into Cox proportional Hazard model, in which model 1 contained only demographic factors, model 2 included socioeconomic factors adjusted for demographic factors, and model 3 showed the effect of health care access factors adjusting for all other risk factor in the model. In order to use the Cox model for survival data, proportional Cox (PH) assumption must be met which assumes that the hazard ratios are constant over time, and it can be evaluated by Schoenfeld residuals.

Hazard ratio and 95% confidence interval was estimated using Cox proportional Hazard model. Cox regression was fitted using SPSS (version 18) and PH assumption was tested by STATA (version 11) software.

Table 1. Case Summary and Overall Comparisons by Kaplan-Meier and Generalized Gamma with Regard to the Three-Year Survival of Breast Cancer Patients

Variable	Total No.	No. of Event	P value
<b>Age</b>			
≥50	520	74	0.01*
<50(ref)	277	23	
<b>Sex</b>			
Female	686	88	0.462
Male	114	12	
<b>Marital status</b>			
Single	54	4	0.05
Married	640	84	
Divorced	36	0	
Widowed	70	12	
<b>Education</b>			
<High school diploma	258	46	<0.001*
Diploma	264	36	
Academic education (ref)	278	18	
<b>Complete treatment</b>			
Yes	786	94	0.5
No	10	2	
<b>Childhood place of residence</b>			
Urban	690	92	0.03*
Rural (ref)	106	6	
<b>Chronic disease</b>			
Yes	150	20	0.44
No	628	70	
<b>Inheritance</b>			
Yes	268	30	0.5
No	528	68	
<b>Smoking</b>			
Yes	32	2	0.4
Quit	28	2	
No	736	94	
<b>Siblings</b>			
>4	454	68	0.01*
≤4(ref)	346	32	
<b>Treatment type</b>			
Incomplete	170	4	<0.001*
Complete (ref)	630	96	
<b>Municipal district</b>			
North (ref)	162	8	0.01*
East	124	14	
West	90	8	
Center	42	8	
South	40	8	
<b>Home ownership</b>			

Table 1. Continued

Variable	Total No.	No. of Event	P value
Home size	640	80	0.72
No	158	18	
Home size			
<30	172	14	0.46
30-60	162	8	
>60	76	6	

\*, Statistically significant (P<0.05)

## Results

The study was performed on 797 breast cancer patients, aged 25-93 years with mean age of 54.66 (SD=11.86) years and median age of 54 years. After 3 years diagnosing breast cancer, 700 (87.8%) patients were alive and 97(12.2%) patients were dead.

Variables Age, sex, inheritance, chronic disease, childhood residence, sibling, smoking, marital status, education, district, home ownership, home size, complete treatment and treatment type were entered separately to the Kaplan-Meier model. According to log rank test, variables age, education, childhood residence, sibling, treatment type, and district were significant (p<0.05). Case summary of variables and results of overall comparison by KM method in 3-year survival of breast cancer patients are shown in Table 1.

Cox regression models 1,2, and 3 were applied to significant variables in KM method to predict the effect of social determinants of survival time of breast cancer patients. PH assumption was tested by Schoenfeld residuals and it was held for all the variables in the Cox model (p>0.05). The results of Cox regression models are shown in Table 2.

In the first model, variables age, sibling, and childhood residence were entered into Cox model. Variables age and child residence were significant in this model (p<0.05). The hazard of dying due to cancer throughout three years is about 1.68 times for older patients to younger ones. Also, the hazard of dying due to cancer for patients with more than four siblings was 1.48 times the hazard of those with fewer siblings.

In the second model, variables education and district were entered into the Cox model. Variables district was significant in this model. The hazard of dying due to cancer was higher in East (HR=2.76, P=0.04), Center (HR=4.87, P<0.01), and South (HR=4.59, P<0.01) in comparison with North.

In the third model, variable treatment type was entered which was not significant.

## Discussion

This study sought to assess the correlation of three-year survival rate of breast cancer patients registered in Shohada-E-Tajrish cancer registry center with different aspects (personal, familial, social and economical) of the social determinants of health. Based on the results, the most important determinants of three-year survival rate

Table 2. Hazard Ratio of Death because of Breast Cancer by Cox PH Model

Variable	Model 1			Model 2			Model 3		
	P value	HR	95%CI	P value	HR	95%CI	P value	HR	95%CI
Demographic									
Age									
≥50	0.03*	1.68	(1.05,2.69)	0.74	1.14	(0.52,2.5)	0.67	1.18	(0.54,2.59)
<50(ref)		1			1			1	
sibling									
>4	0.07	1.48	(0.96,2.26)	0.27	1.43	(0.75,2.71)	0.12	1.66	(0.87,3.16)
≤4(ref)		1			1			1	
Child residence									
Urban	0.04*	2.34	(1.02,5.35)	0.16	2.78	(0.66,11.62)	0.25	2.29	(0.55,9.63)
Rural (ref)		1			1			1	
Socioeconomic									
Education									
<Highschool				0.06	2.37	(0.94,5.98)	0.04*	2.58	(1.03,6.5)
Diploma				0.1	2.06	(0.86,4.94)	0.07	2.23	(0.93,5.36)
Academic(ref)					1			1	
District									
North(ref)					1			1	
East				0.04*	2.76	(1.05,7.25)	0.03*	2.88	(1.11,7.53)
West				0.06	2.76	(0.95,8.02)	0.06	2.8	(0.97,8.1)
Canter				0.004*	4.87	(1.66,14.26)	0.006*	4.6	(1.55,13.64)
South				0.008*	4.59	(1.49,14.12)	0.008*	4.48	(1.47,13.63)
Health Care Access									
Treatment Type									
Incomplete							0.92	-	-
Complete(ref)									

\*, significant at p<0.05

for breast cancer were age, level of education, municipal district of residence and childhood conditions.

Previous studies mainly focused on the personal and socioeconomic aspects of social determinants of health (Byers et al., 2008; Bigby et al., 2005; Gorey et al., 2009; Harper et al., 2009). However, the current study covered some other aspects as well.

In our study, age of affliction with breast cancer was among the most important factors determining the three-year survival rate. Adami et al. reported that the survival rate of breast cancer decreased after the age of 49 (compared to the age range of 40 to 49 years) and the lowest survival rate belonged to the age group of over 75 years (Adami et al., 1986). Dialla et al. showed that patients in the age range of 50 to 74 years were diagnosed with more advanced tumors than those below the age of 50 years odds ratio of 1.27 (Dialla et al., 2015). Moreover, 50 to 74 year-old females living in deprived areas were more commonly diagnosed with advanced stages of cancer (Dialla et al., 2015). Fallahzadeh et al. (2014) in their study in Iran reported that the five-year survival rate of breast cancer patients over the age of 50 years was lower than that of patients younger than 50 years. This reduction in survival rate with aging may

be related to the knowledge of individuals, conduction of self-examinations for detection of breast cancer or screening with mammography, which all result in earlier detection of breast cancer. Moreover, the elderly may not be able to receive the treatment according to the guideline due to having underlying diseases or debilitating conditions; this can negatively affect their survival rate.

In the current study, high level of education increased the three-year survival rate of breast cancer. Level of education has been referred to as an influential factor on health in many previous studies (Steenland et al., 2002). Herndon et al. mentioned the level of education below high school diploma to be a risk factor for death in women with breast cancer (Herndon et al., 2013). Level of education has a close association with the level of income and socioeconomic status of individuals. In other words, difference in the level of education reflects different socioeconomic status of individuals. This difference affects the health status of individuals in different ways. Women with higher levels of education show up for regular screening of breast cancer more frequently and this results in earlier detection of cancer. Moreover, these individuals often have higher level of income and can easily and quickly receive the best health

care service available. Comprehensive treatment of breast cancer positively affects the survival rate. Our results confirm this finding as well. Furthermore, subjects with higher education often reside in areas with more advanced medical facilities. As demonstrated in the current study, place of residence also affects the survival rate of breast cancer. Dialla et al., (2012) showed that living in deprived areas was one of the reasons behind late detection of breast cancer in advanced stages. Dasgupta et al. reported that the place of residence and distance from medical centers were among the important factors determining the survival rate of breast cancer. In our study, living in northern part of the city was associated with higher three-year survival rate of breast cancer. Place of residence probably affects the access to diagnostic and therapeutic facilities. Evidence shows that providing equal access to diagnostic and therapeutic services for all individuals can increase the survival rate of cancer patients (Akinyemiju et al., 2013).

Childhood conditions are also among the social determinants of health, which have been paid less attention to. Poor health conditions during childhood lead to poor health consequences in the adulthood (Braithwaite et al., 2009). For some neoplasms such as the stomach cancer, strong evidence supports the effect of childhood conditions on cancer-related morbidity and mortality (Naess et al., 2007). However, studies on breast cancer are still ongoing. This study showed that living in rural areas during childhood and having fewer siblings increased the survival rate of breast cancer patients. Higher number of siblings was associated with higher cancer mortality in a previous study (Naess et al., 2004). The significant effect of childhood conditions on survival rate of lung cancer has also been reported (Strand et al., 2010).

Social class during childhood and its specific aspects such as early physical environment (place of residence) and psychosocial environment (family size) can also affect survival rate of cancer in adulthood via mechanisms such as nutrition, infection and stress (WHO, 2010). However, further investigations are required to scrutinize the details of the correlation of childhood conditions with adulthood diseases such as breast cancer. Effects of childhood social class must also be investigated by identifying specific aspects of the early physical or psychosocial environment.

Social determinants of health such as childhood conditions, city region residency, level of education and age affect the three-year survival rate of breast cancer. Future studies are required to assess the role of factors such as childhood social class in survival rates of cancers, which have been paid less attention to.

One limitation of this study was that the level of income of patients was not evaluated. Moreover, the information acquired from the relatives of deceased patients might have not been very accurate. Assessment of different aspects of social determinants of health was the strength of this study.

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