The cost of breast cancer: A comparison between private and public hospitals

Abolhasan Afkar
Guilan University of Medical Sciences
Habib Jalilian
Tabriz University of Medical Sciences
Abolghasem Pourreza
Tehran University of Medical Sciences
Habibeh Mir
Tabriz University of Medical Sciences
Abdolhosein Emami Sigaroudi
Guilan University of Medical Sciences
Somayeh Heydari (saeedehheydari5@yahoo.com)
Guilan University of Medical Sciences

Research article

Keywords: breast cancer, burden of disease, direct costs, indirect costs, cost of illness

Posted Date: August 24th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-50581/v1

Version of Record: A version of this preprint was published on March 11th, 2021. See the published version at https://doi.org/10.1186/s12913-021-06136-6.

Abstract

Backgrounds Breast cancer is the most prevalent cancer among women. Breast cancer imposes a considerable economic burden on the health system. This study aimed to compare the cost of breast cancer among patients who referred to private and public hospitals in Iran (2017).

Methods This was a prevalence-based cost of illness study. A total of 179 patients were selected from private and public hospitals using the census method. The researcher-constructed checklist was used for data collection. Data were analyzed using SPSS software version 22.

Results The estimated total mean ± SD direct cost of patients who referred to the private hospital and the public hospital was $10051.78 ± 19484.61 and $3956.33 ± 6783.02, respectively. Further, the total mean indirect cost of patients who referred to the private hospital was lower than those referring to the public hospital at $1870.89 (%15.69 of total costs) and $22348.5 (%84.95 of total costs), respectively. These differences were statistically significant ($P < 0.05$).

Conclusion Breast cancer imposes a substantial cost on patients, health insurance organizations and the whole society in Iran. Therefore, the adoption of effective measures for the prevention and early diagnosis of breast cancer is urgently needed.

Background

Cancer is a leading cause of death worldwide. The number of cancer cases and deaths is projected to grow rapidly due to population ageing and adopt lifestyle behaviours that increase cancer risk. This is especially important in low- and middle-income countries as they undergo an economic transition (1). The estimated number of new cases and deaths of cancer was 2088849 and 626679, respectively, worldwide in 2018 (2).

Breast cancer is a major public health problem, and 1.7 million new cases are diagnosed per year. It has been shown that almost 60% of deaths from breast cancer occur in developing countries (3, 4). In 2018, breast cancer was the most commonly diagnosed cancer in women (24.2%, i.e. nearly one in 4 of all new cancer cases diagnosed in women worldwide were breast cancer) (5). In 2018, it was estimated that 627,000 women died from breast cancer, contributing approximately 15% of all cancer deaths among women (5). It has been estimated that the incidence of women breast cancer worldwide will reach approximately 3.2 million new cases per year by 2050 (4).

Breast cancer in developing countries represents one-half of all breast cancer cases and 62% of cancer mortality (6). In Iran, breast cancer is the fifth leading cause of cancer mortality (7–9). According to GLOBOCAN database 2018, the number of new cases, deaths and 5-years prevalence from breast cancer for women in Iran was estimated to be 13776, 3526 and 40825, respectively (10). In the last 30 years, the probability of breast cancer incidence for individuals aged 15–79 years in Iran has increased, according to the statistics (11). According to the statistics, 6160 breast cancer cases are diagnosed in the country

each year, and 1063 cases result in death (12). In 2035 compared to 2012, the number of new cases will be nearly two times greater (13).

Breast cancer imposes a considerable economic burden on societies (14–16). For example, the total cost of breast cancer was more than three times the total cost of prostate cancer (17). A study by Figueiredo et al. indicated that between 2004 and 2014, public healthcare costs increased, and the correlation between breast cancer and public healthcare costs was positive, mainly influenced by governmental strategies (18). Breast cancer imposes a significant financial burden on healthcare systems of Iran (19, 20). Policymakers and health planners are interested in understanding the economic burden of illnesses to assess the optimal allocation of health resources to various diseases and estimate the potential costs and benefits of public health interventions (20).

Cost of Illness (COI) studies indicate the importance of a particular disease and provide a baseline for assessing new interventions (20) and financial losses as a result of illness (21). The aim of the COI-studies is providing an estimate of how much society spends on a particular disease and identifying different cost components (22). The COI can be used as a criterion for decision making in allocating limited budgets and resources for governmental health policies in effective control of diseases (21). A comprehensive economic analysis demands consideration of both direct and indirect costs such as productivity losses as a result of individuals unable to work because of hospitalization or outpatient visits, and also premature death arising from the illness (21).

In future, the cost of cancer care will increase as new sophisticated, expensive treatment modalities are adopted to raise the standard of care (23). Breast cancer is on the rise in Iran, and since patients are mostly diagnosed at more advanced stages of the disease (24, 25), mortality resulting from breast cancer is high (26). So, the presentation of accurate data about the economic burden of the disease will allow informed decision making by health care policymakers in Iran about the prevention and treatment of the disease. Therefore, the objective of this study was to compare the cost of breast cancer among patients who referred to private and public hospitals in Iran in 2017.

Methods

Database and study population

This was a prevalence-based cost of illness study, which was conducted from the societal perspective using bottom-up approach costing.

The statistical population in this study included all patients with breast cancer. One hundred seventy-nine patients with breast cancer who admitted to the private hospital (N = 103) and the public hospital (N = 76) in Rasht (a city in the north of Iran) between Aug 2016 and Aug 2017 included in this study.

The cost of illness is divided into three general categories: direct costs, indirect costs, and intangible costs. Direct costs divided into two categories: direct medical costs and direct nonmedical costs. Direct

medical costs involve all hospitalization and outpatient costs caused by health care procedures. Direct nonmedical costs involve transportation, food and lodging costs incurred for receiving medical treatment. Indirect costs include lost productivity due to premature deaths from illness and lost productivity due to absenteeism and presenteeism due to complications of illness as well as informal care costs. Finally, intangible costs include the cost of pain and suffering in patients and their families and relatives. In most cost of illness studies, intangible costs are often not calculated because of the methodological difficulty.

Data Collection Tools

In this study, the economic burden of breast cancer was assessed by calculating direct medical costs, direct nonmedical costs, and indirect costs. Data related to the hospitalization part of direct medical costs were extracted from patients' records and data related to the outpatient part of direct medical costs, direct nonmedical costs and indirect costs were obtained via an interview with patients and their family members, respectively. The researcher-made checklist was used for data collection. The initial draft of the checklist extracted from two records: 1. "Cost-of-illness studies - a primer" (27)and 2. "Cost-of-illness studies: concepts, scopes, and methods" (28). Then, to complete the checklist, we interviewed 5 oncologists, 2 researchers who had conducted at least one cost of illness study, 2 professors in the field of Health Economics and 8 breast cancer patients. The checklist consists of demographic variables (age, marital status, monthly income status, educational status, job status, supplemental insurance status, and the type of basic insurance), duration of the disease and treatment type and questions of cancer-related costs.

Indirect costs were estimated using the Human Capital Approach. Indirect costs were estimated by summing two parts: 1) The costs of lost productivity due to patients and their families' missed workdays and 2) the cost of premature death due to breast cancer. First, in order to estimate the cost of missed workdays per patient, we calculated the average number of missed workdays by patients and their families because of breast cancer and then multiplied by the minimum daily wage rate (310000 (2017)), in this way we estimated the cost of missed workdays per patient. Also, by having the number and the mean age of premature death and retirement age (60 years old) in Iran, the total number of years lost due to premature death resulting from breast cancer was calculated and multiplied by the number of days of the year and the minimum daily wage rate, in this way the cost of premature death was calculated. Finally, the total cost of lost productivity calculated by summing these two parts.

The equations used for indirect costs calculation are as follows:

1. The cost of missed workdays = the mean (patients missed workdays + patient family's missed workdays) × minimum daily wage rate
2. C = the mean {(retirement age– age at premature death) × (the number of patients who died ÷ sample size)} × (minimum daily wage rate × the number days of the year)

To recall bias prevention, patients' treatment process were followed up every two months for one year. All costs in this study were expressed as US Dollars based on the Exchange rate of Central Bank of the

Islamic Republic of Iran (US$ 1 = 31389 Rials (2017)).

Data analysis

Data were analyzed using SPSS software version 22 and excel (2016). Descriptive statistics (mean ± SD, frequency, and percent) were used to assess the demographic variables status. K-S test (Kolmogorov-Smirnov) was applied to assess the normality of data. Since the P-Value for all variables was less than 0.05 ($P < 0.05$), non-parametric tests, including Mann-Withney and Kruskal-Wallis, were used to assess the association between demographic variables and costs. The Spearman correlation coefficient also was used to examine the correlation between age at diagnosis and costs.

Results

A total of 179 patients with breast cancer were included in the analysis. The majority of patients were covered by the basic insurance (98.9%), and only 36.3% of patients were covered by supplemental insurance. Most of the patients (64.2%) held a diploma degree and more than half of the patients were non-natives (54.2%). A statistically significant difference was found between supplemental insurance status and total medical direct cost ($P < 0.05$) Table 1.

The mean ± SD of age at diagnosis, age and age at death estimated at 45.41 ± 9.38, 47.98 ± 10.08 and 49.94 ± 11.80, respectively. The estimated mean ± SD number of hospital admission and the length of hospital stay of patients who referred to the private hospital was 1.35 ± 0.50 and 2.71 ± 2.49, respectively whereas those who referred to the public hospital was higher at 1.48 ± 085 and 8.63 ± 1049, respectively. Additionally, 10.7% of patients who referred to the private hospital and 6.6% of those referring to the public hospital postponed their treatment process for more than two months due to financial barriers.

Table 1
Demographics variable and direct medical cost (N = 179)

Variable	Modes	N (%)	Mean ± SD	P-Value
Age	**< 40 years**	39 (21.8)	9296.40 ± 20497.07	0.32
	40–60 years	121 (67.6)	6885.56 ± 14597.73	
	> 60 years	19 (10.6)	4929.51 ± 8636.47	
Marital status	**Single**	15 (8.4)	5736.24 ± 9906.48	0.30
	Married	164 (91.6)	7328.07 ± 15980.12	
Education status	**Illiterate**	40 (22.1)	11233.46 ± 16101.96	0.06
	Diploma	115 (64.2)	10775.84 ± 17394.16	
	Academic education	24 (13.7)	20483.23 ± 35.063	
Supplemental Insurance status	**Yes**	65 (36.3)	11426.54 ± 23500.14	0.001*
	No	114 (63.7)	4795.51 ± 7278.65	
Type of Basic insurance	**Social security insurance**	84 (46.9)	7635.86 ± 16707.22	0.79
	Iranian health insurance	63 (35.0)	7687.49 ± 17521.67	
	Relief foundation insurance	19 (10.7)	3595.23 ± 4095.73	
	Other basic insurances	13 (7.3)	6038 ± 7559.84	
Habitation status	**Native (patients resident in the city of Rasht)**	82 (45.8)	6856.29 ± 16059.34	0.92
	Non-native (non-Rasht patients)	97 (54.2)	7477.41 ± 15173.80	

*P < 0.05 was considered as significant

As shown in Table 2, the direct medical costs of breast cancer patients who referred to the private hospital and the public hospital were $9884.56 (%82.90 of the total costs) and $3616.45 (%13.74 of the total costs), respectively. The hospitalization costs and outpatient costs of patients who referred to the private hospital were higher than those referring to the public hospital. The highest component of hospitalization costs of patients who referred to the private hospital was related to surgery cost at $982.28 whereas that of patients who referred to the public hospital was related to hoteling costs at $378.40 ± 549.78. In summary, outpatient costs were the main component of the direct medical costs for breast cancer patients who referred to the private hospital and the public hospital.

Besides, the total mean nonmedical direct cost of patients who referred to the private hospital and the public hospital was $166.64 (%1.39 of the total costs) and $339.84 (%1.29 of the total costs), respectively. The highest component of the direct nonmedical cost of patients who referred to the private hospital and the public hospital was attributed to commuting and food costs at $154.27 and $247.65, respectively Table 2.

Table 2
Mean ± SD of breast cancer costs ($)

Variable	Private Hospital	Public Hospital	P-Value
Hospitalization costs			
Diagnostic costs	301.92 ± 233.62	104.70 ± 160.29	0.001*
Surgery costs	982.28 ± 606.01	194.95 ± 335.45	0.001*
Hoteling costs	358.84 ± 423.44	378.40 ± 549.78	0.02*
Drug costs	31.70 ± 76.23	265.80 ± 526.26	0.001*
Visit Costs	35.63 ± 95.42	143.78 ± 226.11	0.001*
Other hospitalization costs[1]	116.11 ± 288.41	162.79 ± 321.29	0.01*
Total hospitalization cost	1828.15 ± 940.13	1250.45 ± 1551.48	0.001*
Outpatient costs			
Chemotherapy costs	761.01 ± 1197.97	194.98 ± 539.14	0.001*
Radiotherapy costs	553.70 ± 1338.42	159.16 ± 711.07	0.001*
Outpatient diagnostic costs	2427.02 ± 7438.13	425.96 ± 943.74	0.12
Outpatient visit costs	462.56 ± 1122.23	102.26 ± 322.46	0.01*
Other outpatient costs[2]	3865.66 ± 11693.92	1483.62 ± 59.84.34	0.16
Total outpatient costs	8062.55 ± 19369.35	2365.99 ± 6428.49	0.004*
Total medical direct costs	9884.56 ± 19425.76	3616.45 ± 6410.91	0.001*
Non-medical direct costs			
Commuting and food costs	154.27 ± 688.61	247.65 ± 702.20	0.37
Accommodation costs	12.37 ± 125.56	92.22 ± 567.07	0.36
Total non-medical direct costs	166.64 ± 697.21	339.87 ± 896.18	0.41
Total direct costs	10051.78 ± 19484.61	3956.33 ± 6783.02	0.001*
Indirect costs			
The cost of missed workdays (patient)	655.84 ± 2693.72	140.34 ± 1223.49	0.05*
The cost of missed workdays (family)	1215.04 ± 3043	959.01 ± 2694.81	0.08
The total of missed workdays	1870.89 ± 4928.15	1099.36 ± 3081.79	0.03*

*P < 0.05 was considered as significant

Variable	Private Hospital	Public Hospital	P-Value
The cost of premature death	0	21249.14 ± 11626.35	-
Total indirect costs	1870.89 ± 4928.15	22348.5 ± 18626.44	0.03*
Total costs	11959.72 ± 20527.53	22972.37 ± 12657.11	0.001*
*P < 0.05 was considered as significant			

1. intravenous chemotherapy cost, cost of faculty members, mastectomy cost, Forensic medicine cost, hospital cost

2. Physiotherapy cost, Injection cost, over-the-counter drug price, prescription drug cost, paying extra cost to the surgeon, cost of caregivers, vitamin cost

The total mean indirect cost of patients who referred to the private hospital was $1870.89, making up %15.69 of the total cost, and for those referring to the public hospital was $ 22348.8, comprising %84.95 of the total costs. This difference was statistically significant (P < 0.05). Further, according to our findings, the total missed workdays of patients, and patients' families who referred to the private hospital was estimated to be 66 and 123 days while those of patients who referred to the public hospital estimated at 14 and 97 days, respectively. Both in the private hospital and the public hospital, the mean cost of lost workdays was considerably higher for family caregivers than for the patients themselves.

The reimbursement rate of basic insurance for patients who referred to the public hospital was higher than those referring to the private hospital (%90.68. VS %37.85). Additionally, %26.77 and %6.39 of costs paid by patients who referred to the private hospital and the public hospital, respectively Table 3.

Table 3
Mean ± SD of hospitalization costs based on the type of payer ($)

Type of payer	Private Hospital	% of the total hospitalization cost	Public Hospital	% of the total hospitalization cost
Basic insurance	691.45 ± 870.57	37.85	1147.08 ± 1460.13	90.68
Supplemental insurance	645.85 ± 694.86	35.36	0	0
Subsidy	0	0	36.96 ± 103.83	2.92
Patient	489.07 ± 645.94	26.77	80.93 ± 88.44	6.39

The major component of the total costs of patients who referred to private hospitals was related to the direct costs at %84.30 (almost 5.6 times greater than those referring to the public hospital) which was equivalent to 1.92 times GDP per capita. In comparison, the major component of the total costs of patients who referred to the public hospitals was related to the indirect costs at %84.95 (almost 5.41 times greater than those referring to the private hospital) which was equivalent to 4.28 times GDP per capita Table 4.

Table 4
Main costs of breast cancer

Costs	Private hospital		Public hospital	
	% of total costs	% of GDP per capita	% of total costs	% of GDP per capita
Medical direct costs				
Total hospitalization costs	15.33	35.02	4.75	23.95
Total outpatient costs	67.62	154.48	8.99	45.33
Total medical direct costs	82.90	189.39	13.74	69.29
Non- medical direct costs				
Commuting and food costs	1.29	2.95	0.94	4.74
Accommodation costs	0.10	0.23	0.35	1.76
Total non-medical direct costs	1.39	3.19	1.29	6.51
Total direct costs	84.30	192.59	15.04	75.80
Indirect costs				
The cost of missed workdays (patient)	5.50	12.56	0.53	2.68
The cost of missed workdays (patient's family)	10.19	23.28	3.64	18.37
The total cost of missed workdays	15.69	35.84	4.17	21.06
The cost of premature death	0	0	80.78	407.14
Total indirect costs	15.69	35.84	84.95	428.20

Discussion

In this study, the estimated mean of age at diagnosis, the age of patients and age at death was 45.41, 47.98 and 49.94 years old, respectively. In our study, the mean age of patients was 47.98 years old, while

in Davari et al. (2013), the mean age of patients estimated at 49 years old, in Iran (29). So it can be concluded that the age of breast cancer onset has decreased in Iran in recent years. The average mortality age of breast cancer is still lower than other cancers, and the economic burden of this disease will rise in the predictable future, according to one study in Japan (21).

In this study, the total mean cost of breast cancer among patients who referred to the public hospital estimated at $ 22972.37 (76632.08 PPP current international $) (1.92 times greater than those referring to the private hospitals), which was equivalent to 4.4 times GDP per capita while that of patients who referred to the private hospital was $11959.72 (41457.52 PPP current international $), which was equivalent to 2.29 times GDP per capita (Gross Domestic Product per capita = 5219.1 USD (2016)). The results showed that direct costs were the major component of the total costs of patients with breast cancer who referred to the private hospital ($10051.78), accounting for %84.04 of total costs and almost 1.92 times GDP per capita. In contrast, the major component of the total cost of those referring to the public hospital was related to the indirect costs ($22348.5), accounting for %84.95 of total costs and 4.28 times GDP per capita.

The indirect cost of patients who referred to the public hospital was 11.94 times greater than those referring to the private hospital ($22348.5 VS $1870.89), and this difference was statistically significant ($P < 0.05$). The total mean of indirect cost in patients who referred to the public hospital accounted for %84.95 of the total costs, whereas that of patients who referred to the private hospital was %15.69 of the total costs. In contrast, the estimated mean medical direct cost of patients who referred to the private hospital was $9884.56 (34264.12 PPP current international $) (2.73 times greater than those referring to the public hospital), making up %82.9 of total costs, 1.89 times GDP per capita whereas that of patients who referred to the public hospital was lower at $3616.45 (12536.16 PPP current international $), comprising %13.74 of total costs and 69.29 percent of GDP per capita. Patients who referred to the private hospital incurred more direct medical costs (approximately 2.38 times) than those who referred to the public hospital.

The difference between direct and indirect costs in patients referred to private and public hospitals may be due to several reasons. First, premature death was the major component of the total indirect cost of breast cancer patients who referred to the public hospital, whereas that did not occur among breast cancer patients in the private hospital. This may be because private hospitals offered better services which resulted in a higher survival rate and a lower mortality rate. Besides, given that the mean age of patients with breast cancer referring to the public hospital ($49.776.66 \pm 9.89$) was higher as compared with those referring to the private hospital (46.66 ± 10.06), and this difference was statistically significant ($p < 0.05$), the high mortality rate in the public hospital can be because most of the older patients referred to the public hospital. On the other hand, it is likely that patients with advanced-stage cancer referred more to public hospitals for receiving services. Second, None of the patients who referred to the public hospital had supplementary insurance, while most of the patients who referred to the private hospital, in addition to basic health insurance, were covered by supplemental insurance. Supplemental insurance has increased patients access to more advanced and expensive treatment services and has made services

more inelastic by reducing the patients' co-payment or have led to increased induced demand. Also, in Iran, only people who had better socio-economic status and better income level were able to afford supplemental health insurance and subsequently received more expensive and advanced services, which in turn postponed their death. Third, tariffs in the private sector are 2–4 times higher than that of the public sector. Therefore, direct medical costs are higher in patients referring to the private sector. Finally, it can be concluded that those who referred to the private sector had better access to more advanced and expensive treatment services due to their better socio-economic status and supplemental insurance coverage, which caused the mortality rate and indirect costs among these patients to be lower, but due to more treatment services utilization, they incurred higher direct medical costs.

Since the present study was performed at cross-sectional and prevalence-based method, matching was not conducted between patients referring to the public and the private hospitals in terms of age, income level and disease stage and also the effect of confounding variables was not controlled. Since it is not possible to conclude with any certainty, it is necessary to investigate the cause of this difference in costs and mortality rate between patients referring to the public and the private hospitals in future studies using a perspective and controlled design.

Of the direct medical costs, outpatient costs were higher than hospitalization costs in both private and public hospitals. The outpatient cost of patients who referred to the private hospital was 3.4 times greater than those referring to the public hospital ($8062.55 VS 2365.99). The major component of outpatient costs of patients who referred to the private and the public hospitals was related to diagnostic cost at $2427.02 (%30.10 of total outpatients cost) and $425.02 (%18 of total outpatient costs), respectively. Furthermore, the minor component of the outpatient costs of patients who referred to the private hospital and the public hospital was related to visit costs at $462.56 (%5.73 of the total outpatient costs) and $102.26, (%4.32 of the total outpatient costs), respectively. This difference was statistically significant ($P < 0.05$).

The results of our study suggest that more attention should be paid to the management of outpatient costs for breast cancer patients in both private and public hospitals. The study by Allaire et al. in the US, reported that the outpatient costs caused by breast cancer were equivalent to 94% of the total cost of breast cancer (30). In the study of Ekwueme et al., the estimated monthly direct medical costs for breast cancer treatment among younger women enrolled in Medicaid was $5,711 per woman. The estimated monthly cost for outpatient services was $4,058, for inpatient services was $1,003, and for prescription drugs was $539 (31).

Furthermore, the hospitalization costs of patients who referred to the private hospital ($1828.15) were 1.46 times greater than those referring to the public hospital ($1250.45). This difference may, in part, be because of the different tariffs or difference in the type of provided services. The most component of total hospitalization cost of patients who referred to the private hospital was related to surgery cost at $982.28 (%53.73 of the total hospitalization cost), while that of patients who referred to the public hospital was attributable to hoteling cost at $378.40 (%30.26 of the total hospitalization cost). Moreover,

drug cost had the lowest rate in breast cancer patients who referred to the private hospital at $31.70. In contrast, the lowest cost among those referring to the public hospital was related to the diagnostic cost at $104.70. This difference was statistically significant ($P < 0.05$). In the study of Davari et al., in 2013, in Iran, most of the treatment costs were related to drug therapy (29).

In the private hospital, the mean of chemotherapy cost for those who had received chemotherapy estimated at $1451.57 per patient, making up %12.13 of the total costs while in the public hospital was $548.83 per patient, which accounted for %2.38 of the total costs. Likewise, The mean of radiotherapy cost for those who had received radiotherapy in the private hospital and the public hospital was estimated to be $678.95 (%5.67 of the total costs) and $189.00 (%0.82 of the total costs) per patient, respectively. In the study of Omondi Michelle et al., in 2016, patients on chemotherapy alone cost an average of $1364.3; while those treated with surgery cost an average of $1265.6, and those on radiotherapy $1175.1 (32). A study by Elias et al. showed that the average annual cost of cancer drugs was 6.475$ per patient, which the highest amount of drug costs were related to breast cancer (33). The study also showed that the correlation between direct medical costs, outpatient costs, chemotherapy costs and age at diagnosis was statistically significant and negative at $P < 0.05$.

Moreover, the total direct nonmedical cost of patients who referred to the public hospital was 2.03 times greater than those referring to the private hospital ($339.87 VS $166.64), and this difference was not statistically significant ($P > 0.05$). The highest component of the total nonmedical direct cost of patients who referred to the private hospital and the public hospital was associated with commuting and food costs.

In the study of T. A. Dinesh et al., in India, there was a significant difference in the direct cost of care for cancer in private hospitals ($27,425.50459 vs $21,232.61905), whereas the indirect cost of care for cancer was significantly higher in government hospitals ($10,341.66667 vs $6565.137615) (34). A study by Kounichika et al. in Japan, indicated that the mortality costs accounted for 65–70% of the total cost (21), which the results of these studies are in line with our results.

The total cost of missed workdays for patient and patient’s family who referred to the private hospital was 1.7 times greater than those referring to the public hospital, and the difference was not statistically significant ($P > 0.05$). Both in the private and the public hospital, the cost of missed workdays of patient’s family members was greater than patients themselves. These costs (opportunity cost) are imposed on patients' families in real terms but are hidden from policymakers' view.

In our study, basic insurance played an important role in the reimbursement of direct medical costs and reducing the proportion of out-of-pocket expenses in direct medical costs. The majority of breast cancer costs in public hospitals was paid by basic insurance (%90.68), %6.39 of the costs was paid by the patient, and only a small proportion was paid from the targeted subsidy plan by the government (%2.92). To the contrary, in the private hospitals, %35.36 of costs was reimbursement by supplemental insurance, %37.85 of costs was reimbursement by basic insurance, and the remaining %26.77 of costs (6.04 greater than those referring to the public hospitals) was paid by patients. The total out of pocket payments in the

private hospital estimated at $3881.23 (approximately 0.38 of total direct costs and 2.83 times higher than in the public hospital), while in the public hospital was $1367.19 (about 0.34 of total direct costs). Although most of the cancer patients in the private sector were covered by supplemental insurance, they paid higher co-payments. Since tariffs in the private sector are 2–4 times higher than that of the public sector, patients referring to private hospitals paid more out of pocket payments despite supplemental insurance. Therefore, these patients are likely to have better socio-economic status, more financial capacity (purchasing power) and more ability to pay. On the other hand, despite higher costs, these patients may prefer to go to private hospitals because of the shorter waiting time and better service quality.

Limitations

This study had several limitations. First, since some patients refused to answer the questions asked of them, the selection bias (sampling bias and attrition) of respondents in reviewing the costs could not be avoided. Second, the indirect costs consisted of only the missed workdays and premature mortality, which would greatly undervalue the indirect economic burden of illness. The lack of data on permanent leaving the job by patients and caregivers during the recovery period could also underestimate the indirect cost estimates. Third, the cost of breastfeeding was not calculated due to the paucity of data. Fourth, intangible economic costs of breast cancer patients and their families, including the pain, sorrow, were not included because they are difficult to convert into a monetary value (35). Given this was a cross-sectional and prevalence-based study, matching was not conducted between patients referring to the public and the private hospitals in terms of age, income level and disease stage and also the effect of confounding variables were not controlled. An additional limitation is that this study conducted in only two private and public hospitals that can limit the generalization of study findings to all private and public sector.

Policy Implications

Given that the cost of premature death in the private hospital was zero, it is not possible to conclude with certainty whether cancer patients who referred to the public hospital were at the final stage of the disease or benefited from better services or both? If the low mortality rate and low indirect costs in patients referred to the private hospital be attributed to the quantity and quality of services provided to cancer patients referring to the private sector and considering the high share of indirect costs of total costs in patients referred to the public hospital, it is necessary that health policymakers take the necessary measures to improve the quantity and quality of public sector services. Also, despite the insurance coverage, patients suffer a high amount of OOP payment, and a substantial and wide-ranging effort is needed to support breast cancer patients. This suggests that insurance policies need to be revised to increase financial support among cancer patients, especially for those who are currently uninsured. It is recommended that the results of this study to be used in future studies to evaluate the cost-effectiveness of screening interventions, early detection and preventive interventions, and health policymakers take an appropriate policy to reduce the economic burden of this disease.

Conclusion

Breast cancer imposes a substantial economic burden on patients at private and at public hospitals, healthcare system and society. Indirect costs were considerably higher for breast cancer patients and their caregivers referring to the public hospital, especially in terms of premature mortality than those referring to the private hospital, which can show a significant proportion of the total costs. Because indirect costs do not impose on the health system and health insurance organizations, health policymakers do not pay enough attention to these costs. Therefore, these costs must be addressed at the macro level of economic policymaking. Support strategies also should be adopted for cancer patients and their family members at parliament and government level, and unemployment insurance, improved for cancer patients.

Abbreviations

COI: Cost of Illness

GDP: Gross Domestic Product

Declarations

Ethics approval and consent to participate

This study was approved by the Deputy of Research and Technology, the Guilan University of Medical Sciences [grant number; 690320003]. Written consent was obtained from the authorities of the hospital prior to the start of the study. The questionnaire was completed by an in-person interview. Besides, prior to conducting the study, study objectives were explained to the participants, and informed consent was obtained from them. They were informed that the data was kept confidential and anonymous.

Consent for publication

Not Applicable.

Availability of data and materials

No further data will be made available.

Competing interests

The authors have indicated that they have no conflicts of interest regarding the content of this article.

Acknowledgements

The authors would like to thank the staff of the hospitals of Aria, Golsar, and Razi in Rasht who helped in the process of the data collection in this study. Additionally, we would like to thank women with breast

cancer who participated in this study.

Funding

This study was supported by the Deputy of Research and Technology, the Guilan University of Medical Sciences.

Author contributions

'SH', 'AP', 'AA', and 'AES' contributed to the study design. 'SH' and 'HJ' contributed to the development of the economic model, the interpretation of the results and the drafting of the manuscript. 'SH' wrote the manuscript. 'HM' contributed to this article by conducting interviews with patients. All authors have approved the final version of the manuscript to be published and agree to be accountable for all aspects of the work.

References

1. Torre LA, Siegel RL, Ward EM, Jemal A. Global cancer incidence and mortality rates and trends—an update. Cancer Epidemiology and Prevention Biomarkers. 2016;25(1):16-27.
2. WHO IAfRoC. GLOBOCAN. 2018.
3. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. CA: a cancer journal for clinicians. 2015;65(2):87-108.
4. Tao Z, Shi A, Lu C, Song T, Zhang Z, Zhao J. Breast cancer: epidemiology and etiology. Cell biochemistry and biophysics. 2015;72(2):333-8.
5. The International Agency for Research on Cancer (IARC) WHO. Latest global cancer data: Cancer burden rises to 18.1 million new cases and 9.6 million cancer deaths in 2018. 12 September 2018.
6. Panieri E. Breast cancer screening in developing countries. Best practice & research Clinical obstetrics & gynaecology. 2012;26(2):283-90.
7. Cancer IAfRo. GLOBOCAN 2012: estimated cancer incidence, mortality and prevalence worldwide in 2012. 2012.
8. Movahedi M, Haghighat S, Khayamzadeh M, Moradi A, Ghanbari-Motlagh A, Mirzaei H, et al. Survival rate of breast cancer based on geographical variation in Iran, a national study. Iranian Red Crescent Medical Journal. 2012;14(12):798.
9. Akbari A, Razzaghi Z, Homaee F, Khayamzadeh M, Movahedi M, Akbari ME. Parity and breastfeeding are preventive measures against breast cancer in Iranian women. Breast cancer. 2011;18(1):51-5.
10. WHO IAfRoC. Iran, GLOBOCAN 2018. 2018.
11. Forouzanfar MH, Foreman KJ, Delossantos AM, Lozano R, Lopez AD, Murray CJ, et al. Breast and cervical cancer in 187 countries between 1980 and 2010: a systematic analysis. The lancet. 2011;378(9801):1461-84.

12. Otaghvar HA, Hosseini M, Tizmaghz A, Shabestanipour G, Noori H. A review on metastatic breast cancer in Iran. Asian Pacific Journal of Tropical Biomedicine. 2015;5(6):429-33.
13. Valipour AA, Mohammadian M, Ghafari M, Mohammadian-Hafshejani A. Predict the future incidence and mortality of breast cancer in Iran from 2012-2035. Iranian journal of public health. 2017;46(4):579-80.
14. Kim SG, Hahm MI, Choi KS, Seung NY, Shin HR, Park EC. The economic burden of cancer in Korea in 2002. European journal of cancer care. 2008;17(2):136-44.
15. Lamerato L, Havstad S, Gandhi S, Jones D, Nathanson D. Economic burden associated with breast cancer recurrence: findings from a retrospective analysis of health system data. Cancer: Interdisciplinary International Journal of the American Cancer Society. 2006;106(9):1875-82.
16. Yabroff KR, Lund J, Kepka D, Mariotto A. Economic burden of cancer in the United States: estimates, projections, and future research. Cancer Epidemiology and Prevention Biomarkers. 2011;20(10):2006-14.
17. Max W, Sung H-Y, Stark B. The economic burden of breast cancer in California. Breast cancer research and treatment. 2009;116(1):201-7.
18. dos Santos Figueiredo FW, do Carmo Almeida TC, Cardial DT, da Silva Maciel É, Fonseca FLA, Adami F. The role of health policy in the burden of breast cancer in Brazil. BMC women's health. 2017;17(1):121.
19. Mousavi SM, Mohaghegghi MA, Mousavi-Jerrahi A, Nahvijou A, Seddighi Z. Burden of breast cancer in Iran: a study of the Tehran population based cancer registry. Asian Pacific Journal of Cancer Prevention. 2006;7(4):571.
20. Daroudi R, Sari AA, Nahvijou A, Kalaghchi B, Najafi M, Zendehdel K. The economic burden of breast cancer in Iran. Iranian journal of public health. 2015;44(9):1225.
21. Matsumoto K, Haga K, Kitazawa T, Seto K, Fujita S, Hasegawa T. Cost of illness of breast cancer in Japan: trends and future projections. BMC research notes. 2015;8(1):539.
22. Luppa M, Heinrich S, Angermeyer MC, König H-H, Riedel-Heller SG. Cost-of-illness studies of depression: a systematic review. Journal of affective disorders. 2007;98(1-2):29-43.
23. Xu K, Evans DB, Kawabata K, Zeramdini R, Klavus J, Murray CJ. Household catastrophic health expenditure: a multicountry analysis. The lancet. 2003;362(9378):111-7.
24. Vostakolaei FA, Broeders MJ, Rostami N, Van Dijck JA, Feuth T, Kiemeney LA, et al. Age at diagnosis and breast cancer survival in iran. International journal of breast cancer. 2012;2012.
25. Keramatinia A, Mousavi-Jarrahi S-H, Hiteh M, Mosavi-Jarrahi A. Trends in incidence of breast cancer among women under 40 in Asia. Asian Pac J Cancer Prev. 2014;15(3):1387-90.
26. Rafiemanesh H, Salehiniya H, Lotfi Z. Breast Cancer in Iranian Woman: Incidence by Age Group, Morphology and Trends. Asian Pacific journal of cancer prevention: APJCP. 2016;17(3):1393-7.
27. Segel JE. Cost-of-illness studies—a primer. RTI-UNC Center of Excellence in Health Promotion Economics. 2006;1:39.

28. Jo C. Cost-of-illness studies: concepts, scopes, and methods. Clinical and molecular hepatology. 2014;20(4):327.
29. DAVARI M, MOKARIAN F, HOSSEINI M, ASLANI A, NAZARI A, YAZDANPANAH F. DIRECT MEDICAL COSTS OF BREAST CANCER IN IRAN, ANALYZING PATIENTS LEVEL DATA FROM A CANCER SPECIFIC HOSPITAL IN ISFAHAN, IRAN. 2013.
30. Allaire BT, Ekwueme DU, Guy GP, Li C, Tangka FK, Trivers KF, et al. Medical care costs of breast cancer in privately insured women aged 18–44 years. American journal of preventive medicine. 2016;50(2):270-7.
31. Ekwueme DU, Allaire BT, Guy Jr GP, Arnold S, Trogdon JG. Treatment costs of breast cancer among younger women aged 19–44 years enrolled in Medicaid. American journal of preventive medicine. 2016;50(2):278-85.
32. Atieno OM, Opanga S, Martin A, Kurdi A, Godman B. Pilot study assessing the direct medical cost of treating patients with cancer in Kenya; findings and implications for the future. Journal of medical economics. 2018;21(9):878-87.
33. Elias F, Khuri FR, Adib SM, Karam R, Harb H, Awar M, et al. Financial burden of cancer drug treatment in Lebanon. Asian Pacific Journal of Cancer Prevention. 2016;17(7):3173-7.
34. Dinesh T, Nair P, Abhijath V, Jha V, Aarthy K. Economics of cancer care: A community-based cross-sectional study in Kerala, India. South Asian Journal of Cancer. 2020;9(1):7.
35. Kim YA, Oh I-H, Yoon S-J, Kim H-J, Seo H-Y, Kim E-J, et al. The economic burden of breast cancer in Korea from 2007-2010. Cancer research and treatment: official journal of Korean Cancer Association. 2015;47(4):583.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Questionnaire.docx