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Original Article

The Economic Burden of Breast Cancer in Iran

Rajabali DAROUDI [1, 2], Ali AKBARI SARI [2], Azin NAHVIJOU [1], Bita KALAGHCHI [1], Massoomeh NAJAFI [1], *Kazem ZENDEHDEL [1,3]

1. *Cancer Research Center, Cancer Institute of Iran, Tehran University of Medical Sciences, Tehran, Iran*
2. *Dept. of Health Economics and Management, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*
3. *Cancer Research Models Center, Cancer Institute of Iran, Tehran University of Medical Sciences, Tehran, Iran*

***Corresponding Author:** Email: kzendeh@tums.ac.ir

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Abstract

Background: Although breast cancer imposes a considerable economic burden on high-income countries, there is limited knowledge about its economic burden in low- and middle-income countries (LMCs), including Iran. In this study, we estimated the economic burden of breast cancer in Iran in 2010.

Methods: We used the prevalence-based approach and estimated the direct and indirect costs of all breast cancer cases in 2010. We used several data sources, including national cancer registry reports, hospital records, occupational data, and interviews with experts.

Result: The economic burden of breast cancer was US$947,374,468. Most of the cost (77%) pertained to the productivity lost due to breast cancer deaths and the direct medical cost accounted for 18.56% of the estimated total cost. Out of the US$175,860,607 as the direct medical cost, the chemotherapy cost constituted the main part ($76,755,740), of which prescriptions of trastuzumab accounted for 41% ($31,529,280).

Conclusion: The economic burden of breast cancer in Iran is substantial and is expected to increase significantly due to the increasing incidence rate. Strategies for the prevention and early detection of breast cancer should be prioritized in the national cancer control program.

Keywords: Breast cancer, Economic burden, Iran

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Introduction

Breast cancer is the most common cancer among women in both developed and developing countries. The incidence rate of this cancer is increasing, especially in developing countries (1, 2).

Breast cancer imposes a considerable economic burden on societies (3–5). For instance, the total cost of breast cancer was more than three times the total cost of prostate cancer, the most common cancer in men (6). In addition, the average lifetime cost (ten years) for the breast cancer patient was higher than that for cervical, liver, lung and colorectal cancer in Taiwan (7).

Policy makers and health planners are interested in understanding the economic costs of illnesses to assess the allocation of health resources to disease categories and to evaluate the potential costs and benefits of public health interventions (3). Cost of illness (COI) studies show the importance of a particular disease, provide a baseline for assessing new interventions and determine the medical research priorities (8). Regional estimation of the economic cost of breast cancer is essential to assess alternative strategies and plan for preventing and controlling this disease in developing countries. Nevertheless, currently, an estimation of the economic burden of breast cancer in these countries is lacking (9).

In order to calculate the economic burden of a disease, the direct costs, resulting from the use of the resources for medical care, and the indirect

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costs, resulting from the loss of economic resources and opportunities associated with disease and treatment, are calculated(10). Direct costs are usually divided into two groups: direct medical costs and direct non-medical costs. Direct medical costs include costs for hospitalization, surgery, outpatient visits, radiation therapy and chemotherapy/immunotherapy. The direct non-medical costs borne by patients and their families include the costs of transportation to health-care centers, housekeeping services, alterations to property and costs for complementary and alternative medicine (5, 10, 11).

Similar to other developing countries, the incidence rate of breast cancer has increased in Iran in recent years and it is the most common cancer in women (12), but there is limited knowledge of the cost of breast cancer. In Iran, the average direct medical cost per breast cancer patient per month for stages I to IV was US$222.17, 224.61, 316.51 and 828.52, respectively (13). However, the economic burden (direct and indirect cost) of breast cancer has not been estimated in Iran.

This study provides an estimate of the economic burden of breast cancer in Iranian women in 2010.

Materials and Methods

'Prevalence-based' and 'incidence-based' methods are the two main approaches to the estimation of the economic burden of cancer (5, 14). In this study, we used the prevalence-based approach to estimate the economic burden imposed by breast cancer in the year 2010.

Estimation of incidence and prevalence

We used national cancer registry data to estimate the breast cancer incidence and prevalence in Iran in 2010. The Ministry of Health of Iran launched its cancer registry program in 2003 and has published annual reports since then. We used data from the last report of the cancer registry, which provides cancer statistics for the year 2009, to estimate the incidence and prevalence of breast cancer in 2010. The details of our estimation are described elsewhere (15). In brief, after correcting for the underestimation of the incidence and mortality rate of breast cancer, we estimated the prevalence for 2010 using the annual percentage change (APC) and survival rates. Data on the survival rate for breast cancer were obtained from a systematic review of the published reports from different parts of the country (15).

Direct medical costs

To estimate the direct medical costs, we categorized the whole disease process into three phases: initial care, continuous care and terminal care (7). The initial care costs included the cost of diagnosis, surgery, chemotherapy and radiotherapy. The continuing care costs included the cost of hormonal therapy, outpatient visits and routine laboratory and radiology services, such as mammography. The terminal care cost was the cost of the last year of life.

To estimate the total direct medical costs, we estimated the average cost of each treatment in each phase and the number of patients who received the treatment in the country in 2010. The average cost for each treatment in each phase was then multiplied by the number of patients treated in the corresponding phase in 2010.

To estimate the average cost of inpatient care, including surgery, chemotherapy and radiotherapy, we reviewed the medical records of patients who were treated at the Cancer Institute of Iran in 2010, the largest referral cancer hospital in the country, which admits patients from the entire country. Because the tariff of medical services is identical across Iran, the results from this center can be generalized to the country. The costs of chemotherapy drugs were not recorded in patients' records, so we calculated these costs according to the type of chemotherapy regimen. We extracted the patients' chemotherapy regimen from the records and calculated the frequency of each regimen. The average cost of each regimen was computed according to the drugs' price and the prescription dose.

Since trastuzumab is an expensive drug in the treatment of breast cancer and places a major economic burden on almost all countries, we paid particular attention to the cost of this drug in this project. To estimate the cost of trastuzumab for

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breast cancer patients, we used the trastuzumab guideline published by the Ministry of Health of the I.R. of Iran. According to this guideline, trastuzumab is recommended for early-stage breast cancer patients who are HER2 positive. The initial dose is 8 mg/kg and the subsequent doses are 6 mg/kg every 3 weeks for 1 year (a 52-week regimen) or 9-week treatment with an initial dose of 4 mg/kg and subsequent doses of 2 mg/kg with an appropriate chemotherapy regimen. For metastatic breast cancer patients, it is recommended to combine trastuzumab with an appropriate chemotherapy regimen until the disease progression or occurrence of other indications of discontinuation (16). However, the Ministry of Health of Iran reimburses the trastuzumab cost only based on the 9-week regimen. Therefore, we estimated the total cost of trastuzumab according to the 9-week regimen. However, we performed a sensitivity analysis to estimate trastuzumab's cost based on the 52-week regimen.

We used expert opinion, the medical tariff and clinical practice guidelines (CPGs) in Iran to estimate the average cost of outpatient care, including diagnostic tests, follow-up visits, laboratory and radiology services and hormonal therapies. Since the tariff of medical services in the private sector differs from that in the public sector in Iran, we estimated the patients who are treated in the private sector and used the private tariff for them.

The cost of terminal care is about two to three times more than that of initial care (7, 14, 17, 18). Because we could not estimate the average terminal cost of breast cancer in Iran, we assumed that the average terminal care cost was twice as much as the average initial care cost.

The number of patients who received each of the treatments in 2010 was estimated using the current clinical practice guidelines and according to the epidemiological and pathological patient characteristics, such as the stage of the disease, patient age, menopausal status, tumor size, involvement of lymph nodes and hormone receptor and HER2/neu status. These data were extracted from previous studies (12) and the Cancer Institute of Iran.

Direct non-medical costs

Considering the lack of studies and data about the non-medical costs of cancer patients, including breast cancer patients, we estimated the transportation costs for the patients in the initial and continuing phases. Other direct non-medical costs were not included in our analyses. The cost of transportation to health-care centers was estimated based on a survey of 100 breast cancer patients. We used the clinical practice guidelines in Iran and interviewed experts to estimate the average number of journeys made by each patient.

Indirect cost

We used the human capital approach to estimate the indirect costs, assuming that the monetary value of productivity lost due to morbidity or premature death caused by an illness equals the current wage (10). As breast cancer patients are usually able to perform their daily activities, the morbidity costs were not calculated for them (6).

Patient time costs

We estimated these costs for five-year prevalence cases. Since we were unable to estimate the exact time lost for the patients, we used medical records and the clinical practice guidelines in Iran and obtained expert opinion to estimate the average number of days that each patient lost due to receiving care in the initial and continuing phases. Then we multiplied the average number of lost days by the average daily wage. We used different daily wages for employed and unemployed patients. For non-employed patients, we used the minimum daily wage approved by the Iranian Ministry of Cooperation, Labor and Social Welfare in 2010. The data on daily wages were extracted from the Ministry's websites (19). The data on the employment rate of breast cancer patients was extracted from previous studies in Iran (20, 21). Usually a family member accompanies the patient during visits; thus, we estimated the time costs for a family member as the patient, assuming that the family members are unemployed.

Mortality cost

The estimation of the mortality costs requires three parameters, including the number of deaths,

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the years of potential life lost and the value of the productivity lost (6).We used data from a previous study to estimate the number of deaths in different 5-year age groups due to breast cancer in Iran in 2010 (22). To estimate the potential years of life lost, defined as the remaining life expectancy at the age of death, we used the World Bank 2010 report on Iranian women's life expectancy (23). We used the employment rate in breast cancer patients and the annual average earnings to estimate the value of the productivity lost. For unemployed women and those who are older than 60 years, we used the minimum daily wage to estimate the annual average earnings and assumed that the current pattern of the employment rate remains constant over time and that there is a 10% increase in the annual wage according to the inflation rate in previous years (24). A 5% discount rate was considered to convert the stream of lifetime earnings into a present value. All the costs were converted to US dollars (US $) using the average annual 2010 exchange rate (US$1=Rial 12,290) (25).

Results

We estimated that the number of new breast cancer cases was about 10,000 and the 5-year prevalence was 39,316 in 2010.

We present the components of the direct medical costs of breast cancer in Table 1. Since diagnostic and surgical procedures were performed for almost all patients, the expenditure on these procedures was calculated for all the incidence cases. The numbers of cases receiving radiotherapy and chemotherapy in 2010 were 8120 and 9500. Based on studies conducted in Iran, 2400 cases were eligible to receive trastuzumab (16).

Table 1: The direct medical cost of breast cancer in the I.R. of Iran, 2010(estimated in US dollars)

Procedures	Number of patients	Mean cost, $US	Total cost, $US	Total cost (percent)
Diagnosis/staging	10000	158.91	1,589,100	0.90
Surgery	10000	1287.85	12,878,500	7.32
Radiotherapy	8120	923.48	7,498,658	4.26
Chemotherapy	9500	4760.68	45,226,460	25.72
Trastuzumab	2400	13137.20	31,529,280	17.93
Hormone Therapy & Fallow-up	34756	632.64	21,988,036	12.50
Terminal care	3867	14261.85	55,150,574	31.36
Total	-	-	175,860,607	100.00

The greatest part of the direct medical cost (43.65%) was the cost of chemotherapy ($76,755,740). The most commonly used chemotherapy regimens were 4AC4T, TAC and CEF, with 46%, 19% and 16%, respectively. An amount of $31,529,280 of the chemotherapy cost (41.07%) was related to trastuzumab. The result of the sensitivity analysis for the trastuzumab cost showed that the mean cost for the 52-week regimen was $60,249 individually and $144,596,563for all the patients.

The terminal care costs ($55,150,574) were the second-highest medical costs (31.36%) of the total medical cost (Table1).

Patients spent $21,606,293 on transportation during their treatment. The average transportation for patients in the initial care phase consisted of about 50 trips, and it was about 7 trips for patients in the second year onwards. The mean cost per journey was estimated to be about $29.

The mean time of absence from work was 23.63 days. Since the mean daily wage for employed and

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unemployed women was $22.35 and $9.67, respectively, we estimated that the patient's time cost was about $20,441,309 in 2010 (Table 2).
In Table 3, we provide the age-specific mortality rate and the cost due to mortality of breast cancer. The mortality of breast cancer in 2010 in Iran was 3898 cases. Most patients who died were in the age groups of 40–49 and 50–59 years and the total mortality cost was $729,467,259.
Overall, the economic burden of breast cancer in 2010 was $947,375,468. The main components of the cost were mortality (77%) and the direct medical cost (18.56%) (Fig.1).

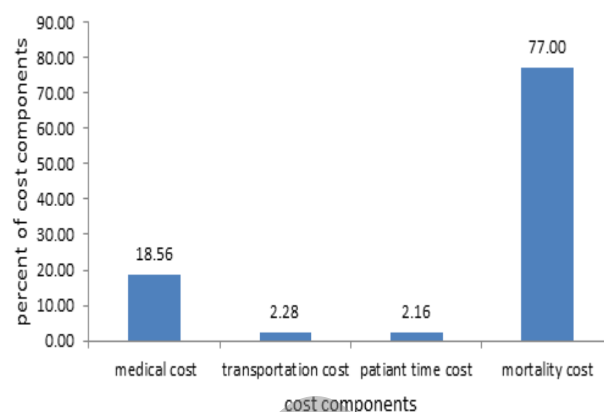

Fig. 1: The economic burden of breast cancer in Iran, 2010

Table 2: The patient time cost for breast cancer in the I.R. of Iran, 2010

Status	Number of patients	Mean of missed work days	Total of missed work days	Mean Cost per days, $US	Total cost, $US
Employed patients	8256	23.63	195,089	22.35	4,360,245
Unemployed Patients	31060	23.63	733,948	9.67	7,097,275
Accompanies	39316	23.63	929,037	9.67	8,983,789
Total					20,441,309

Table 3: The mortality cost for breast cancer in the I.R. of Iran, 2010

Age Group (yr)	Number of death	Mean mortality cost, $US	Total Cost, $US
≤ 20	4	1,038,808	4,155,232
20-29	84	727,680	61,125,120
30-39	487	464,534	226,228,058
40-49	994	270,247	268,625,518
50-59	960	137,414	131,917,440
60-69	682	50,876	34,697,432
70 ≤	687	3,957	2,718,459
Total	3898		729,467,259

Discussion

To the best of our knowledge, this is the first economic burden study of breast cancer in Iran. We showed that the economic burden of breast cancer in Iran was $947,375,468 in 2010 and most of this cost was attributed to productivity losses.

The chemotherapy cost accounted for the main part of the direct medical costs. This point was confirmed in another retrospective study (13). Another study in Vietnam, a middle-income country, showed that the chemotherapy cost was the dominant cost in the medical costs of breast cancer (26). However, in the USA and Canada, inpatient

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and surgical costs were the largest part of the breast cancer direct medical costs (6, 27). The medical costs of breast cancer in developing countries are lower than those in developed countries are (26). The cost of health-care services in Iran is less than in some other Middle Eastern countries and developed countries (28). In Iran, the tariff of outpatient and inpatient services in the public sector is much lower than that in the private sector. For example, the hospitalization tariff in private hospitals is at least three times higher than in public hospitals (29). The cost of surgery for breast cancer in Iran in the private sector is 4.7-fold higher than in the public sector, while the cost of medication is equal in the public and private sectors (13). The public services tariff in Iran is unreal and is much lower than the cost price of services (30), indicating that the public service tariff and the cost of cancer treatment will increase in the near future.

The different result in this study from other studies from the USA and Canada might be due to the low price of services in Iran and, on the other hand, the high prices of new chemotherapy drugs, which are based on the international price. In 2006, the cost of treatment with trastuzumab in the USA was $70,000(6); this cost in Iran in 2010 was $13,137 for the 9-week regimen and $60,249 for the 52-week regimen. We found that 17.93% of the total medical cost of breast cancer was attributed to the 9-week trastuzumab treatment. Using the 52-week regimen, which is prescribed in western countries, would increase the share of this treatment to 50% of the total medical cost.

Our result showed that terminal care costs were the second-highest direct medical cost after the chemotherapy cost. Because of the lack of data on terminal care costs, we assumed that this part of the cost was twice as much as the initial care cost. In the USA, the cost of breast cancer patients in the final year of life was three times more than the initial care cost (up to 12 months after diagnosis) (17). In Taiwan, the cost of the final year was 5.7 times the cost of the first 6 months after diagnosis (7). Warren et al. estimated the monthly mean cost paid by Medicare for elderly women with early-stage breast cancer. They showed that the payment in the terminal phase (for patients who died from cancer) was about 1.7-fold higher than the cost in the first 6 months after diagnosis (18).

Patient time costs are an important part of the burden of illness from the society, employer and patient perspective, and similarly to other direct and indirect costs, they should be included in the evaluation of the economic burden of disease (31). The patient time lost was calculated as 141.7 hours in the initial and continuing care phases. Yabroff et al. used the hourly wage rate in the USA to estimate the patient time costs associated with cancer care. In their study, the patient time lost in the initial and last-year-of-life phases of care for breast cancer patients was 108.8 hours (31, 32). They indicated that the patient time was underestimated because they did not calculate some patient time items. In Canada, most employed women had an average 32.3 weeks' absence from work due to the process of their treatment in the first year after diagnosis and lost 27% of their projected usual annual wages (33). Besides, in Iran, the time for receiving services is longer than in other countries. This might be because the services in the private sector are more expensive than in the public sector so the waiting list in the public sector is relatively long (34).

Because the average age of breast cancer diagnosis is 49 years in Iran and the majority of breast cancer patients are diagnosed at a young age (12, 35), a large part (77%) of the economic burden of breast cancer in Iran is due to the value of productivity lost. In USA, the largest productivity losses from cancer in women under the age of 55 were related to breast cancer. This rate in women aged above 55 years belonged to lung cancer first and then to breast cancer (36).

Breast cancer is the most common cause of cancer mortality among women in the world (2). In recent years, due to screening and early detection programs, the mortality rate of breast cancer in developed countries, such as European countries and North America, has decreased, while it has increased in developing countries because of the increased incidence rate (1). Therefore, the cost of productivity losses of breast cancer in developing countries will increase.

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Breast cancer is a costly disease and imposes a large economic burden on Iran and many other low- and middle-income countries (LMCs). It seems that, in accordance with the growing trend of postmenopausal breast cancer incidence in LMCs and the importing of new and expensive medication, such as Trastuzumab, the costs of breast cancer, especially the direct cost, will increase in the future. To prevent this, policy makers should conduct some interventions to reduce the incidence and mortality of breast cancer. Since many studies have shown that, the costs of breast cancer in the early stages are lower than those in the advanced stages are (7, 13, 14), early detection can reduce the mortality and thus the cost of breast cancer. According to the suggestions of WHO and the Breast Health Global Initiative (BHGI), low- and middle-income countries should prioritize the efforts to downstage breast cancer through population awareness and improved equitable access to care (37). International experts evaluated the national cancer control status in Iran in 2011 and recommended developing a national strategy for the early detection of cancer and developing evidence-based early detection guidelines for those cancers that are amenable to early detection through screening, including breast cancer (37). We recommend a comprehensive plan including public awareness program, training of the healthcare providers and establishment of prevention and early detection clinics in the country to decrease the burden of breast cancer through prevention and down staging of the detected cancers. Although WHO recommends mammographic screening for women after the age of 50 years (38), it is important to estimate cost-effectiveness of the screening program before starting a national program in each country. The result of this study can provide data for such studies and appropriate estimation of the disease burden with and without screening.

The strength of this study was its use of several databases to gather the required data. Considering that LMCs usually lack high-quality data at the individual or national level, our methods can be used as an alternative for the estimation of costs in many LMCs.

However, this study had some limitations. First, our result may be underestimated; as we mentioned, the treatment tariff in Iran may not reflect the real cost imposed on the health-care system and the tariff will increase to meet the real cost in the near future. Second, we used the human capital approach to calculate the indirect cost. Although this method is still widely used, the value of life for some groups, like children, women and retired people, are underestimated (10). Third, because of the inaccessibility of appropriate data, we could not estimate some kinds of expenditure, like the cost of local recurrence of disease and the cost of patients and their family (the cost of care at home, informal and complementary therapies and intangible costs like pain and depression); furthermore, due to the lack of valid data, we had to rely on expert opinion. This study was conducted based on the data of patients hospitalized in 2010. However, we have used prevalence approach for this analysis and prevalence of breast cancer will not change considerably in a short time period so the results can be generalized to the subsequent years.

Conclusion

The economic burden of breast cancer in Iran is substantial and is expected to increase significantly due to the increasing incidence rate. Strategies for the prevention and early detection of breast cancer should be prioritized in the national cancer control program.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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