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Economic Evaluation

Economic Burden of Gynecological Cancers in Iran

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ABSTRACT

Background: Gynecological cancers (GCs) are an important cause of morbidity and mortality among women worldwide. The incidence of cancer is increasing in Iran, and according to statistics, it has become the most important cause of mortality. This study aimed to assess the economic burden of GCs, including cervical, ovarian, and endometrial cancers, in Iran in 2014.

Methods: We used a prevalence-based cost of illness methodology to investigate the annual healthcare cost of GCs and to determine the productivity loss. The productivity loss was estimated, using the human capital approach. We obtained our data from a referral hospital for the year 2014; we also used expert opinion and occupational and statistical data. To estimate direct medical cost, we used bottom-up approach and we estimated the average cost of each procedure, multiplied by the number of patients receiving the procedure.

Results: The total cost of GCs in Iran was estimated at $51 million in 2014. The direct costs were $32 million, and indirect costs were $19 million of the total annual cost. The total cost of ovarian cancer was the highest among 3 cancers.

Conclusions: Knowing that the cost of GCs has a significant impact on the burden of disease and imposes an economic burden on the country could force policy makers to allocate their resource in the prevention programs and new approach in patient's management. This could lead to diagnose more GCs in the early stages, reduce mortality, and increase the quality of life.

Keywords: cervical cancer, economic burden, endometrial cancer, gynecological cancers, ovarian cancer.

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Introduction

Cancer is a leading cause of mortality worldwide. According to the Global Cancer Observatory (GLOBOCAN) 2018, most people affected by cancer died in developing countries.[1] Gynecological cancers (GCs) are an important cause of morbidity and mortality among women worldwide. The most common cancers of the female reproductive system include cervical, endometrial, and ovarian cancers, whereas vulvar, vaginal, and fallopian tube cancers and choriocarcinomas are rare.[2] According to GLOBOCAN 2018, more than 1 million women (approximately 1 250 000) are affected by cervical, endometrial, and ovarian cancers worldwide.[1] Approximately 1659 patients (7% of all cancer-related deaths) die of GCs in Iran, and nearly 4060 women receive a diagnosis of these cancers each year. The incidence of cancer is increasing in Iran, and according to statistics, it has become the most important cause of mortality.[3,4]

The total economic burden of premature death and disability from cancer was US$1.16 trillion in 2010 worldwide, which represents 2% of the world's gross domestic product.[5] In addition, the total economic cost of cancer in the European Union (EU) exceeded €126 billion. The financial burden of cancer on the EU healthcare systems was estimated at €51 billion, accounting for 4% of the total EU healthcare expenditure.[6] In 2002 in Korea, the estimated total cost of cancer was $9.4 billion, which was 1.72% of gross domestic product.[7]

It is important for policy makers and healthcare planners to understand the cost of illness for assessing the allocation of health resources to disease categories and evaluating the potential costs and benefits of public health interventions. The cost of illness studies can indicate the importance of particular diseases, provide a framework for assessing new interventions, and determine medical research priorities.[8] Nevertheless, limited estimation of the economic burden of GCs is currently available.[9–17]

Cancer economic studies showed that economic characteristics such as patient time cost or travel burden of a disease are dependent on the pattern of medical care, type of cancer, phase of care, and stage of disease at diagnosis. These factors could affect the result of economic studies.[18]

Therefore, this study aimed to estimate the economic burden of GCs per stage of disease in Iran in 2014.

Methods

We used a prevalence-based approach to estimate the economic burden of GCs in 2014. Our perspective was societal. We

used the incidence rate and 5-year prevalence rate of these 3 cancers from GLOBOCAN 2012. The incidence number and 5-year prevalence number of patients for each cancer were as follows: cervical cancer (947 and 686), ovarian cancer (1619 and 1113), and endometrial cancer (795 and 679), respectively.[19]

Data Sources

The main data sources were data from health information system of a referral hospital in which more than 10 000 patients with cancer per year referred for management in all over the country.[20] We included all patients admitted to the hospital for the year 2014. The subjects of data derived from health information system were patient's name and family name, social security number, medical record code, age, type of treatment (including type of surgery, chemotherapy regimen, and radiotherapy), stage of disease, and cost of treatment. The second data source was expert opinion. We interviewed experts to standardized international guidelines for Iran.

Epidemiologic and economic data were obtained from GLOBOCAN 2012 and World Bank.[21,22] Other data such as daily wages or medical tariffs were abstracted from the annual report of the Ministry of Cooperatives, Labour, and Social Welfare and Ministry of Health and Medical Education.[23]

Ethical Issues

This work was approved by Ethical Committee of Tehran University of Medical Sciences. We observed all ethical consideration. To use anonymous data, each patient received a code before data entry.

Direct Medical Costs

We estimated direct medical costs (DMCs) by designing the management process of each cancer, on the basis of international guidelines and expert opinion to find the most practical management process for patients. We divided the procedures into treatment and follow-up procedures. On the basis of the process of each procedure, the treatment costs included the cost of visits, diagnosis, surgery, chemotherapy, and radiation therapy, and the follow-up costs included the cost of visits, imaging modalities, and laboratory examinations for each cancer. We used bottom-up approach to estimates patient's expenditures from patient's medical report.

We estimated the average cost of each procedure, multiplied by the number of patients receiving the procedure. Because the main procedures for GCs treatment include surgery, chemotherapy, and radiotherapy and patients undergoing these procedures need to be hospitalized, we used the patient's billing form in the medical records and we included all patients referred to this hospital in 2014. Next, we calculated the average cost of hospitalization for each cancer. It should be noted that the cost of chemotherapy drugs was not included in the hospitalization costs of chemotherapy.

To estimate the cost of chemotherapy, we used patient's medical records to identify commonly used chemotherapy regimens and calculate the number of courses. We also used the records of medical equipment department to identify the chemotherapy drug's list and to determine the cost of each drug.[24] Because the tariff for medical services in the private sector differs from that of the public sector in Iran, we estimated the number of patients, who were treated in the private sector and used the private tariff for them. To estimate the number of patients who received services from public and private sectors, we used the report of the Ministry of Health and Medical Education about the services in public and private sectors. The percentages of patient diagnosed in public and private sector were 70% and 30%, respectively, and the percentages of patient treated in public and private hospitals were 80% and 20%, respectively. We calculated DMC based on this classification.[25,26]

Direct Nonmedical Costs

The direct nonmedical costs included the additional costs of medical care, such as transportation, accommodation, and meals for the patients. Nevertheless, owing to a lack of data, we only calculated the transportation costs. The transportation costs were estimated, based on the average number of patient's transfers by using the clinical practice guidelines in Iran and expert opinion. Although the transportation cost was different because of distance and type of vehicle, we used the mean transportation cost based on public transportation. The mean transportation cost was $75 for the whole country for each patient, and the average number of transportations based on patient's journey was 10 trips. This cost was not included as an out-of-pocket cost.

Indirect Costs

To calculate indirect costs (ICs), we used a human capital method. We calculated the cost of productivity loss owing to disability, absence from work, and premature death. To estimate the cost of productivity loss, we calculated the number of absence days from work, multiplied by the average daily wage. Because we studied about the burden of GCs, we divided women population into employed and homemakers. We used different daily wages approved by the Ministry of Cooperatives, Labour, and Social Welfare of Iran in 2014 for these 2 types of women's work. Since most women are homemakers and on the basis of their work at home, which accounts to some productivity, we assumed that their salary is equal to the minimum daily wage.[23] In addition, patients usually have companions during hospitalization. Accordingly, the time costs for the patients' companions were estimated, assuming that they were unemployed (the minimum wage was considered).

To estimate the cost of productivity loss owing to premature death, we determined and categorized the number of deaths on the basis of age groups, using the data available in the GLOBOCAN.[4] To estimate life expectancy at the age of death (potential years of life lost), we measured the life expectancy of Iranian women in 2014 in different age groups, according to the World Bank report.[22] According to Haacker et al,[27] we considered a 5% discount rate to convert the stream of lifetime earnings into the present value. All costs were reported in US dollars, using the average annual exchange rate in 2014 (US$1 = 27 502 rials).

Results

The incidence rate of GCs was approximately 3500, and the 5-year prevalence rate was 10 000 patients in 2014. The results for each cancer based on the adjusted cost per the percentage of cancer stage were estimated.

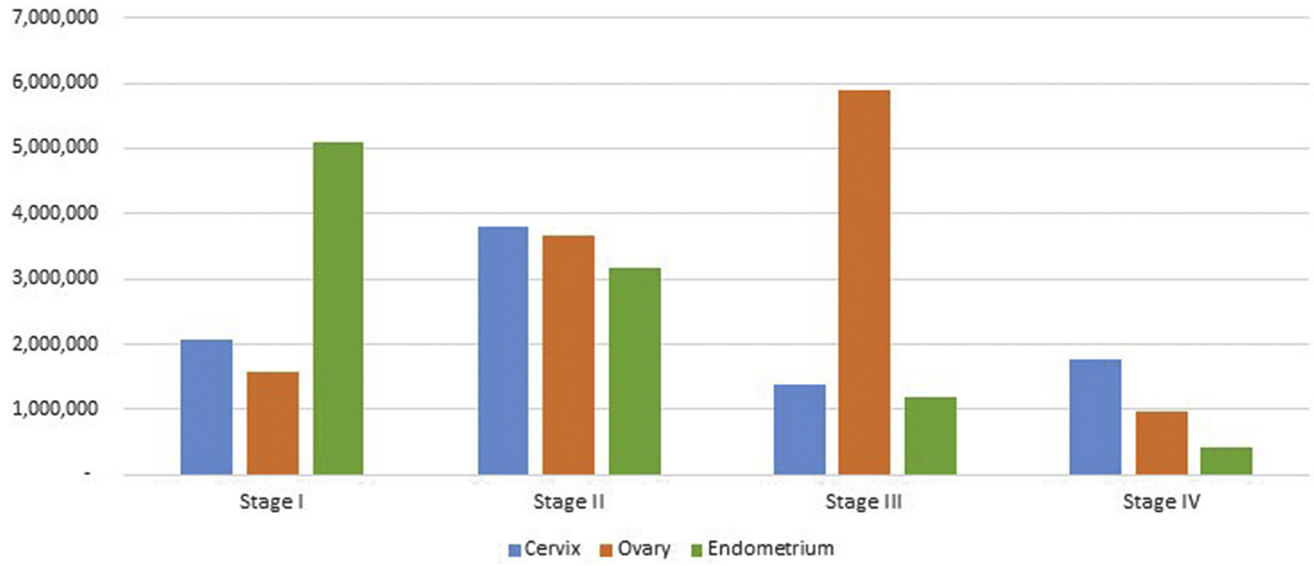
Cervical Cancer

According to the number of patients referred to the hospital, the percentage of patients with cervical cancer stage I, II, III, and IV was 31.7%, 38.9%, 11.9%, and 17.5%, respectively. The corresponding treatment costs were $2 079 279, $3 789 866, $1 388 418, and $1 765 26, respectively.

Ovarian Cancer

The stage distribution of ovarian cancer was as follows: stage I (26.35%), stage II (25.37%), stage III (41.26%), and stage IV (7%). The

Figure 1. Comparison of the stage distribution and the cost of treatment for each cancer in Iran in 2014.



cost of treatment of ovarian cancer per stage was $1 573 735, $3 671 288, $5 888 670, and $965 982, respectively.

Endometrial Cancer

We determined the percentage of patients receiving a diagnosis of endometrial cancer per stage as follows: stage I (57.77%), stage II (29.13%), stage III (11.62%), and stage IV (1.47%). The cost of treatment of each stage was $5 107 331, $3 170 555, $1 191 456, and $430 421, respectively. Figure 1 compares the stage distribution and cost of treatment for each cancer. The total transportation cost for all GCs was estimated at $1 752 599. The components of DMC for GCs are presented in Table 1.

Table 1. The direct costs of GCs in Iran in 2014.

Procedure	Cost in public sector	Percentage from total cost	Cost in private sector	Percentage from total cost
Cervical cancer				
Diagnostic procedure	132 069	2.77	304 582	1.32
Surgery	1 402 058	29.45	7 010 289	30.53
Chemoradiation	3 048 787	64.05	15 243 933	66.39
Follow-up	176 809	3.71	401 841	1.75
Total cost	4 759 724	100	22 960 645	100
Ovarian cancer				
Diagnostic procedure	264 526	4.09	609 752	2.04
Surgery	5 132 615	79.53	25 663 074	85.86
Chemotherapy	464 574	7.19	2 322 869	7.77
Follow-up	591 806	9.17	1 291 257	4.32
Total cost	6 453 521	100	29 886 952	100
Endometrial cancer				
Diagnostic procedure	218 208	4.18	502 539	2.06
Surgery	1 708 577	32.79	8 542 885	35.12
Radiotherapy	2 551 912	48.97	12 759 559	52.46
Chemotherapy	312 180	5.99	1 560 901	6.41
Follow-up	419 293	8.04	952 938	3.91
Total cost	5 210 169	100	24 318 822	100

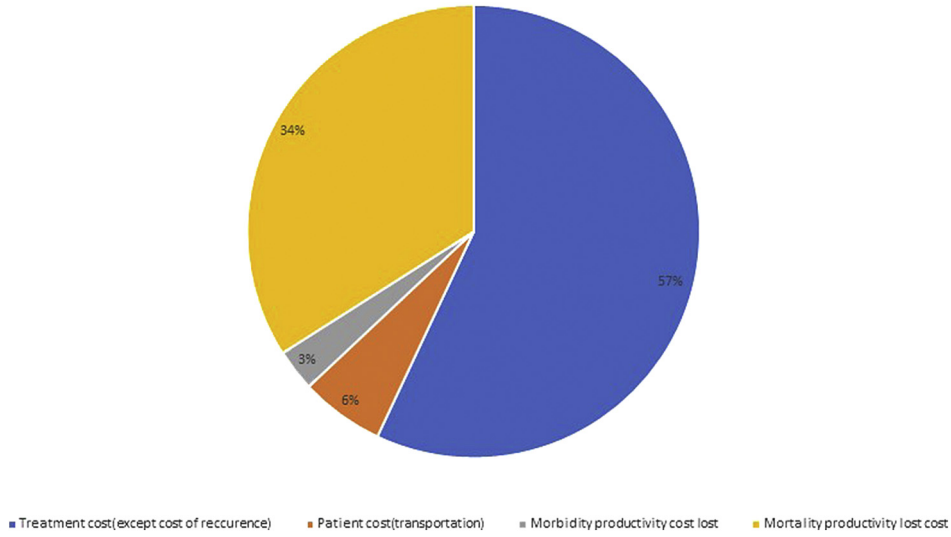
GCs indicates gynecological cancers.

Table 2. The economic burden of GCs in Iran in 2014.

Procedure cost	Total cost ($)	Percentage from total cost (%)	Burden of GCs based on total cost (%)
Cervical cancer			
Treatment cost (except cost of recurrence)	8 357 074	46.94	
Patient cost (transportation)	666 861	3.74	
Morbidity productivity lost cost	348 514	1.95	
Mortality productivity lost cost	8 429 679	47.35	
Total	17 802 128	100	35
Ovarian cancer			
Treatment cost (except cost of recurrence)	11 662 545	54.59	
Patient cost (transportation)	1 289 361	6.03	
Morbidity productivity lost cost	673 844	3.15	
Mortality productivity lost cost	7 737 681	36.21	
Total	21 363 431	100	42
Endometrial cancer			
Treatment cost (except cost of recurrence)	9 440 889	78.74	
Patient cost (transportation)	996 291	8.31	
Morbidity productivity lost cost	520 681	4.34	
Mortality productivity lost cost	1 030 616	8.59	
Total	11 988 476	100	23
GCs			
Treatment cost (except cost of recurrence)	29 460 509	57.59	
Patient cost (transportation)	2 952 513	5.77	
Morbidity productivity lost cost	1 543 039	3.01	
Mortality productivity lost cost	17 197 975	33.61	
Total	51 154 035	100	100

GC indicates gynecological cancer.

Figure 2. The economic burden of GCs in Iran in 2014.



GC indicates gynecological cancer.

We estimated the total IC of disability and absence from work to be $1 543 039 in 2014. In addition, the total economic burden of GCs was $51 154 035 in Iran in 2014.

The main cost components were treatment cost (57.59%) and cost of productivity loss owing to mortality (33.61%), as shown in Table 2 and Figure 2.

Discussion

This study is the first economic analysis of GCs in Iran. Ovarian cancer was found to be the costliest GCs cancer. Management of cancer was evaluated in terms of diagnosis and treatment. The most expensive parts of treatment were chemoradiation for cervical cancer with an estimated cost of $5 487 816, surgery for ovarian cancer with an estimated cost of $9 238 707, and radiation therapy for endometrial cancer with an estimated cost of $4 593 441. We found that the treatment costs of ovarian and endometrial cancers had the greatest economic impacts ($11 662 545 and $9 440 889, respectively). In addition, the cost of productivity loss owing to endometrial cancer mortality had the greatest economic impact ($8 429 679). The overall burden of GCs was estimated at $51 154 035.

The cost of GCs is of great importance in the female population, which constitutes a large proportion of the total population. In this regard, Max et al[15] reported that approximately $200 million were spent on cervical, ovarian, and endometrial cancers in the United States. The costs of ovarian, cervical, and uterine cancers were estimated at $292 million, $206 million, and $126 million, respectively, which is similar to our results. Moreover, the DMC of ovarian, endometrial, and cervical cancers was $12 951 906, $10 437 180, and $9 023 935, respectively; the shorter duration of treatment is the cause of lower DMC in cervical cancer.

We used bottom-up approach to estimate DMC. This method is suggested for hospitalized patient.[28] Tan et al[29] compared bottom-up approach with top-down approach. They concluded that using bottom-up approach to estimate DMC for patients with long time stay in the hospital is more beneficial than using top-down approach.

Using patient's medical report helped us to have access to patient's information such as stage of disease. This may lead to reduce information bias. Yue et al[30] conducted a study about the economic burden and treatment pattern of GCs based on a panel survey in which patients reported by themselves. They mentioned that some of their information such as survival and stage of disease were missed or had errors because of the use this method.

Cervical cancer stage II was more costly than other stages because of the large number of patients in stage II and the high cost of chemoradiation; these results are similar to the study by van Ballegooijen et al.[16] In addition, ovarian cancer stage III was more costly than other stages because of the large number of patients in this stage and the high cost of chemotherapy. Kim et al[13] studied the treatment pattern of ovarian cancer in central and Eastern Europe and found that the main cost of ovarian cancer was related to chemotherapy because of multiple lines of treatment. Moreover, an economic burden study was conducted in Spain to estimate the burden of ovarian cancer per stage. The results of this study were consistent with our study, because they found that more than 80% of the cost of ovarian cancer was related to stage III and IV and 71.2% of the cost was DMC owing to chemotherapy.[17]

Patients with endometrial cancer stage I spent more money than patients in other stages of the disease. The high cost of treatment is attributed to the number of patients in stage I and the high cost of radiotherapy and surgery. The cost of productivity loss owing to morbidity and mortality of cervical, ovarian, and endometrial cancers was $8 778 193, $8 411 525, and $1 551 296, respectively; this variation is attributed to differences in the incidence and mortality rates of GCs. In addition, the mortality cost of cervical cancer was higher than its treatment cost, as reported in previous studies.[7,15]

Moreover, the treatment costs of ovarian and endometrial cancers were higher than the mortality costs.[31,32] These 2 cancers differ from cervical cancer because of the high mortality of cervical cancer. Previous studies have shown that the IC of other cancers is higher than that of GCs.[15] We believed that the higher cost of treatment for GCs in Iran is related to Iranian culture, where the number of homemakers is higher than employed women and this has led to fewer IC being shown. This result was contrary to other studies.[15,23,33] Several economic studies on cancer have been conducted in Iran. In this regard, Daroudi et al[34] evaluated the burden of breast cancer in Iran, and Vahdatimanesh et al[35] designed an economic study of colorectal cancer. Moreover, Rezapour et al[36] concentrated on oral cancer, whereas Foroughi et al[37] measured the prostate cancer burden. All of these studies showed that chemotherapy was the most expensive part of disease management, and this intervention accounted for DMC.

This study had some limitations. First, there was a lack of information about GC staging in Iran, and we estimated GC staging according to the valid and representative data, available at the referral hospital. Second, there were not enough data regarding the palliative care costs. Despite these limitations, we believe that this is the first study in Iran, estimating the cost of GCs per stage. The present results can help healthcare decision makers to find a better approach for disease management and allocate resources effectively for optimal care programs.

Conclusion

Our results clearly showed that the costs of GCs, imposed on the healthcare system, were significant and mostly related to treatment. The reported costs can be incorporated in future studies to estimate the cost-effectiveness of interventions. They can be also used in preventive programs, such as cancer awareness and screening programs. Moreover, the present results can help policy makers to allocate resources efficiently. Future studies on GCs must be policy based, including cost-effectiveness studies of new interventions (eg, targeted therapy and immunotherapy) and preventive programs (eg, cancer awareness and screening programs). Owing to the high cost of productivity loss to mortality, implementation of screening and diagnostic programs can improve the survival rate and quality of life of patients and reduce the cost of productivity loss owing to mortality, as one of the most important parts of GC economic burden.

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