Research Paper: Productivity Loss of Diabetes in Iran (South Khorasan Province)

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ABSTRACT

Background: This study aims to assess the productivity loss in diabetic patients living in South Khorasan Province, Iran, in 2017.

Methods: This cost of illness and analytical study was performed on 1003 patients with diabetes referred to hospitals and healthcare centers in South Khorasan Province. After being randomly selected, the participants filled the short form health and labor questionnaire by the human capital method to estimate the productivity loss caused by health problems. Data were collected in person or via phone interviews. The collected data were analyzed by data quantile regression model using Stata v. 11.

Results: The Mean±SD productivity loss based on actual and labor law income was 19.61±46.24 and 16.61±49.39 dollars, respectively. In addition, the results showed that the Mean±SD number of lost working days is 0.81±2.39 days.

According to the regression model, gender, educational levels, marital status, and employment status affected the number of working days lost at 0.25 quantile (P≤0.05).

Conclusion: Improving productivity in diabetic patients and consequently reducing the resulting economic burden is essential to promoting their physical, mental, and social health.

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1. Introduction

Cost analysis shows the financial impact of disease and provides information to policymakers. Diabetes imposes a considerable burden on society in the form of high medical costs, lost productivity, and intangible costs in the form of reduced quality of life [1].

Diabetes reduces life expectancy and imposes significant treatment costs on the patient over a lifetime [2, 3]. In 2014, at least 422 million adults had diabetes (of all types) worldwide, which was more than the estimation made in 1980 (108 million) [4].

Diabetes is rising worldwide, with a global prevalence of 8.8% in adults in 2017, anticipating a further increase to 9.9% by 2045. On the whole, it reflects a population of 424.9 million people with diabetes worldwide in 2017, with an estimate of a 48% increase to 628.6 million people by 2045 [5].

The prevalence of diabetes more than doubled among men during 1991-2014, and its prevalence increased among women by 50%. Diagnosis of diabetes is expected to rise due to the aging population, increased obesity, and other risk factors [6].

Diabetes is a major global health threat. Its global prevalence has increased over the past four decades. Diabetes was the 15th leading cause of years of life lost in 2015 [7].

In Iran, the latest studies show that 4.5 million Iranians aged 25-79 years have diabetes. One in four people with diabetes is not aware of his or her illness [8]. Studies on the global burden of diseases in 2017 showed that diabetes is one of Iran's top ten causes of death [8, 9].

The economic impact of productivity loss in lost income, tax revenue, and Gross Domestic Product (GDP) is an essential issue for individuals, society, and the country [9]. Diabetes prevalence has been rising rapidly and primarily affecting young adults, which can adversely affect productivity and, as a result, threaten the livelihood of many families in the area [10]. Diabetes imposes an increasing economic burden on national health care systems worldwide [11, 12]. About 10.8% ($548 billion) of the global health expenditure was allocated to diabetes and its complications in 2013 [13], and 12% of the world's total health budget in 2014. Moreover, the cost of diabetes for every Iranian was $722 [14]. It is necessary to calculate the financial burden of diseases (such as diabetes) to estimate the economic impact of health problems on communities [15]. Despite the significance of this disease, there is a shortage of Cost of Illness (COI) research about diabetes costs, especially indirect expenditures costs [16].

A COI study aims to identify and measure all the costs of a particular disease, including the direct, indirect, and intangible dimensions. Indirect costs are more challenging to calculate than direct costs since determining productivity is more difficult with individuals at the workplace or in unpaid jobs [17, 18]. As one of the indirect costs of illness, productivity loss is affected by the complications, inability, and mortality caused by the disease in individuals, families, and society [19, 20]. Productivity loss may be temporary, such as taking time off to undergo treatment (temporary absenteeism) or permanently due to early retirement (permanent absenteeism). When people return to work after illness or injury but are less productive than before their diagnoses, the associated loss is presenteeism. Estimates of lost productivity provide a societal perspective on the burden of disease [21, 22]. This study aimed to determine productivity loss in patients with diabetes living in South Khorasan Province, Iran, in 2017.

2. Methods

Study design and sample size

This cross-sectional study was performed on 1000 patients with diabetes (type I and II) in healthcare centers and hospitals affiliated with Birjand University of Medical Sciences (South Khorasan Province). These centers include Valiasr Hospital (the largest hospital affiliated with Birjand University of Medical), Shahid Chamran Hospital (Ferdos City), Shahid Atashdast Hospital (Nehbandan City), Mostafa Khomeini Hospital (Tabas City), Shohada Hospital (Ghaen City), Emam Ali Hospital (Sarayan City), and Shafa Hospital. At first, 20 questionnaires were filled in person or via phone calls to determine the sample size. Afterward, the sample size was estimated at 1000 people based on the dispersion of answers using PASS. In addition, the mentioned standard deviation was calculated concerning the lack of similar studies in this field in Iran and considering the existing cultural differences between Iran and other countries using a pilot study. The subjects were selected by stratified sampling method, where 11 towns of South Khorasan Province were considered clusters, and subjects were selected in each town in a systematically randomized manner.

Data collection

The research tool was a short form health and labor questionnaire [23]. It consists of six sections: demographic characteristics, health status, smoking status, patients' underlying diseases, employment status, job characteristics, absenteeism, work performance, and unpaid work. Absenteeism is measured by the number of absent workdays due to health issues in the past 3 months. Presentism and reduced work performance at work is measured by an hour estimating method as per the Health Literacy Questionnaire (HLQ). Respondents were first asked to think of the work they completed during the past 7 days and answer if they would complete the same work in less time if they did not experience any health problems. If they answered yes, they would be asked to indicate the time in hours they actually used to do all the work during the past 7 days and the time they would use to do the same work if they did not experience any health problems. In addition, the reliability of the tool was assessed and confirmed by Ebrahimipour et al. through the intraclass correlation coefficient on 30 samples selected randomly at a working day loss of 0.96 and productivity loss of 0.99 [24]. After receiving the approval from the Vice-Chancellor for Research of the University and hospital authorities, the list of patients with diabetes, including their names and phone numbers, was received from the healthcare centers of the province (about 7000 individuals). In addition, people were interviewed in person or via phone calls. First, the researchers introduced themselves, explained the research objectives, and after receiving verbal consent, they entered the responses into the questionnaire. In cases where the patient was unwilling to cooperate for any reason, the following number was selected based on random sampling, and the procedure continued until a specified number of questionnaires were completed. However, only patients with diabetes were considered in determining productivity loss, and other diseases caused by diabetes (e.g., foot ulcer and amputation) were not included.

Data analysis

Data were entered into Excel 2017 based on the coding system explained in the questionnaire's guide, and the working day loss and productivity loss were estimated for each person. Data analysis was performed in Stata 11 using descriptive (frequency, percentage, Mean±SD) and inferential statistics. Concerning abnormal data distribution, we used the quantile regression at a significant level of 0.05 and 0.5, 0.25%, and 0.75 quantiles to predict the dependent variables by independent variables. Each variable was first considered an independent variable separately to create these models, and productivity loss was regarded as the dependent variable. Afterward, items receiving a P≤0.20 were entered into the regression model. In addition, the model's goodness of fit was evaluated through the coefficient determination index. In these models, qualitative variables over two states were considered dummy variables, with the lowest level being the baseline. Weighting was performed in all regression models as above. Variables were divided into smaller classes at the time of regression analysis due to many independent variable classes.

In this study, all costs are expressed in Purchasing Power Parity (PPP) (in US$) terms. In addition, productivity loss in patients with diabetes who had absence days from work was estimated by multiplying the hospitalization days and days of absence from work in one month before the disease into actual and labor law income (daily income of labor law=$20.44, In 2017) [24, 25].

In addition, the productivity loss of diabetes who attended work despite health problems was estimated by calculating the number of working days with disability (the number of days of attending work regardless of health issues multiplied by the "productivity of these days minus one") into actual and labor law income. On the other hand, productivity loss based on the actual income of patients was estimated by using patients' income instead of labor law income. In addition, productivity loss for daily activities was estimated using the average hourly wage of a local worker ($6.37). In this regard, the number of hours performed by family members and nurses was turned into days and multiplied by the income of local workers. Ultimately, the total productivity loss was calculated by adding the productivity loss in these three sections. Labor law (also known as labor law or employment law) mediates the relationship between workers, employing entities, trade unions, and the government [26, 27].

3. Results

Table 1 presents the frequency of demographic characteristics of the studied patients.

The mean productivity loss based on actual income and labor law income of patients with diabetes was $19.61±46.24 and $16.61±49.39, respectively. In addition, the number of working days lost was 0.81±2.39 days.

Table 1. Distribution of evaluated subjects based on demographic characteristics

Variables		No. (%)
Gender	Male	554(55.7)
	Female	441(44.3)
	Total	995(100)
Pregnancy	Yes	35(8.2)
	No	394(91.8)
	Total	429(100)
Employment status	Employed (full or part-time)	362(85.0)
	Unemployed	32(7.5)
	Student	16(3.8)
	Retired	16(3.8)
	Total	426(100)
Monthly income (Tomans per month)	<1500000	14(10.0)
	1500000-2200000	103(73.0)
	>2200000	24(17.0)
	Total	141(100)
Place of residence	Rural	843(85.7)
	Urban	141(14.3)
	Total	984(100)
Educational levels	Elementary school	119(14.0)
	Junior high school	133(15.6)
	Diploma	358(42.1)
	Associate degree or BSc	222(26.1)
	MSc or higher	18(2.1)
	Total	850(100)
Marital status	Never-married	59(5.9)
	Married	817(82.1)
	Divorced	22(2.2)
	Widowed	97(9.7)
	Total	995(100)
Smoking status	Always	33(3.3)
	Often	80(8.0)
	Quit	43(4.3)
	No	840 84.3)
	Total	996(100)

Variables		No. (%)
Health status Based on individual statements	Excellent	36(3.6)
	Very good	377(38.0)
	Good	450(45.4)
	Not so good	112(11.3)
	Bad	17(1.7)
	Total	992(100)
Age (y)	<30	146(14.6)
	30-45	329(32.9)
	45-60	290 29.0)
	>60	228(22.8)
	Total	993(100)
Body mass index, kg/m^2	<18.5	13(1.3)
	18.5-25	325(33.2)
	25-30	532(54.5)
	>30	107(11.0)
	Total	977(100)

The mean absence from work was two days a month. In addition, the mean health score of the participants was seven, meaning that patients scored 7 out of 10 on days when they came to their work despite illness (Table 2).

Quantile regression modeling at 0.25, 0.50, and 0.75 quantiles revealed that gender, educational levels, marital status, and employment status significantly impacted productivity loss in the 0.25 quantile. On the other hand, no variable had an impact on income level at 0.50 quantile. Ultimately, only the variables of educational level and marital status affected actual productivity loss at 0.75 quantiles. The regression results at 0.25, 0.50, and 0.75 quantiles for the variable of labor law productivity loss are presented in Table 3.

Table 4 presents the quantile regression results at 0.25, 0.50, and 0.75 quantiles for the variable of actual productivity loss. As observed, no variable had an impact on income level at 0.50 quantile, and only the variable of educational levels had an effect at 0.75 quantiles. Therefore, the variables of gender and educational levels had a significant impact on productivity loss at 0.25 quantile.

The quantile regression model results at 0.25, 0.50, and 0.75 quantiles for the variable of working days lost are presented in Table 5. According to this, the variables of

Table 2. Mean working days lost, mean absence from work and mean score of the participants based on day

Variable	Mean±SD	Inter Quantile Range	Percentile 95
Working days lost	0.81±2.39	0.50	3.35
Absence from work	7±2	-	-
Score of the participants	2±1	-	-

Table 3. Results of quantile regression model

Productivity Loss Based on Labor Law Income		25%		50%		75%	
		Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Gender	Male	-30784*	<0.05	-7696	>0.05	130834	>0.05
	Female		Reference group				
Educational levels	Elementary school	123138*	<0.05	138531	>0.05	207796	>0.05
	Junior high school	0	>0.05	38480	<0.05	284757*	<0.05
	Diploma	0	>0.05	-15392	>0.05	-15393	>0.05
	University level degree		Reference group				
Marital status	Single	38480*	<0.05	92353	<0.05	361718*	<0.05
	Married						
Employment status	Non-government employee	-30784*	<0.05	-53873	>0.05	-30784	>0.05
	Government employee	-30784*	<0.05	-30784	>0.05	0.6	>0.05
	Worker		Reference group				
Monthly income (PPPUS$: 37650 Rial)	<398.41	0	>0.05	7696	>0.05	100051	>0.05
	398.41 - 584.33	0	>0.05	30784	>0.05	123139	>0.05
	>584.33		Reference group				
_cons		61569	>0.05	>0.05	>0.05	-23089	>0.05

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* Variables are statistically significant at the given significance level (set at the level of 5%)

gender, educational levels, marital status, and employment status affected the number of working days lost at 0.25 quantile. On the other hand, no variable affected the working days lost at 0.50 quantile. In the end, the variables of educational levels and employment status affected the number of working days lost at 0.75 quantile.

4. Discussion

According to the present study results, the Mean±SD productivity loss based on actual income and labor law income per diabetic patient was $19.61±46.24 and $16.61±49.39, respectively. In other words, every patient with diabetes loses $19.61 and $16.61 based on actual income and labor law income. The loss of life from diabetes declines as age increases and is significantly higher in actual income compared with labor law income. Results indicated total working days lost per year because of presentism was 2.39 days.

According to the latest statistics on the GDP per capita, the PPP of the province was estimated at 2357 dollars [25]. In addition, the share of productivity loss of patients with diabetes was 0.9% and 0.8% based on actual income and labor law income, respectively. If all direct and indirect costs of this health problem were calculated, they would significantly share GDP per capita. In the research by Ebrahimipour et al., the mean productivity loss based on actual income and labor law income in the patients were 424.97 and 637.45 dollars, respectively. Moreover, the mean working days lost was 44 days in three months after the accident (14.6 days per month) [19], which is higher than our results [28]. Patients with diabetes showed reduced efficiency and increased time lost from work due to their health conditions, resulting in losses in work productivity [24].

In the regression model based on the variable of productivity loss while considering the actual income, only the variables of employment status and educational levels could predict the dependent variable. It

Table 4. Results of quantile regression model

Productivity Loss Based on Actual Income		25%		50%		75%	
		Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Gender	Male	-30833*	<0.05	-31791	>0.05	62750	>0.05
	Female	Reference group					
Productivity loss	Elementary school	123333*	<0.05	180416	>0.05	268750	>0.05
	Junior high school	17433	>0.05	10000	>0.05	313750*	>0.05
	Diploma	-15833	>0.05	47000	>0.05	9333	>0.05
	BSc and MSc and higher	Reference group					
Marital status	Singel	11190	>0.05	68208		251726	
	Married	Reference group					
Employment status	Non-gaver-ment job	0	>0.05	-500	>0.05	21666	>0.05
	Employed	0		-2708	>0.05	5833	>0.05
	Worker	Reference group					
Monthly income (PPPUS$: 37650 Rial)	<398.41	-34642	>0.05	-37142	>0.05	76666	>0.05
	398.41 - 584.33	-25833	>0.05	15208	>0.05	124166	>0.05
	>584.33	Reference group					
_cons		72500	>0.05	2532	>0.05	25416	>0.05

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* Variables are statistically significant at the given significance level (set at the level of 5%).

seems that the higher the educational level, the better their job and consequently the higher their income, which will have a higher impact on productivity loss. Gender had a significant reverse effect on productivity loss. In other words, men had higher lost productivity costs, which was not unexpected considering that men are more involved in occupations and can have three working days loss [9, 28]. In addition, when productivity loss based on actual income is changed to productivity loss based on labor law income, there was no change in this variable in men, but it was decreased in women, indicating a lack of fixed monthly income in the evaluated women. Regarding the type of occupation variable, sellers had a higher impact on working days lost than the base level. After eliminating income, the difference in results of dependent variables is due to the nature of jobs. Regarding the dependent variable of labor law income, the difference in the productivity loss of patients was due to the difference in the number of working days lost since a fixed income was considered for all participants. In this respect, the model results are similar to the regression model of working days lost. Treatment of diabetes can lengthen life years and increase the number of productive years lived.

5. Conclusion

Diabetes can directly or indirectly affect the quality of life by increasing the financial burden on people. Improving productivity in diabetic patients and consequently reducing the resulting economic burden is essential to promoting their physical, mental, and social health. Effective increase productivity in people with diabetes needs attention from the government and community participation. One of the significant limitations of the present study was the estimation of productivity loss based on self-report and the problem of remembering the missed working days. To reduce errors, we decreased the recall period to one month ago, similar to previous studies [5, 18, 24, 28].

Table 5. Results of quantile regression model

Working Days Lost		25%		50%		75%	
		Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Gender	Men	-0.4*	<0.05	-0.1	>0.05	1.7	>0.05
	Female	Reference group					
Educational level	Elementary school	1.6*	<0.05	1.8	>0.05	2.7	>0.05
	Junior high school	0	>0.05	0.2	>0.05	3.7*	<0.05
	Diploma	0	>0.05	-0.2	>0.05	-0.2	>0.05
	BSc and MSc and higher	Reference group					
Marital status	Single	0.5*	<0.05	1.1	>0.05	4.7*	<0.05
	Married	Reference group					
Employment status	Non-government job	-0.4*	<0.05	-0.7	>0.05	-0.4	<0.05
	Employed	-0.4*	<0.05	-0.4	>0.05	0.001	>0.05
	Worker	Reference group					
Monthly income (PPPUS$: 37650 Rials)	<398.41	0	>0.05	0	>0.05	1.3	>0.05
	398.41 - 584.33	0	>0.05	0.3	>0.05	1.6	>0.05
	>584.33	Reference group					
_cons		0.8	>0.05	1	>0.05	-0.3	>0.05

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* To interpret impact, a class of categorical variables must be considered as a group reference.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of the Mashhad University of Medical Sciences (Code. 392330.23.11.1398).

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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