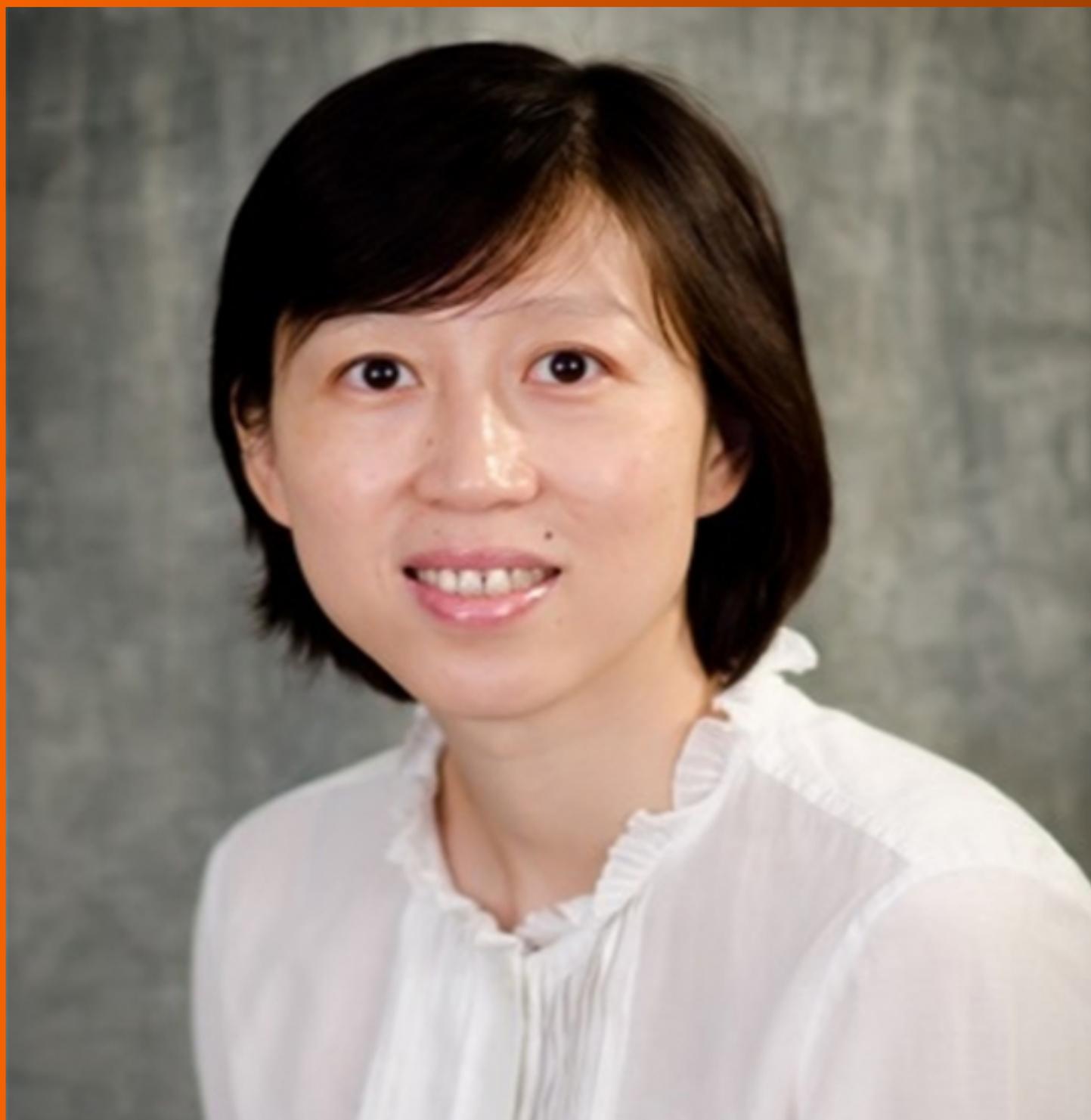


# World Journal of *Diabetes*

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## Retrospective Study

# Comparison of awareness of diabetes mellitus type II with treatment's outcome in term of direct cost in a hospital in Saudi Arabia

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**Author contributions:** Alomar MJ contributed in the proposal, design of the method, writing revision and analysis; Al-Ansari KR contributed in the performance of data collection writing and analysis; Hassan NA contributed equally to the work including design, writing and analysis.

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There is no conflict of interest to this study.

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## Abstract

**BACKGROUND**

Saudi Arabia is among the top 10 countries with the highest prevalence of diabetes. Cost of prevention and the indirect cost must be calculated to increase the awareness of society and to emphasize disease prevention and limit further complications.

**AIM**

To understand the importance of awareness and the impact on the expenditure of diabetes mellitus and treatments outcomes.

**METHODS**

A prospective descriptive and comparative survey was carried out among patients with diabetes mellitus in Saudi Arabia.

**RESULTS**

One hundred and one participants were included in the study of which 40% were female and one third were above the age of 50. The mean of the first HbA1c reading was 6.95, and the median was 7. The mean of the second reading of HbA1c was 7.26, and the median was 7. The mean body mass index was 32.1, and the median was 30.9. The average yearly cost of the medication was 995.14 SR. Comparing participants who think that a healthy low-sugar diet can affect blood sugar with those who do not, showed a statistically significant difference when cost was considered ( $P$  value = 0.03). Also, when comparing the group of participants who know when to take their oral hyperglycemic medicine and their yearly direct cost and those who do not know when to take it, by using independent sample T test, showed significant statistical difference ( $P$  value = 0.046).

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## CONCLUSION

It is essential for the governments to invest in ways to prevent and help in the early detection of such an expensive disease by performing national screening and education programs. Many pharmaco-economic studies can be done to help the decision-maker in our hospitals think about strategies to help the patient to be physically fit by offering gymnasium or places to walk or contract.

**Key words:** Middle East; Diabetes; Lifestyle; Hypoglycemic

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**Core tip:** This study evaluated diabetic patients' compliance to hypoglycemic medications, dietary control, and their impact on cost effectiveness. It shows that lack of compliance has negative impact on patients' therapeutic outcomes, which in turn affects cost of medications and management of diabetic complications. Further educational campaigns are important among diabetic patients in order to reduce negative health consequences and economic outcomes.

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## INTRODUCTION

Diabetes mellitus (DM) is a non-communicable metabolic degenerative disorder associated with a high risk of chronic complications and comorbidities<sup>[1]</sup>. Obesity and many other inabilities could lead to diabetes if they happen in pre diabetic patients<sup>[2]</sup>.

Around 422 million people are diagnosed with DM, and 80% of diabetes deaths occur in low- and middle-income countries. Approximately 1.5 million deaths in 2012 were directly caused by diabetes worldwide, while 2.2 million deaths were caused by higher blood glucose level due to the increases of risk of cardiovascular disease in the same year. The prevalence of the disease increased dramatically many fold during the last 3 decades, aligning with the increase of prevalence of obesity, overweight, and physical inactivity<sup>[3]</sup>. If no drastic actions are taken, the number of people living with diabetes is expected to reach 552 million by 2030<sup>[4-6]</sup>. Cost of prevention and indirect cost must be calculated to increase the awareness of society and to emphasize the importance of disease prevention and limiting further complications<sup>[7]</sup>. Saudi Arabia is among the top 10 countries with the highest prevalence of diabetes<sup>[8-10]</sup>. Early prevention can limit the complications and their impact on the person's quality of life, reducing the cost with positive impact on the Health system<sup>[11]</sup>. Most countries spend between 5% and 20% of their total health expenditure on diabetes<sup>[12,13]</sup>. Fourteen percent of the population in the Eastern Mediterranean Region has diabetes<sup>[14]</sup>, approximately 35 million people. The expected prevalence of diabetes in Middle East and North America (MENA) will be 60 million in 2030<sup>[15,16]</sup>.

The sixth edition of the International Diabetes Federation Diabetes Atlas reports that only 2.5% of global health expenditure on diabetes is spent in the MENA Region<sup>[17]</sup>. The anticipated prevalence for diabetes 2010-2030 in the Gulf countries are: United Arab Emirates 18.7%-21.4%, Kingdom of Saudi Arabia 16.8%-18.9%, Bahrain 15.4%-17.3%, Kuwait 14.6%-16.9%, and Oman 13.4%-14.9%<sup>[18,19]</sup>. The recent and rapid socio-economic development of the Gulf Cooperation Council countries has been associated with this rising prevalence.

"The prevalence of obesity in adults of 30-60 years in Saudi Arabia increased by 1.5% for women and 4.1% for men annually between 1992 and 2005. In Qatar and Kuwait, 35% and 36% of male; and 45% and 48% of female adults were found to be obese"<sup>[20]</sup>. Equally alarming are the numbers for younger age cohorts: In Kuwait, 21% of males and 18% of females aged 10-19 years were obese<sup>[21-23]</sup>.

The statistics of World Health Organization in Saudi Arabia in 2016 showed that the rate of diabetes in males was higher than that in females. Also, the level of overweight females was higher than that in males, and the rate of physical inactivity

was higher among women 67.7%, while in men it was 52.1%<sup>[24]</sup>.

The purpose of this study was to describe the relationship between direct medical costs and individual demographic characteristics, different regimen of treatment, and glycemic control. Here, we include the monthly cost of medications and the pharmacy average consumption of each oral hypoglycemic medication listed in the formulary. In addition, awareness of these patients of the disease and the role of lifestyle modifications in addition to oral hypoglycemic medication are explored. Lack of sufficient awareness will lead to high treatment cost with low therapeutic outcomes.

## MATERIALS AND METHODS

A prospective descriptive and comparative face-to-face survey was carried out among patients with DM in Saudi Arabia. The study included both genders of patients visiting the primary care medical center. Patients aged between 35 to 75 years who were on oral hypoglycemic were selected within the inclusion criteria. Pregnant women were excluded from the study. The prices and quantities of average monthly ordering costs of the medicine were collected from the institution.

A random convenience sample of patients following up with the chronic disease clinic (CDC) were selected for this study to help ensure a representative sample. The participants were males and females from different backgrounds and educational and socio-economic levels. The total number of patients registered to follow up in December 2016 was 371, among which 196 patients were not able to come to the appointment and therefore considered as no shows. Among the remaining, 112 patients were involved in this study. The sample size for the study was calculated using raosoft online calculator (<http://www.raosoft.com/samplesize.html>), with a margin of error of 9%, confidence interval of 96%, and response distribution of 50%, and the population number of patients is 371 was used.

A structured questionnaire was used to collect data. The questionnaire was translated into Arabic, the national language of Saudi Arabia, to ensure proper understanding of the questions. The questionnaire was collected by the researcher. The questionnaire was divided into two parts. The first section included questions about the respondents socio-demographic data including, gender, age range, onset of the disease, medical history, and the and the regimen of the hyperglycemic medication. The second part was used to determine the level of knowledge about DM type 2 by checking the awareness of disease, their knowledge about its complications, and how far they are trying to control it by healthy diet and exercise. After finishing the data collection process, data were extracted as an Excel file, and then data were copied on SPSS (version 24, Armonk, NY, United States). Responses were coded and entered into SPSS for analysis using basic frequencies, descriptive, independent samples *t*-test.

Ethical standards for conducting the study were maintained as follows: (1) Confidentiality of all patients guaranteed; (2) Patients' information obtained from the survey was confidential; and (3) Patients can withdraw from the study at any time.

## RESULTS

A total of 112 questionnaires were collected, of which 11 responses were incomplete and hence excluded from the study. At the end, a total of 101 responses out of 112 received responses were adopted for the study. Socio-demographic characteristics are listed in [Table 1](#).

### **Health status of respondent**

One third of the participants had only DM (30.7%) as past medical history. More than half (63.4%) suffered from DM with other cardiovascular comorbidities, and 5.9% had diabetes with other diseases.

During 2015 to 2016, the last subsequent two reading of HbA1c of intervals from 3-9 mo were recorded from patients' files, the mean of the first reading was 6.95, and the median was 7. The mean of the second reading of HbA1c was 7.26, and the median was 7. The mean body mass index (BMI) was 32.1, and the median was 30.9.

### **Lifestyle behavior**

Among all participants, 36.6% were not doing any exercise, the remaining ( $n = 65$ ) were classified according to the type of exercise they do, which was mostly walking 55.4%. About one forth (25.7%) of 952 of the people doing exercise said they do it daily, and 13% said they exercised once a week. The mean was 2.7, and the median of

**Table 1 Socio-demographic characteristics**

Characteristic	Frequency	Percentage
Gender		
Male	61	60.4
Female	40	39.6
Age		
30-39	12	11.9
40-49	22	21.8
50-59	34	33.7
60-69	27	26.7
70-79	6	5.9
Onset of the disease		
< 1	7	6.9
1-5	37	36.6
6-10	28	27.7
> 10	29	28.7
Regimen of treatment		
No medicine, only healthy lifestyle	2	2
Single therapy	51	50.5
Double therapy	35	34.7
Triple therapy	13	12.9

the time to exercise per week was 2. Around one third (33.7%) of the participants exercised between 30 to 59 min every time they exercised, while 36.6% did not do any exercise at all.

In their daily diet, more than half of the participants ate three meals/d (60.4%), 25.7% ate two meals/d, 9.9% ate four meals/d, 3% ate one meal/d, and 1% ate five meals/d. Concerning preferred food, 53.5% prefer mixed refined carbohydrates and complex carbohydrates, 31.7% said they prefer refined carbohydrates, 12.9% prefer protein-based diet, and 2% prefer complex carbohydrates only. About their daily consumption of dates, their answers varied between 5.9% did not eat any dates, to 1% eating 22 dates/d. The mean of their consumption was 6.12 dates/d and the median was 5.

### General awareness of participants

Approximately 75% of participants believe that healthy diet can help control blood sugar level, 11.9% did not know, while 12.9% did not believe that it has an effect on blood sugar and suggested that diabetes is a result of if emotional and genetic factors. More than half of the participants (51.5%) were not following any healthy low sugar diet. As regard to exercise, 67.3% believe that it can lower blood sugar level, and 32.7% did not believe that it has any direct effect on blood sugar but did think it is good for general health. Most of the participants (93%) know when to take their oral hyperglycemic medication, while 8% did not know exactly the correct time to take their medicine either before or after food. Around half of them (45.5%) will skip their tablet if ever missed, 35.6% will take the tablet once they remember, 10.9% will double the next dose, and 7.9% said they did not have an idea what to do if ever they missed their oral hyperglycemic medications.

Regarding hypoglycemic symptoms, one third of them (28%) did not know how to deal with them, and 73% knew how to deal with them. More than half of them (63.4%) never visited a diabetic educator. Sixty-five percent said they have full awareness of the disease, while around one third of participants (34.7%) think they are not aware enough. The average yearly direct cost of the hyperglycemic medication of the participants (without any medicine used to treat its complications) was 995.14 SR. The median was 614.4SR with results of being widely distributed. Only two of the participants were not on any medicine because they do not adhere to the regimen (yearly cost is zero), and they were instead following a strict healthy diet and exercise only. The maximum yearly direct cost was 3417 SR, and this patient was taking 6 mg of Glimeperide once a day and 50 mg of Vildagliptine twice a day.

When comparing participants who think a healthy low-sugar diet can affect blood sugar level with their yearly direct cost (mean of yearly direct cost is 952.8 SR) and

those who think low-sugar diet has no effect on their blood sugar level (mean of yearly direct cost is 1334.6 SR) the difference is statistically significant. This is when using independent sample *t*-test, with *P* value = 0.03. Comparing participants who know when to take their oral hyperglycemic medicine and their yearly direct cost (the mean of direct cost = 976.7 SR) and those who did not know (the mean of direct cost = 1209.1 SR) by using independent sample *t* -test, showed significant statistical difference with *P* value = 0.046.

On the other hand, when comparing the yearly cost between the group of participants who are following low sugar diet and those who are not following such a diet, it showed no significant statistical difference by independent sample *t* -test with *P* value = 0.656. Also, there was no statistically significant in the yearly direct cost between the group of participants who think exercise can lower blood sugar level and those who think it has no effect on blood sugar with *P* value = 0.141.

Comparing male and female genders regarding lifestyle showed a statistically significant difference between the number of dates consumption with a *P* value = 0.003 by Levene's test for Equality of Variance by Independent Samples Test. Also, when comparing the type of food preferred as refined carbohydrates and the awareness of participants about the importance of a healthy diet on blood sugar level *versus* gender the *P* value = 0.004 and 0.009, respectively, by using Linear-by-Linear association Chi square test. Using the same type of test to compare gender *versus* physical activity, the *P* value = 0.002. Using Chi square test to compare gender *versus* full awareness of disease, the *P* value = 0.078. When comparing gender *versus* how to deal with hypoglycemic attack with *P* value = 0.026 by using Linear-by-Linear Association. On the other hand, there was no significant statistical difference for gender *versus* following healthy diet and visiting diabetic educator.

### **Awareness of a healthy lifestyle**

The mean HbA1c for the second reading of the participants who said a low-sugar diet can help to decrease blood sugar level *versus* participants who said there is no effect of a low-sugar diet on blood sugar-level was 7.04 *versus* 7.98, respectively, which was statistically significance different (*P* value = 0.007) by independent sample test. On the other hand, there was no relationship between awareness of the significance of healthy diet and BMI levels. The mean BMI of the participants who said the healthy low-sugar diet can lower blood sugar level was 31.6 and the mean of those who said it has no effect on the blood sugar level was 31.8 (independent sample *t* test, *P* value = 0.951).

Thirty-eight percent of the participants were not following a low-sugar diet, although they had the awareness of the impact of a healthy low-sugar diet on blood sugar results. Eight-point nine percent of participants were not following such a diet because they did not have an idea if low-sugar diets had an effect or not. The significant statistical difference according to Pearson chi-square asymptotic significance had a *P* value of 0.001.

Regarding the awareness of the importance of exercise, the mean BMI of the participants who think exercise can lower blood sugar level was 32.05, and the mean of those who said it had no effect on the blood sugar level was 32.20 (independent sample *t*-test, *P* value = 0.695). When comparing the second HbA1c reading between people who think exercise would improve blood sugar level (the mean is 7.11) and those who think it would not (mean is 7.57), it was statistically significant (*P* value = 0.049, Levene's test for equality of variance descriptive data). Of those patients who think exercise could decrease blood sugar, 41.1% of them did not exercise, 10 of 68 exercised once/wk, and only 16 of 68 exercised daily. On other hand, 10 out of 33 who did not think exercise has an effect on blood glucose level do exercise daily for general health only, not because of its importance on blood sugar level. While 28.7% (19 out of 66) think they have full awareness of the disease, they do not think exercise can lower blood sugar level.

### **Visiting diabetic educator**

Among participants who have visited a diabetic educator, 48.6% will skip the missed dose (18 out of 37), 32.4% will take it once remember, and 18.9% of them will double the next dose to compensate for the missed one. There was no statistically significant difference between the people who ever visit diabetic educator and their daily preferred type of food (*P* value = 0.832). Data taken from the pharmacy and supply department in the hospital where the study was conducted showed that the direct cost of diabetes is 133258620 SR.

Participants who are aware of the importance of a low sugar diet have better HbA1c (7.04) in comparison to those who do not have this awareness (HbA1c = 7.98) (*P* value = 0.007). There is, however, no significant difference in BMI between participants who have an awareness of healthy diet (31.6) and not (31.8). Both

categories are obese. On the other hand, participants who are aware of the importance of exercise have better a HbA1c result (mean of HbA1c is 7.11) in comparison to those who did not have this awareness (mean of HbA1c is 7.57) ( $P$  value = 0.049, Levene's test for equality of variance descriptive data). These data will encourage us to increase their awareness in order to give better HbA1c results.

## DISCUSSION

This study explored participant awareness of DM and the importance of a healthy lifestyle (diet and physical activity) and its impact on their health from a financial and therapeutic point of view. The main past medical history among participants is diabetes with other cardiovascular diseases. Since diabetes is associated with many comorbidities, it is recommended that individuals maintain a healthy lifestyle and HbA1c levels below 7.0%<sup>[25]</sup>. The International Expert Committee recommended that persons with HbA1c level between 6.0 and 6.5% were at particularly high risk and might be considered for diabetes prevention interventions<sup>[26,27]</sup>. As mentioned in results, HbA1c score worsened instead of improving during the treatment course, which reflected some defect in the chain of treatment. United Kingdom Prospective Diabetes Study and Diabetes Control and Complications Trial demonstrated that improving HbA1c by 1% for diabetic patient cuts micro-vascular complications risk by 25%<sup>[28]</sup>. In addition to other research that has also shown that people with type 2 diabetes who reduce their HbA1c level by 1% are 19% less likely to suffer cataract, 16% are less likely to suffer heart failure and 43% are less likely to suffer amputation or death due to peripheral vascular disease<sup>[29,30]</sup>. Diabetic patients must be encouraged to lose weight, be more physically fit, and follow a healthy diet and active lifestyle to minimize their risk of complications and increase their quality of life. A high BMI score is associated with substantially shorter healthy and chronic disease-free life expectancy. Physical inactivity has been identified globally as the fourth leading risk factor for mortality. It becomes increasingly important to identify high-risk populations and to implement strategies to delay or prevent diabetes onset<sup>[31]</sup>. It is recommended to all individuals with diabetes to have physical activity as part of the therapy plan<sup>[32]</sup>. The recommendation is to exercise at least 150 min/wk. It is recommended to do at least 30 min of moderate or vigorous physical activity 5 d of the week. To lose weight or maintain weight loss, they might need to do 60 min or more of physical activity 5 d/week<sup>[33]</sup>.

In this study, the results are far away from the international recommendations; participants were not following the correct duration and frequency of exercise. Studies have shown that weight loss of 5%-7% improves blood glucose control in type 2 diabetes, reduces cardiovascular risk factors, reduces insulin resistance, contributes to weight loss, and improves well-being<sup>[34,35]</sup>. Another way of lowering BMI and controlling blood sugar is to follow a healthy diabetic diet, it is one of the most important services that should be offered to diabetic patients. The recommendation is to limit refined carbohydrates and processed meals. They should focus on high fiber diet and complex carbohydrates like vegetables. Complex carbohydrates are digested slowly, thus preventing the body from producing too much insulin. Carbohydrate counting is a way to plan meals. It has a bigger impact on blood sugar levels than fats and proteins. Some studies have shown that eating too much protein, especially animal protein, may actually cause insulin resistance. A key factor in diabetes is a healthy diet that includes protein, carbohydrates, and fats<sup>[36]</sup>. According to this study's results, when compared with the recommended diabetic diet, most of the participants preferred to eat carbohydrates with a smaller number of meals. This result when compared with another study conducted in Iran in 2015, showed that consumption of 24.2 g of one type of dates (approximately two dates) at the snack time did not cause significant alterations in blood glucose level<sup>[37]</sup>. However, as sugar caused the same effect on blood glucose, these snacks may not be considered very healthy for patients with type 2 diabetes, even though they have good content of minerals, vitamins, fiber, and antioxidants<sup>[38,39]</sup>.

Lack of knowledge among participants regarding hyperglycemic medicine affects the incidence of hypoglycemic reactions, which is considered as indirect cost. Unfortunately, many studies from both developed and developing countries have reported that diabetes knowledge is generally poor among diabetic patients<sup>[40-43]</sup>. Health care clinic programs to increase patients' awareness about DM and to keep them educated and motivated are essential in order to improve their understanding, compliance, and management and, thereby, their ability to cope with the disease. According to Canadian guidelines for diabetes care, they recommend that all people with diabetes who are able should be taught how to self-manage their diabetes and

offered timely diabetes education that is tailored to enhance self-care practices with comprehensive programs. Incorporate behavioral/ psychosocial interventions, as well as knowledge and skills training with shared decision making, and problem-solving skills are more likely to improve a diabetic's glycemic control<sup>[44-46]</sup>. Education of diabetics is one of their rights to be offered in the healthcare system to enhance their treatment outcomes and to minimize the side effect and complications. In this study, the yearly direct cost was higher with the group of participants who had less awareness about the impact of a healthy low-sugar diet on blood sugar level and the group of participants who did not know how to take their oral hyperglycemic medications. But the difference was not statistically significant between the yearly direct cost and those of participants who said they were on diabetic diet (maybe due to their misunderstanding of the best type of carbohydrate and portion recommended), number of meals, dates consumption, and other techniques of a diabetic diet. The same result was found for yearly direct cost and the group of participants who think exercise can lower blood sugar level, which was maybe due to the improper and insufficient time of exercise that does not follow the guideline recommendations mentioned above.

Although around 60% of both genders never visited a diabetic educator, they are almost the same in the awareness of healthy diet and its impact on blood sugar level. Men prefer refined carbohydrates + complex carbohydrates (which are healthier) compared to half of women who mainly prefer refined carbohydrates. The male participants consumed more dates than women, and this difference was highly statistically significant ( $P$  value = 0.003). With all of this similarities and differences, there was no significant difference in the yearly cost of both genders.

The rise in diabetes in the gulf region has been linked to many different factors, including diet, exercise, and lifestyle changes due to rapid economic change, increased fast food, and sedentary lifestyle<sup>[47]</sup>. In Saudi Arabia, for example, the consumption of meat for each person had increased by 2.2% per year between 1993 and 2003, while fiber rich food has decreased<sup>[48]</sup>. The dietary regime in the Gulf Cooperation Council region has moved away from "predominantly consuming dates, milk, fresh vegetables and fruit, whole wheat bread, and fish to mostly foods rich in high saturated fats and refined carbohydrate diets coupled with a low dietary fiber intake"<sup>[49]</sup>.

In conclusion, poor awareness and limited diabetic education service were considered barriers to get better treatment outcomes. Male patients were more likely to be aware about the disease and adhere more to physical activity than females. There is a greater need for primary care providers to offer continuous diabetes awareness to the public whenever possible to provide the knowledge of preventing disease progression as it is global endemic disease with rapidly increasing prevalence. According to the World Health Organization, it can be prevented and managed through diet and physical activity. The burden of diabetes is huge worldwide; this study showed that the standards of diabetes care in the region can be improved. It may be useful to consider some of the interventions applied worldwide. These could potentially be as effective, and there is a degree of overlap. For example, the use of patient education by small group or a one-on-one setting education programs, diabetes specialist nurses, and self-glucose monitoring appear to be potentially useful and are relatively well-developed components of systems elsewhere.

It is essential for the governments to invest in ways to prevent and help in the early detection of such an expensive disease by performing national screening and education programs. Many pharmaco-economic studies can be done to help the decision maker to think about strategies to help the patient to be physically fit by offering gymnasiums or places to walk or to have a contract with a specialized gym to refer them there. Even if this seems costly, it has a good economic impact.

## ARTICLE HIGHLIGHTS

### **Research background**

Saudi Arabia is among the top 10 countries with the highest prevalence of diabetes. Cost of prevention and indirect cost must be calculated to increase the awareness of the society and to emphasize the importance of disease and limiting further complications.

### **Research motivation**

Diabetes complications are the most expensive medical consequences encountered during diabetes management. Lack of patient education regarding lifestyle changes and medication use leads to treatment failure, which adds burden to both patients and the government.

### **Research objectives**

The purpose of this study was to describe the relationship between direct medical costs and individual demographic characteristics, different regimen of treatment, and well glycemic control. Here, we include the monthly cost of medications and the pharmacy average consumption of each oral hypoglycemic medication listed in the formulary. In addition, awareness of these patients of the disease and the role of lifestyle modifications in addition to oral hypoglycemic medication are explored. Lack of sufficient awareness will lead to high treatment cost with low therapeutic outcomes.

### Research methods

A prospective descriptive and comparative face-to-face survey was carried out among patients with diabetes mellitus in Saudi Arabia. The study included both genders of patients visiting the primary care medical center. Patients aged between 35 to 75 years who were on oral hypoglycemic were selected within the inclusion criteria. Pregnant women were excluded from the study. The prices and quantities of average monthly ordering costs of the medicine were collected from the institution.

### Research results

Results of this study show a lack of proper counseling about lifestyle changes and medication use among patients with diabetes. This study urges other researchers to focus on patient counselling techniques and the barriers diabetic patients encounter during therapy.

### Research conclusions

This study shows that there is a lack in patient education about the proper way to manage diabetes, which affects money expenditure on diabetic management. This study proposes the use of well-structured techniques by diabetic educators that include organized follow up plan and utilization of modern technology to reduce diabetic complications and improve quality of life.

### Research perspectives

Future research should focus on the utilization of social media in promoting diabetes education in both diabetic and pre diabetic patients.

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