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Research Article

Compliance with Second Visit of Diabetes Mellitus Screening Program and Impact of Dietary and Exercise Modification on Glycemic Control

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Abstract

Background: Diabetes is frequently not diagnosed until complications appear. Therefore, diabetes can be considered the top candidate for early detection and management**.** ***Objectives***: To assess the non-compliance level of the 2nd visit of the screening program for diabetes and to evaluate the effect of diet and exercise modification on glycemic control. ***Methods***: The first part was a cross-sectional study with analytic components, and the second was an interventional study during a period of one year, from September 2023 to September 2024. It included 400 adults aged ≥ 40 years, who were included in the program of early diabetes detection and showed an elevated blood sugar level; then they were scheduled for the 2nd visit for follow-up. HbA1c %, body mass index, and waist circumference were evaluated, and then these patients were put on a diet and exercise program to be evaluated again after three months. ***Results***: The prevalence of non-compliance is 64.4%. Lower educational level, not enough time to explain problems by the provider, fear and worry about diagnosis, hesitation to treatment, and not giving an appointment for a 2nd visit are independent risk factors. Means of BMI, WC, and HbA1c were significantly decreased after three months of lifestyle modification. ***Conclusions***: Non-compliance with the 2nd visit of the program of early detection of diabetes is a common problem among Iraqis. The primary care infrastructure and expertise are lacking in Iraq, and healthcare provision relies heavily on secondary and tertiary care.

Keyword: Compliance, Diabetes mellitus, Dietary control, Physical activity, Primary health care, Screening.

الامتثال للزيارة الثانية لبرنامج فحص داء السكري وتأثير تعديل النظام الغذائي والتمارين الرياضية على التحكم في نسبة السكر في الدم

الخلاصة

الخلفية: لا يتم تشخيص مرض السكري في كثير من الأحيان حتى تظهر المضاعفات. لذلك، يمكن اعتبار مرض السكري المرشح الأول للكشف المبكر والعلاج. **الأهداف**: تقييم مستوى عدم الامتثال للزيارة الثانية لبرنامج فحص مرض السكري وتقييم تأثير تعديل النظام الغذائي والتمارين الرياضية على التحكم في نسبة السكر في الدم. **الطرائق:** كان الجزء الأول عبارة عن دراسة مقطعية بمكونات تحليلية، والثاني دراسة تدخلية خلال عام واحد، من سبتمبر 2023 إلى سبتمبر 2024. وشملت 400 شخص بالغ تتراوح أعمارهم بين ≤ 40 عاما، تم تضمينهم في برنامج الكشف المبكر عن مرض السكري وأظهروا ارتفاع مستوى السكر في الدم. ثم تم تحديد موعد لهم في الزيارة الثانية للمتابعة. تم تقييم HbA1c ومؤشر كتلة الجسم ومحيط الخصر ، ثم تم وضع هؤلاء المرضى على نظام غذائي وبرنامج تمارين ليتم تقييمهم مرة أخرى بعد ثلاثة أشهر. **النتائج**: معدل انتشار عدم الامتثال 64.4٪. المستوى التعليمي المنخفض، وعدم وجود وقت كاف لشرح المشاكل من قبل مقدم الخدمة، والخوف والقلق بشأن التشخيص، والتردد في العلاج، وعدم تحديد موعد للزيارة الثانية هي عوامل خطر مستقلة. انخفضت متوسطات مؤشر كتلة الجسم وWC و HbA1c بشكل ملحوظ بعد ثلاثة أشهر من تعديل نمط الحياة. **الاستنتاجات**: عدم الالتزام بالزيارة الثانية لبرنامج الكشف المبكر عن مرض السكري مشكلة شائعة بين العراقيين. وهناك نقص في البنية التحتية للرعاية الأولية والخبرة في العراق، ويعتمد توفير الرعاية الصحية بشكل كبير على الرعاية الثانوية والثالثية.

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INTRODUCTION

Diabetes mellitus (DM) is not only a well-known leading cause of death but also an increasing burden on healthcare worldwide [1]. It was estimated that 451 million people aged 18–99 years had diabetes in 2017, and these figures are expected to reach 693 million by 2045 [2]. Diabetes affects individuals of all ages, genders, and geographic locations. In Iraq, there were 1.2 million cases of DM in adults (20-79 years) with a prevalence of 7.2% and 519,600 cases of DM in adults that were undiagnosed in 2015. The number of deaths in adults due to DM was 16893 [3]. A recent report demonstrated that almost half of all people with diabetes

(44.7%; 239.7 million) were unconscious of their medical condition in 2021 [4]. There is strong evidence that primary health care (PHC) is one of the most cost-effective strategies in curbing morbidity, disability, and premature mortality of DM [5]. DM causes more blindness, renal disease, and amputations than any other disease. The estimated burden on the health-care system is around 245 billion dollars [6]. Recognizing the importance of PHC, the WHO has developed the Package of Essential Non-Communicable Disease Interventions (WHO PEN) for Primary Care in low-resource settings. The WHO PEN has a special focus on DM and its integrated management given its burden [7]. Screening is the process by which asymptomatic persons who are at high risk of the disease are identified for further investigation, as a fasting blood glucose (FBG) ≥ 126 mg/dL is diagnostic for DM and warrants retesting; a 75-g OGT test is also suitable, and screening is positive with a 2-hour post-load value of ≥ 200 mg/dL. Values ≥200 mg/dL are repeated on a different day to confirm the diagnosis of diabetes [8]. There are no randomized trials examining the effectiveness of screening for DM. The American Diabetes Association (ADA) recommends screening for diabetes for patients 45 years and older without risk factors. The ADA also recommends testing for diabetes in adults who are overweight or obese (BMI ≥ 25 kg/m²) and have one or more additional risk factors for diabetes [9]. The non-compliant patients, especially those with chronic diseases, are more prone to encountering serious difficulties [10]. The rate of non-compliance in patients with chronic diseases in developed countries on long-term treatment is on the order of 50%. This could be even higher in developing countries [11]. Strict glucose management can slow or stop the development of DM complications. There is also strong evidence that maintaining a healthy lifestyle, which includes eating a balanced diet, losing a small amount of weight, and getting regular exercise, can lower the risk of type 2 DM complications and maintain healthy blood glucose levels [12]. The aim of this study is to assess the prevalence, determinants, and possible causes of non-compliance with the 2nd visit of the screening program for diabetes applied in PHCC in Baghdad during 2024 and to evaluate the effect of diet and exercise modification in controlling those who were newly diagnosed with type 2 DM.

METHODS

Study design and setting

This study was composed of two steps: the first was a cross-sectional study with analytic components, and the second was an intervention that was carried out at PHCCs working on a health visitor program in the Al-Karkh side of Baghdad province during a period of one year from September 2023 to September 2024. A simple random sample of three districts was selected from the Baghdad Al-Karkh Health Directorate (Al-Adil, Al-Karkh, and Al-Dora districts), and then a simple random sampling technique was used to select two PHCCs working on the health visitor program from each of the selected districts.

Study population and sample size

The study population included all adults aged ≥ 40 years attending the selected PHCCs and newly diagnosed with elevated blood sugar (fasting plasma glucose ≥ 126 mg/dl) and included in the program of early detection of diabetes and scheduled for the 2nd visit for follow-up. Then, each included individual who passed the 2nd appointment date was phoned and questioned. Both the compliant and the non-compliant individuals regarding the 2nd appointment were completed with the questionnaire. The factors that might affect attending the 2nd visit were searched among the non-compliant individuals, and more than one factor was allowed to be selected. They were informed about the purpose of the study, and those who agreed to participate were enrolled in the study. Those who refused to participate were excluded from this study. The sample size was calculated using the following equation: $n = (z^2pq)/d^2$, in which n = sample size, z = 1-α/2 percentile of a standard normal distribution = 1.96, p= expected proportion (14%) (3), q= 1-p, and d= absolute precision = 0.05. The estimated sample was 185, but we included 400 respondents to consider any non-response and to increase the power of this study. The estimated sample size was proportionally distributed among the selected PHCCs, and accordingly the estimated data collection time for each PHCC was estimated according to the estimated number of participants supposed to be collected from the selected PHCCs. The time required for completing the interview with each participant was considered as the system to include the next patient.

Data collection tools

A self-administered questionnaire has been applied to all attendants to collect needed information. The questionnaire consists of three parts filled out by the researcher (patients' socio-demographic characteristics, factors related to PHCC, and factors related to participants that might affect attending the 2nd visit). An assigned panel of experts edited, reviewed, revised, and approved the questionnaire. This questionnaire was filled out by contacting participants either directly at the 2nd visit or by phone call after the date of the 2nd visit for those who skipped this visit. In the second step of the study, those who attended the 2nd visit (Compliant) and showed an elevation of blood glucose level again were evaluated immediately and after three months of follow-up: HbA1c % level, body mass index (BMI), calculated by weight in kilograms divided by the square of height in meters. All patients use the same scale to measure their weight and height. BMI = Weight (kg)/Square height (m²), and waist circumference (WC) is calculated

by placing the tape measure directly on the skin halfway between the lowest rib and the top of the hipbone without wearing more than one layer of light clothing. Those patients were subjected to non-drug interventions such as diabetes meal planning. We instruct the patients to follow a good meal plan that includes more non-starchy vegetables, such as broccoli, spinach, and green beans; fewer added sugars and refined grains, such as white bread, rice, and pasta; and focusing on whole foods instead of highly processed foods as much as possible. Table 1 shows the food instructions that applied to the patients to follow [13] (Figure 1).

Table 1: Food instructions that applied to the patients to follow for three months [13]

Item	Instruction
Bread, rice, potatoes, pasta, cereals, and other starchy food	Make one of these foods a part of every meal. Choose the whole meal, whole grain, brown or high fiber white bread.
Milk, yoghurt, cheese and other dairy foods	Try to include at least 3 servings throughout the day.
Meat, fish, eggs, and beans (protein foods)	Aim to include these foods with 2 of your meals daily. Try to eat more fish and aim for 1 or 2 portions of oily fish such as salmon, sardines or pilchards each week.
Vegetables and fruit	Aim to have a mixture of 5 portions (about a handful) of vegetables/salad and fruit each day and choose from a variety including fresh, frozen or tinned.
Sugar and sweet foods	These do not need to be avoided, and small amounts can be included in your diet. Sweets, chocolate and cake are all high in sugar and will increase your blood glucose level quickly. Foods that contain less than 5g sugar per serving are considered low sugar and over 10g per serving is considered high sugar.
Salt	Too much salt in your diet is not good for you. Try to avoid adding salt to your food and limit salty processed foods such as crisps and ready meals.

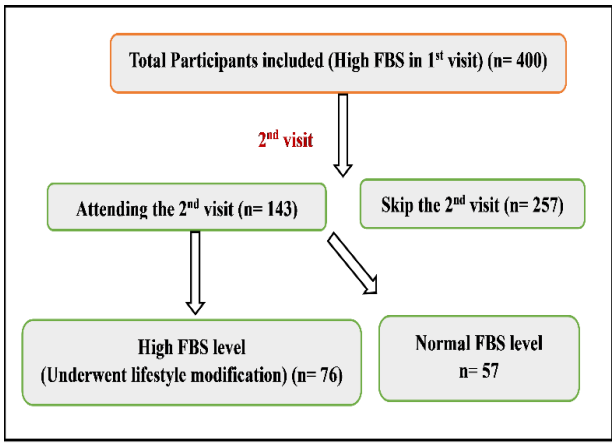

Figure 1: Flowchart of the study.

The second tool used in the study was the physical activity device. The aim of using this device was to get at least 150 minutes of moderate-intensity physical activity every week. To reach that goal, it is recommended to be active for 30 minutes on most days. You could start with a 10-minute walk after dinner and build up slowly [14]. During light-intensity activities, most people can sing; during moderate-intensity activities, they can talk but not sing; and during vigorous activities, even talking is difficult [15].

Ethical considerations

The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Administrative approvals were granted from the Scientific Committee of the College of Medicine, Ibn-Sina University for Medical and Pharmaceutical Sciences. Names were removed and replaced by identification codes. All information is kept confidential in a password-secured laptop, and data is used exclusively for research purposes.

Statistical analysis

The data was analyzed using Statistical Package for Social Sciences (SPSS) version 26 and was presented as mean, standard deviation, and ranges. Categorical data are presented by frequencies and percentages. Logistic regression analysis was applied, using compliance as the dependent variable, and the variables that were found significant in the binary analysis were included in the model as the independent variables. A paired t-test was used to compare the continuous variables before and after lifestyle modifications. A *p*-value less than 0.05 was considered significant.

RESULTS

In this study, the age of participants was ranging from 41 to 82 years with a mean of 69.43 ± 8.3 years; 57.8% of them were males; 78.8% were living in urban area; and 48.8% were currently married; 29% of them were housewives; and 51% of them had finished higher education. We noticed that 64.2% of the participants didn't attend the 2nd visit of screening program of DM (Non-compliant). Regarding those who attended the 2nd visit (35.8%), 53.1% of them showed high blood glucose level again (Table 2). As shown in Table 3, appointment was not given for 2nd visit for 42% of study participants; 23.3% of them said that PHC is not accessible; 8.6% said that physician was unavailable at each visit; screening program was not clear for 38.1% of them; 57.6% said that drugs were unavailable, and time of explaining problem by provider is not enough for 17.1% of them. Regarding participants, 52.9% consulted another place; 59.9% didn't know about coming for the 2nd visit; and the cost of arrival to PHCC was not affordable for 7.8% of them, 61.5% followed healthy lifestyle since 1st visit; 51.8% were being afraid and worrisome about diagnosis; 33.9% didn't believe about benefit from the program, and 56% were hesitant to treatment.

Table 2: Distribution of study participants by general characteristics (n=400)

Variable	n(%)
Age (year)	
< 50	157(39.2)
50-59	123(30.8)
60-69	88(22)
≥ 70	32(8)
Gender	
Male	231(57.8)
Female	169(42.2)
Residence	
Urban	315(78.8)
Rural	65(21.2)
Marital status	
Currently married	195(48.8)
Single	38(9.5)
Divorced / Widowed	167(41.7)
Occupation	
Housewife	116(29)
Employee	110(27.5)
Retired	70(17.5)
Private work	104(26)
Educational level	
Illiterate	45(11.3)
Primary school	69(17.2)
Secondary school	82(20.5)
Higher education	204(51)
Attending the 2nd visit (Compliance to 2nd visit)	
Yes	143(35.8)
No	257(64.2)
Blood glucose level in the 2nd visit (n= 143)	
High	76(53.1)
Normal	57(46.9)

Table 3: Factors might be related to non-compliance to 2nd visit of screening program (n=257)

Factor	n(%)
Factors related to PHCC	
Appointment was not given for 2nd visit	108(42)
PHCC is not easily accessible	60(23.3)
Physicians are unavailable at each visit	22(8.6)
Screening program is unclear	98(38.1)
Drugs are not available at PHCC	148(57.6)
Time of explaining problem by provider is not enough	44(17.1)
Factors related to participants might affect attending 2nd visit	
Consulting another place	136(52.9)
Didn't know about coming for 2nd visit	154(59.9)
Cost of arrival to PHCC is not affordable	20(7.8)
Following healthy lifestyle since 1st visit	158(61.5)
Being afraid and worry about diagnosis	133(51.8)
No believe about benefit from the program	87(33.9)
Hesitant to treatment	144(56)

Logistic regression analysis was applied (Table 4) using results of compliance to the screening program as the dependent variable. Five factors were found to be important independent risk factors for non-compliance to 2nd visit of the screening program of type 2 DM. These factors were lower educational level (Illiterate patients are 6.44 and those who finished primary school are 5.31 more likely being non-compliant than highly educated patients (OR= 6.44 with 95% Confidence Interval (CI): 2.34-16.8; and OR= 5.31 with 95% CI: 1.23-14.33 respectively), no enough time to explain problem by provider is 2.15 more likely increase the non-compliance rate (OR= 2.15 with 95% CI: 1.17-6.9), fear and worry about diagnosis is 5.18 more likely increase the non-compliance rate (OR= 5.18 with 95% CI: 1.81-17.41), hesitation to treatment is 6.72 more likely increase the non-compliance rate (OR= 6.72 with 95% CI: 1.91-20.23), and not giving an appointment for 2nd visit is 7.22 more likely increase the non-compliance rate (OR= 7.22 with 95% CI: 2.76-22.54).

Table 4: Logistic regression analysis of possible risk factors for non-compliance with the 2nd visit of screening program

Variables	Odd's ratio	95% CI
Educational level (Reference is higher education)		
Illiterate	6.44	2.34-16.8
Primary school	5.31	1.23-14.33
No enough time to explain problems by provider	2.15	1.17-6.9
Fear and worry about diagnosis	5.18	1.81-17.41
Hesitation to treatment	6.72	1.91-20.23
Appointment was not given for 2nd visit	7.22	2.76-22.54

As shown in Table 5, we noticed that means of BMI, WC, and HbA1c for those who showed elevated blood glucose level in the 2nd visit (76 individuals) were improved (decreased) after three months of lifestyle modification.

DISCUSSION

Diabetes represents a serious problem of the importance of public health with significant morbidity and mortality. Fortunately, natural history is well studied and has a preclinical (asymptomatic) stage with the availability of screening and diagnostic tools. This makes diabetes suitable for screening, aiming for early detection and control of it [4]. In the first part of this study, which focused on compliance with the screening program, 64.2% of the participants didn't attend the 2nd visit of the screening program for DM (poor compliance). Lower results were found in studies conducted by AlKhaldi YM *et al*. in 2020 [16] and Yashkin AP *et al*. in 2018 [17] when they found that poor compliance was 15% and 39%, respectively. In low- and middle-income countries (LMICs), ensuring access to quality hypertension and diabetes care for affected populations is a complex intervention, which is better implemented via an integrated PHC approach.

Table 5: Comparison in Anthro biometric measures before and after lifestyle modification for individuals showed high blood glucose level in the 2nd visit

Variable	Time		95% CI
	On the 2nd visit	3 Months post-intervention	
BMI (kg/m^2)	31.32±4.9	27.14±3.8	2.4-6.81
Waist circumference (cm)	111.7±13.2	101.81±9.8	6.71-14.4
HbA1c (%)	7.42±1.2	6.31±1.3	0.82-2.51

Values were expressed as mean±SD.

Such integrated intervention must consider the patient's health needs for long-term care across time and disciplines, which poses significant challenges to the weak health systems and constrained resources in LMICs [18]. In the current study, five factors were found to be important independent risk factors for a greater likelihood of non-compliance with the 2nd visit of the screening program for type 2 DM. These factors were lower educational level, not enough time to explain problems by the provider, fear and worry about diagnosis, hesitation to treatment, and not giving an appointment for the 2nd visit. In concern to educational level in the assessment of screening for DM, it may be expected that patients with higher educational levels should have better knowledge about the disease course, complications, and therapy and therefore be more compliant. One major factor that affects compliance is the patient's ability to read and understand medication instructions. Patients with low literacy may have difficulty understanding instructions; this ultimately results in decreased compliance and poor communication for follow-up [19]. Regarding patient-provider relationships, it could be concluded that patient-provider relationships are another strong factor that affects patients' compliance toward the screen and treatment. A healthy relationship is based on patients' trust in providers and empathy from the providers. Studies have found that compliance is good when doctors are emotionally supportive, giving reassurance or respect, and treating patients as an equal partner [20]. For example, physicians who asked a few questions and seldom made eye contact with patients, and patients who found it difficult to understand the physician's language or writing. More importantly, too little time spent with patients was also likely to threaten patients' motivation for maintaining therapy [21]. Poor communication with healthcare providers was also likely to have a negative effect on the compliance of patients. The non-compliant diabetic patients may feel the doctors were lacking concern for their problems. Additionally, multiple physicians or healthcare providers prescribing medications might decrease the confidence of patients in the prescribed treatment. To build a good and healthy relationship between patients and providers, providers should have patients involved in designing their treatment plan and give patients a detailed explanation about the disease and treatment. Good communication is also very important to help patients understand their condition and therapy [22]. Other factors that affect compliance were explained as patients may be unable to take time off work for treatment; as a result, their rate of compliance could be threatened. So, a shorter arrival time between the residence of patients and PHCC systems could improve patients' compliance. Another important factor is that optimal control of diabetes is extremely necessary for preventing complications. Unfortunately, because diabetes may sometimes be asymptomatic or have mild symptoms, unless extremely high, patients often believe that there is no need for medication and screening adherence, and that is why education is so very important in such cases, and this aspect needs to be included in the educational program for them and verified that the patient understands this point [23]. In fact, patients' beliefs about the causes and meaning of illness, and motivation to follow the therapy were strongly related to their compliance with healthcare. Compliance was better when the patient felt susceptible to the illness or its complications, believed that the illness or its complications could pose severe consequences for his health, and believed that the therapy would be effective or perceived benefits from the therapy. On the contrary, misconceptions or erroneous beliefs held by some patients would participate in poor compliance. Patient's worries about the treatment, believing that the disease is uncontrollable, and religious belief might add to the likelihood that they are not compliant with therapy or follow-up [24]. Regarding the 2nd step of this study concerning lifestyle modifications for glycemic control, for those who showed elevated blood glucose levels again after three months of dietary plans and physical activities, we noticed that BMI, WC, and HbA1c were improved. The same results were found in studies conducted by Anand *et al*. [25] and Pot *et al*. [26]. Significant variations in fasting blood sugar levels were among the findings of a study by Sukla et al. that yielded nearly identical results. But the research participants' weight and waist circumferences decreased; however, the difference was not statistically significant [27]. For the benefit of people, diabetes education is essential, but it must be ingrained in daily life or through activities pertaining to diet control, increasing physical activity, avoiding foods rich in fat, checking blood sugar, and taking care of the feet [28].

Study limitations

This study faced some limitations, as access to patient information was difficult, as some of the PHC managers and employees refused to give us the addresses and the phone numbers of patients involved in the screening program and attributed that to the privacy of the patient and security reasons. At the level of the patients, some of them gave the wrong phone number to the healthcare provider, and some of them gave poor information while answering the questionnaire or not answering the phone call at all.

Conclusions

Non-compliance with the 2nd visit of the program of early detection of diabetes is a common problem among the Iraqi population. The most important risk factors for non-compliance are modifiable, and these factors are lower educational level, limited time to explain problems by the provider, fear and worry about diagnosis, hesitation to treatment, and not giving appointment for a 2nd visit. The primary care

infrastructure and expertise are lacking in Iraq, and healthcare provision relies heavily on secondary and tertiary care. Programs for early detection of diabetes were developed for primary care; however, their implementation was not successful. For newly diagnosed type 2 DM, providing intensive long-term DM management support, including diet and physical activity, may help them control DM. There is potential for improvement regarding awareness among both caregivers and patients, communication with secondary care, and finding ways to increase compliance with regular check-ups. To increase knowledge, perhaps there is a need for better guidelines for how primary care should manage these patients. One can assume that this group of patients is not prioritized in an overloaded primary care system, where the prevention work is at risk of being downgraded. Several studies have demonstrated that the best way to improve adherence to follow-up in primary care is through a proactive reminder system, for example, via phone calls/SMS/letters/personal nurse contact [29,30].

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Conflict of interests

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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