Diabetes mellitus (DM) is a chronic metabolic disorder that is highly prevalent around the world (1). DM is a challenging disease with many complications that is usually difficult to manage successfully. Many patients do not achieve good glycemic control and continue to suffer health problems as a result (1–3). Diabetic foot (DF) ulceration is one of the most common complications among diabetic patients (4). It has been shown that such a complication is highly prevalent among Iraqi diabetic patients (5, 6). DF ulceration is associated with significant morbidity and mortality (7, 8). Although many studies worldwide explained the risk factors for developing DF ulcerations (9, 10), but there are a few studies that discuss the medical causes for DF ulceration in Iraq, one of these studies was done in Wasit province (11). The aim of our study was to analyze the medical, therapeutic, and patient risk factors for developing DF ulcerations among diabetic patients in Baghdad, Iraq.

Patients and methods
A cross-sectional study in questionnaire format (Appendix) was prepared by the authors of this study and given to a convenient sample of adult diabetic patients who were receiving medical treatment. This study was done in a surgical ward in a Baghdad teaching hospital during January 2015–April 2015. An additional 10 diabetic patients who are related to the authors of this study were invited to participate in this study to increase the sample size. Seventy-nine patients who provided their verbal informed consent were included in this study.

Ethical approval for this study was obtained from the Ethical Committee of Pharmacy College–Baghdad University. In this study, the term DF referred to present and/or history of DF ulcer.

Statistical analysis
Statistical software (SPSS v. 12, Chicago, IL) was used for data input and analysis. Continuous variables were presented as mean ± standard deviation (SD), and discrete variables were presented as numbers and frequencies. Chi-square test for independence was used to test the significance of association between discrete variables. Unpaired t test was used to test the significance of difference in the mean of two independent samples. Pearson’s correlation was used to test the correlation between continuous variables. For doing correlations, each categorical answer was rated using suitable ascending numbers starting from zero.

All P values used were asymptotic and two sided. Findings with a P value less than 0.05 were considered significant.

Results
The results shown in Table 1 indicate that diabetic patients who suffered from DF were significantly older than those without DF. A long history of DM (more than 10 years) was associated with the development of DF, while the presence of comorbid diseases was not associated with the development of DF.
Table 2 shows that the most important factors that made diabetic patients more prone to develop DF were using a combination of insulin and oral antidiabetic agents, physical activity, and unavailability of medications in the public sector.

Table 3 shows that the frequency of DF occurrence is well correlated with the absence of a home glucose meter, less frequent blood glucose measurements, and with long duration of DM.

Table 4 shows that the high cost of home glucose meter strips was the main cause for unavailability of this apparatus.

Discussion

This study showed that the age of diabetic patients who suffer from DF were significantly higher than those without DF. Similarly, it was found that most of the patients who developed DF were in their fifth and sixth decades of life, with mean age of 59.3 years (12); furthermore, a long history of DM (more than 10 years) was associated with development of DF. In contrast to the finding in this study, researchers found that the duration of DM is not related to DF risk for patients in the United States (10), while another studies showed that diabetic patients who develop DF are usually those with long history of DM (12, 13).

Another important finding in this study is that the patient’s educational level was not significantly different between diabetic patients with DF and those without DF; in contrast to the finding of this study, low educational level was a risk factor to develop DF in diabetic patients in the UAE (14). This difference may be because low level of education is very common among Iraqi diabetic patients (15).

In this study, the presence of comorbid diseases was not associated with the development of DF; while in many other studies comorbidities are associated with increasing DF incidence (17–19). One possible explanation for this strange finding is that whenever the demand for glycemic control increased (as in patients with medical comorbidities), the patient compliance with medical advice will be increased (19). This in turn could mean better glycemic control and fewer complications from hyperglycemic attacks (20, 21).

This study has shown there are many risk factors that make the diabetic patients more prone to develop DF, at which patients who are using a combination of insulin and oral antidiabetic agents were at high risk to develop DF. The same finding was observed in an Indian study where diabetic patients who use a combination of insulin plus oral hypoglycemic agents are at higher risk of developing DF ulcers (22). The use of combined therapy in diabetic patients is common and may be because DM is one of the diseases that progress and become less responsive to treatment with time (23). This hypothesis is consistent with the findings in this study because patients with a long history of DM were at high risk from recurrent DF ulcers. Moreover, it is well known that the use of many medications decrease patient compliance to therapy (24), which further mean losing glycemic control (20) and increasing DF ulcer risk to the patient (21).

Additionally, another finding in this study was the association between physical activity and the risk of developing DF, despite the fact that physical activity can improve glycemic control (25). This might be explained by the fact that most diabetic patients in this study had low educational levels, and around 50% of them did not inspect their feet regularly. This could result in a higher
chance of foot wounds and blisters through physical activity. This in turn might be translated into higher risk for developing DF ulcers. This study also showed that unavailability of medications in the public sector, the free sector, is one of the major risk factors to develop DF ulcerations since nearly one third of participating patients stated that they will stop using their treatment if it is not freely supplied to them, this finding may be rational since many people in Iraq are below poverty line (26) and thus they are unable to purchase their medications from private pharmacies.

It is well known that DF has a high recurrence rate (27). In this study it was found that the frequency of DF occurrence was well correlated with less-frequent blood glucose measurements and with the absence of home glucose meters. Most patients in this study stated that they didn’t own a home glucose meter because even if they can purchase the apparatus they aren’t able to afford the costly strips for the regular glucose monitoring. In this regard, the lack of home glucose meters is surely linked with less-frequent glucose monitoring, which was further linked to bad glycemic control (28), and eventually to more complications with DF. This finding is closely related to what is found by Mehmood et al., at which better glycemic control is associated with better outcomes for patients with DF and may decrease the rate of DF recurrence (29).

There are some limitations in this study like the small sample size and the cross-sectional rather than longitudinal design that affect the reliability of study conclusions.

Table 2. Factors that affect diabetic patients to develop diabetic foot

| Parameter                                      | DM patients with DF | DM patients without DF | P   |
|-----------------------------------------------|---------------------|------------------------|-----|
| Medication used                               |                     |                        |     |
| Oral antidiabetics (%)                        | 24 (44%)            | 20 (80%)               | 0.009|
| Insulin (%)                                   | 11 (20%)            | 3 (12%)                |     |
| Both (%)                                      | 19 (36%)            | 2 (8%)                 |     |
| Presence of home glucose meter                |                     |                        |     |
| Yes available (%)                             | 33 (61%)            | 16 (64%)               | 0.804|
| Not available (%)                             | 21 (39%)            | 9 (36%)                |     |
| Measuring blood glucose level                 |                     |                        |     |
| Daily (%)                                     | 11 (20%)            | 5 (20%)                | 0.930|
| Weekly (%)                                    | 13 (24%)            | 7 (28%)                |     |
| Rarely (%)                                    | 30 (56%)            | 13 (52%)               |     |
| Regular physician visit                       |                     |                        |     |
| Yes (%)                                       | 10 (19%)            | 8 (32%)                | 0.184|
| No (%)                                        | 44 (81%)            | 17 (68%)               |     |
| Therapy compliance and adherence              |                     |                        |     |
| Yes (%)                                       | 32 (59%)            | 10 (40%)               | 0.110|
| No (%)                                       | 22 (41%)            | 15 (60%)               |     |
| Source of used medications                    |                     |                        |     |
| Public diabetic centers (free of charge) (%)  | 23 (43%)            | 7 (28%)                | 0.213|
| Private community pharmacies (with fee) (%)   | 31 (57%)            | 18 (72%)               |     |
| Knowledge about disease and its complication  |                     |                        |     |
| Yes (%)                                       | 22 (41%)            | 7 (28%)                | 0.274|
| No (%)                                        | 32 (59%)            | 18 (72%)               |     |
| Knowledge about hyperglycemia symptoms        |                     |                        |     |
| Yes (%)                                       | 11 (20%)            | 7 (28%)                | 0.452|
| No (%)                                        | 43 (80%)            | 18 (72%)               |     |
| Anyone helps you in your treatment            |                     |                        |     |
| Yes (%)                                       | 24 (44%)            | 10 (40%)               | 0.710|
| No (%)                                        | 30 (56%)            | 15 (60%)               |     |
| Availability of prescribed medication in public centers | 3 (13%) | 5 (72%) | 0.002 |
| No (%)                                        | 20 (87%)            | 2 (28%)                |     |
| Patients who stop treatment if medications are not available freely | 6 (30%) | 2 (33%) | 0.876 |
| No (%)                                        | 14 (70%)            | 4 (67%)                |     |
| Regular foot inspection                       |                     |                        |     |
| Yes (%)                                       | 27 (50%)            | 8 (32%)                | 0.134|
| No (%)                                        | 27 (50%)            | 17 (68%)               |     |
| Physical activity                             |                     |                        |     |
| Yes (%)                                       | 41 (76%)            | 11 (44%)               | 0.005|
| No (%)                                        | 13 (24%)            | 14 (56%)               |     |

DM: diabetes mellitus; DF: diabetic foot.
Table 3. Correlation between different parameters on diabetic foot frequency

| Parameter                          | \( R \) | \( P \) |
|------------------------------------|--------|--------|
| Medication used                    | 0.236  | 0.086  |
| Presence of glucose meter in patient's home | –0.274 | 0.045  |
| Frequency of measuring blood glucose level | 0.331  | 0.014  |
| Medication adherence               | 0.169  | 0.223  |
| Knowledge about hyperglycemia symptoms | –0.143 | 0.302  |
| Knowledge about disease complication | 0.149  | 0.281  |
| Help with the treatment            | 0.221  | 0.108  |
| Regular foot inspection            | 0.189  | 0.172  |
| Physical activity                  | –0.172 | 0.215  |
| Duration of disease                | 0.438  | 0.001  |
| Gender                             | –0.058 | 0.945  |
| Age                                | –0.070 | 0.901  |
| Presence of comorbid conditions    | 0.229  | 0.101  |

Table 4. Reason for non-availability of home glucose meters for patients with diabetic foot

| Parameter                              | \( P \) |
|----------------------------------------|--------|
| Absence of home glucose meter          | 6      | 0.049  |
| High cost of the apparatus             |        |
| High cost of apparatus strips          | 15     |

and therefore, a longitudinal large-scale study should be performed to confirm the results of this study. It is recommended that the Iraqi Ministry of Health ensure adequate and continuous supply not only of antidiabetic medications but also of glucose meter strips; furthermore, diabetic educational programs should be made freely available to all diabetic patients to ensure a better glycemic control which eventually decrease the risk of diabetic complications.

In conclusion, older patients, long history of DM, using multiple antidiabetic medications, and physical activity with less frequent inspection of the feet were some of the major risk factors for developing DF among Iraqi diabetic patients, while the frequency of glucose monitoring is inversely related to the recurrence of DF ulcers.

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Appendix A

Diabetic patient questionnaire

Dear patient,

Hope you are well.

This questionnaire aims to find out the main causes behind developing diabetic foot ulceration among Iraqi diabetic patients. If you like the idea and accept to help us in this regard, please fill in the following questions:

General patient information
Age:
Sex:
Educational level:
Presence of comorbid conditions (like hypertension, angina, renal failure, etc.):
(a) Yes
(b) No

General diabetic information
1. Duration of diabetes?
   (a) Less than 5 years
   (b) Between 5 and 10 years
   (c) More than 10 years
2. Do you know the risks and complication of the disease if you do not adhere with your treatment?
   (a) Yes
   (b) No
3. Do you know the symptoms of hyperglycemia?
   (a) Yes (mention them)
   (b) No
4. Do you have a domestic sugar screening device?
   (a) Yes
   (b) No
If your answer is “No,” then why?
   (a) I cannot buy it
   (b) I cannot buy the strips because they are expensive
5. How often do you scan your blood sugar level?
   (a) At least once a day
   (b) At least once weekly
   (c) Rarely (less than two times/month)

6. Do you visit your physician regularly for evaluation and treatment of your diabetes?
   (a) Yes
   (b) No
   (c) Rarely (in emergency cases)

7. Medicines that you are using to treat diabetes:
   (a) Oral hypoglycemic to reduce the sugar
   (b) Insulin
   (c) Both

8. Is there any person who helps you to take control of your disease and its treatment?
   (a) Yes
   (b) No

9. Are you always adherent to your prescribed treatment in regard to dose and dosing frequency?
   (a) Yes
   (b) No

10. Source of your medical treatment
   (a) A community pharmacy (if you choose this answer then please go directly to question 13)
   (b) Public health centers (if you choose this answer then please answer all the following questions)

11. If you take your treatment from the public clinics, so is it always available?
   (a) Yes
   (b) No

For those who answered No, please answer the following question

12. If your treatment is not available in the public center, so will you stop using your treatment and not try to purchase it from private pharmacies?
   (a) Yes
   (b) No

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13. Do you monitor your foot on an ongoing basis and to verify the absence of bruises and injuries?
   (a) Yes
   (b) No

14. Do you do physical activity (like running, walking, gymnastics, etc.) on a regular basis?
   (a) Yes
   (b) No

15. Have you suffered from diabetic foot ulceration in the past?
   (a) Yes
   (b) No

If you answered (yes) then answer the following question
How many times you got diabetic foot ulceration?
Please specify the number of attacks: