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Original article

Assessment of knowledge among caregivers of diabetic patients in insulin dosage regimen and administration

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ABSTRACT

Background: Inadequate production of Insulin can lead to a complex metabolic disorder named Diabetes Mellitus that is characterized by hyperglycaemia. Diabetes is leading metabolic disease that causes major disability and increased death-rate world-wide. Diabetes can cause neuropathy, blindness, ischaemic heart disease, peripheral vascular disease, increased risk of stroke, and renal diseases. Since the management of diabetes mellitus is complex, the reliance of some patients on their caregivers has increased. In this study, a caregiver is a family member or a paid helper who is willing to provide long-term assistance to a child, an older adult, or a person with a disability.

Aim: The knowledge of caregivers about insulin doses (administration and adjustment) is determined and to study the correlation between the demographic data (age, gender, and marital status) and the knowledge of caregivers.

Methodology: This is a cross sectional type of descriptive study. A questionnaire was built based on literature review and was reviewed and validated by 17 arbitrators and modified accordingly. A pilot study was performed on 5 people of the targeted population to assess the feasibility, duration, and clarity of the data collection tool. The questionnaire was distributed online and had some extra questions to exclude non-relevant responses.

Results: A total of 819 participants filled the online questionnaire. Out of these, 83.6% were female and 16.4% were male. The good knowledge was significantly associated with caregivers who had patients diagnosed with diabetes since less than 6 months when compared with others.

Conclusion: Caregivers who reported that they do not live with the healthcare receiver had less knowledge compared with those they live, and it is statically significant association. 55% were satisfied with their level of knowledge about insulin doses management. This study indicates who lives with patient has caregiver's knowledge on insulin dosages administration 1.766 times from who don't have.

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1. Introduction

Diabetes mellitus (DM) is a complex group of metabolic disorders, that is characterized by hyperglycaemia in addition to altered carbohydrate, protein, and fat metabolism, that resulted from abnormalities in insulin secretion or insulin sensitivity (Alrashed, 2017). Diabetes is mainly categorized into two types: Insulin

Dependant Diabetes Mellitus (IDDM/Type-I/Immune Mediated/Ketosis prone Diabetes) and Non-Insulin Dependant Diabetes Mellitus (NIDDM/Type-II/Non-Immune Mediated/Non-Ketosis prone Diabetes). Diabetes is a leading metabolic disease that causes major disability and death-rate world-wide (Alshammari et al., 2017). Diabetes can cause neuropathy, blindness, ischaemic heart disease, peripheral vascular disease, increased risk of stroke, and renal diseases (Alzahrani et al., 2017). According to the International Diabetes Federation (IDF), in Saudi Arabia, the estimated percentage of total adult population living with diabetes was 18.32%, while in children and adolescents (0–19 years) it was 0.26% (IDF, 2019; Ministry of Health KSA, 2013). Diabetes is known to be a major health threat to the entire world (Wang and Wu, 2017).

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Insulin is the mainstay in treating patients with Type 1 diabetes. The hallmark of T1DM (Type I Diabetes Mellitus) is the dysfunctional β -cells of the pancreas, which normally secrete insulin (American Diabetes Association, 2019). However, many patients with T2DM (Type II Diabetes Mellitus) need insulin at some point. The doses should be adjusted according to blood glucose levels, carbohydrates counting, and physical activity (AlHaidar et al., 2020). The basic type of insulin therapy includes: Long/Ultra-long/Immediate acting Insulin and Rapid/short-acting Insulin. The delivery options for Insulin are: Shots/pens, Insulin Pump, Inhaled Insulin (Afrezza). Many drugs are reported to impair the glucose tolerance like: Anti-psychotic drugs, β blockers, diuretics, corticosteroids, nicotinic acid, HIV-1 protease inhibitors and Oral contraceptives (Beck et al., 2015).

Since the management of diabetes mellitus is complex, the reliance of some patients on their caregivers has increased. Especially for older adults who were recently hospitalized. In this study, a caregiver is a family member or a paid helper who is willing to provide long-term assistance to a child, an older adult, or a person with a disability (Caregiver, 2020). The lack of knowledge about Diabetes can lead to inadequate Diabetes Management practices and can be lethal to the patient (Danner et al., 2020). The knowledge about hypoglycaemia, the diet to be given, use and storage of insulin, use of glucose test strips, the timings and dosage of insulin administration need to be required by the caregivers for proper Diabetes management Dipiro (n.d.), International Diabetes Federation (2020).

Caregivers' behaviour regarding diabetes management is influenced by knowledge and awareness (Lindquist et al., 2011). Previous research showed that caregivers with greater diabetes-related knowledge were capable of achieving better glycemic control in young adults diagnosed with type 1 diabetes. Moreover, adolescents with T1DM acknowledged the significant role played by their caregivers in providing guidance, supervision, and emotional support.

In the light of (Pai and George, 2019) study findings, caregivers of patients taking insulin for T2DM were less aware about the symptoms of hypoglycaemia compared to the patients themselves. Thus a delay in proper management may occur due to caregivers' poor knowledge. As a result, a number of authors have suggested the delivery of ongoing diabetes education to patients and their caregivers.

Schulz and Beach (1999) had given no details about the demographic characters of the caregivers in his study related to health effects of the caregivers. Fredman et al (2010) in his study about the mortality rate of caregivers did not include the description of age, gender, education, occupation. In a study conducted by Martin et al (2017), there was no determination of demographic characters of the informal caregivers.

Considering the crucial role of caregivers in ensuring safe and appropriate insulin regimen, this study was conducted to assess the knowledge of caregivers about insulin doses (administration and adjustment) and to study the correlation between the demographic data (age, gender, and marital status..) and the knowledge of caregivers.

2. Methodology

This cross-sectional descriptive study was conducted in Riyadh between January and February 2020, it involved 819 caregivers who were assessed through a self-administered questionnaire, that was built based on literature review and was reviewed and validated by 17 arbitrators and modified accordingly. A pilot study

was performed on 5 people of the targeted population to assess the feasibility, duration, and clarity of the data collection tool. The questionnaire was distributed online and had some extra questions to exclude non-relevant responses. The questionnaire includes 31 questions in total, and consists of three parts: demographic data, general knowledge about insulin administration and dose adjustment. A caregiver is a family member or a paid helper who is willing to provide long-term assistance to a child, an older adult, or a person with a disability

In the first part, information regarding the following was obtained: age, gender, marital status, educational level, job status, caregiver/patient relationship, date of diagnosis, number of years of care-giving since insulin therapy was initiated. While in the second and third parts, participants' were asked to evaluate a number of statements concerning insulin administration and dose adjustments through 5-point Likert scale: (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree.

3. Inclusion criteria

- 1- Caregivers of diabetic patients taking insulin-based therapy.
- 2- Saudis and non-Saudis in Riyadh, Saudi Arabia.
- 3- Both Arabic and English speakers.

4. Exclusion criteria

- 1- Caregivers of diabetic patients taking non-insulin based therapy.
- 2- Caregivers living outside Riyadh, Saudi Arabia.

4.1. Data analysis

Knowledge was modelled as a binary variable (Existing or not Existing) using the conventional and predetermined cutoffs defined earlier. As such, each participant was allocated in 1 of the 2 mutually exclusive and exhaustive categories of knowledge status. If the average knowledge is >2.5 , it is considered as knowledgeable. Frequencies, Percentages were used to describe demographics and clinical data of the participants; Logistic regression models were fitted to estimate the effect size of the factors by calculating odd ratios (ORs) with 95% confidence intervals (CI). The last category was used as a reference level. All variables significant in the univariate analysis were included in a final multivariate model fitted to obtain adjusted estimates of the ORs and to identify factors that were independently associated with burnout. A P-value less than 0.05 was considered significant. The statistical analysis was performed using SPSS software version 25 (SPSS Inc. Chicago, USA).

5. Characteristics of the study participants

A total of 814 participants filled the online questionnaire. Of all 83.7% were female, The age group between 20 years and 30 years were about 42.3% of the participants sample and It was noted that the majority were holding bachelor's degree (58%). 48.5% of participants were married and 46.2% Single, 96.2% were the Relative of patient. The results showed that 62.4% of the participants live with patient. In addition 54.2% of them have Family history of DM. The demographic characteristics of the sample of caregivers are presented in Table 1.

Table 1

Illustrated caregivers' sociodemographic characteristics and other clinical characteristics related to patients with DM.

Variables	N	%
Age		
<20	96	11.8
20–30	344	42.3
30–40	145	17.8
40–50	139	17.1
>50	90	11.1
Gender		
Male	133	16.3
Female	681	83.7
Marital status		
Single	376	46.2
Married	395	48.5
Divorced	27	3.3
Widow	16	2.0
Educational level		
Less than high school	35	4.3
High school	228	28.0
Diploma	33	4.1
Bachelor	472	58.0
Postgraduate	46	5.7
Job status		
Governmental sector	307	37.7
Private sector	172	21.1
Retired	22	2.7
Student	108	13.3
Unemployed	190	23.3
Volunteer	2	0.2
Work with health reciever	13	1.6
Job status changed		
Yes	276	33.9
No	538	66.1
Reasons if job changed		
Absence	126	15.7
Increasing working hours	54	6.7
Reducing working hours	46	5.7
Resignation	29	3.6
Transfer to another job	21	2.6
Relation to patient		
Relative of patient	783	96.2
Work with patient	31	3.8
Live with patient		
Yes	508	62.4
No	306	37.6
Started taking care of patient since		
Less than 6 months	182	22.4
6 months–1 year	80	9.8
1–5 years	176	21.6
5–10 years	153	18.8
>10 years	223	27.4
Patient diagnosed since		
Less than 6 months	98	12.0
6 months–1 year	69	8.5
1–5 years	154	18.9
5–10 years	141	17.3
>10 years	352	43.2
Started on insulin since		
Less than 6 months	89	10.9
6 months–1 year	59	7.2
1–5 years	159	19.5
5–10 years	134	16.5
>10 years	171	21.0
I dont know	202	24.8
Family history of DM		
Yes	441	54.2
No	230	28.3
I dont know	143	17.6

6. Knowledge of caregivers about insulin doses administration and adjustments

About 80 % of the participants reported that they always use medical wipes before injecting insulin. Asking about insulin injection complication, 60% of the participants agreed that it's associ-

ated with low blood sugar. Regarding the change of insulin injection location, over 50% of the respondents have no knowledge. Moreover, 35% of the respondents don't know about massaging the area of injection. Also, most of the participants agreed that patients with low blood sugar should be given any source of sugars.

In Table 2, more than half of the answers showed that the medical provider educated them on how and when to adjust insulin doses and they totally understood it. 60% of the participants have no knowledge regarding carbs count in patient's meals. Additionally, 55% were satisfied with their level of knowledge about insulin doses management. However, only 24% of the participants reported that they forget to adjust insulin doses if needed. The majority were tended to test blood sugar levels before giving the insulin injection to the patient (67%) and they have good knowledge in regard to adjusting insulin doses according to blood sugar level readings. Around 55% of the participants had agreed that adjusting insulin doses should be done according to patient's physical activity level and the amount of carbohydrates consumed.

7. Association between caregivers knowledge on inulin dosages administration and demographics characteristics

In the univariate logistic regression analysis, caregiver's knowledge on inulin dosages administration was significantly associated with the age, Live with patient and period of taking insulin. For the age variable, the group > 50 was set as reference and the group 20–30 was the only one to be statistically different relative to the reference; For the (live with patient) variable, who lives with patient has caregiver's knowledge on inulin dosages administration and was the only one to be statistically different relative to the reference who don't have. Started on insulin since, the group (I don't know) was set as reference and the two groups 1–5 and > 10 were statistically different relative to the reference.

However, in the final multiple logistic regression analysis, the factors independently associated with caregiver's knowledge on inulin dosages administration were as follows: live with patient (odds ratio [OR] = 1.766, 95% CI 1.285–2.426, P = .000) indicates who lives with patient has caregiver's knowledge on inulin dosages administration 1.766 times from those who don't have, Started on insulin since (>10 years) (OR = 1.780, 95% CI 1.117–2.836, P = .015) indicates who Started on insulin since has caregiver's knowledge on inulin dosages administration 1.78 times more than that don't know (Table 2).

8. Association between caregivers knowledge on inulin adjustments and demographics characteristics

In the univariate logistic regression analysis, caregiver's knowledge on inulin dosages administration was significantly associated with the age, Education Level, Started taking care of patient since, Started on insulin since and Diagnosed with DM since as follows: For the age variable, the group > 50 was set as reference and the two groups less than 20 and 20–30 were to be statistically different relative to the reference, the (Education Level) variable, the post-graduate group was set as reference and all groups were to be statistically different relative to the reference. For the (Started taking care of patient since) variable, the > 10 group was set as reference and the group (less than 6 months) was the only one to be statistically different relative to the reference, the (Started on insulin since) variable, the (I don't know) group was set as reference and the all groups except (less than 6 months) were to be statistically different relative to the reference and the Diagnosed with DM since variable the > 10 group was set as reference and the group (6 months–1 year) was the only one to be statistically different relative to the reference.

Table.2

Association between caregiver's knowledge on insulin dosages administration and demographics characteristics by univariate and multivariate logistic regression analyses. The last category was used as reference level.

Characteristic	Univariate analysis		Multivariate analysis	
	OR (95 %CI)	P value	OR (95 %CI)	P value
Age				
<20	0.613 (0.343–1.097)	0.099	0.873 (0.408–1.867)	0.726
20–30	0.607 (0.379–0.974)	0.038	0.588 (0.318–1.088)	0.091
30–40	0.734 (0.431–1.251)	0.256	0.615 (0.340–1.115)	0.109
40–50	0.878 (0.512–1.505)	0.635	0.760 (0.427–1.353)	0.351
>50	–	–	–	–
Gender				
Male	0.915 (0.631–1.327)	0.641	0.989 (0.663–1.476)	0.958
Female	–	–	–	–
Marital status				
Single	0.861 (0.317–2.343)	0.770	1.363 (0.431–4.316)	0.598
Married	1.297 (0.477–3.524)	0.611	1.915 (0.655–5.597)	0.235
Divorced	1.077 (0.313–3.710)	0.907	1.433 (0.383–5.362)	0.593
Widow	–	–	–	–
Education Level				
Less than high school	0.593 (0.244–1.439)	0.248	0.577 (0.221–1.504)	0.260
High school	0.601 (0.316–1.142)	0.120	0.623 (0.308–1.261)	0.189
Diploma	0.457 (0.184–1.139)	0.093	0.600 (0.230–1.566)	0.297
Bachelor	0.848 (0.459–1.568)	0.600	0.953 (0.459–1.832)	0.884
Postgraduate	–	–	–	–
Relation to patient				
Relative of patient	1.301 (0.633–2.676)	0.474	1.135 (0.526–2.447)	0.747
Work with patient	–	–	–	–
Live with patient				
Yes	1.640 (1.233–2.183)	0.001	1.766 (1.285–2.426)	0.000
No	–	–	–	–
Started taking care of patient since				
Less than 6 months	0.993 (0.671–1.469)	0.971	1.183 (0.685–2.040)	0.547
6 months–1 year	1.198 (0.718–1.998)	0.488	1.296 (0.671–2.501)	0.440
1–5 years	1.426 (0.959–2.123)	0.080	1.416 (0.844–2.375)	0.188
5–10 years	1.285 (0.851–1.942)	0.233	1.197 (0.717–1.999)	0.491
>10 years	–	–	–	–
Started on insulin since				
Less than 6 months	1.473 (0.892–2.430)	0.130	1.227 (0.657–2.292)	0.521
6 months–1 year	1.747 (0.973–3.136)	0.062	1.715 (0.858–3.427)	0.127
1–5 years	1.94 (1.273–2.956)	0.002	1.543 (0.957–2.488)	0.075
5–10 years	1.418 (1.914–2.200)	0.119	1.114 (0.685–1.812)	0.664
>10 years	1.680 (1.114–2.534)	0.013	1.780 (1.117–2.836)	0.015
I dont know	–	–	–	–
Diagnosed with DM since				
less than 6 months	1.210 (0.773–1.895)	0.404	1.640 (0.851–3.160)	0.139
6 months–1 year	1.04 (0.621–1.743)	0.882	1.051 (0.526–2.098)	0.888
1–5 years	1.252 (0.856–1.829)	0.247	1.091 (0.642–1.855)	0.747
5–10 years	1.404 (0.947–2.081)	0.091	1.554 (0.938–2.573)	0.087
>10 years	–	–	–	–

However, in the final multiple logistic regression analysis, the factors independently associated with caregivers knowledge on insulin dosages adjustments were as follows: Age (less than 20) (odds ratio [OR] = 0.333, 95% CI 0.148–0.746, P = .008) indicates who the participant in less than 20 group has caregiver's knowledge on insulin dosages adjustments will decrease 67% times from > 50 and (20–30) (odds ratio [OR] = 0.291, 95% CI 0.149–0.566, P = .000) indicates who the participant in 20–30 group has caregiver's knowledge on insulin dosages adjustments will decrease 70% times from > 50. Education Level (High school) (odds ratio [OR] = 0.412, 95% CI 0.185–0.916, P = .030) indicates who have high school has caregiver's knowledge on insulin dosages administration 59% times from Postgraduate, Started on insulin since (6 months–1 year) (odds ratio [OR] = 4.028, 95% CI 1.9–8.539, P = .000), (1–5 years) (odds ratio [OR] = 2.857, 95% CI 1.712–4.765, P = .000), (5–10 years) (odds ratio [OR] = 2.007, 95% CI 1.209–3.333, P = .007) and (>10 years) (odds ratio [OR] = 1.842, 95% CI 1.138–2.984, P = .013) indicates the participants that Started on insulin since (6 months–1 year, 1–5 years, 5–10 years and > 10 years) have caregiver's knowledge on insulin dosages administration 4.028,

2.86, 2 and 1.84 times (respectively) more than that don't know. Diagnosed with DM since (6 months–1 year) (OR = 0.447, 95% CI 0.209–0.954, P = .037) indicates the participants that Diagnosed with DM since (6 months–1 year) have caregiver's knowledge on insulin dosages administration will decrease 55% from > 10 years (Table 3).

ethical Consideration

All participants in the study were given information about the nature of their participation and were asked to sign a consent form. Besides, all the obtained information was used for scientific research purposes only and treated as confidential through a coding system. The study protocol was approved by the Institutional Review Board of the Research Unit at King Saud University Medical City prior data collection.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table.3

Association between caregivers knowledge on inulin dosages adjustments and demographics characteristics by Univariate and multivariate logistic regression analyses. The last category was used as reference level.

Characteristic	Univariate analysis		Multivariate analysis	
	OR (95 %CI)	P value	OR (95 %CI)	P value
Age				
<20	0.256 (0.137–0.477)	0.000	0.333 (0.148–0.746)	0.008
20–30	0.306 (0.182–0.513)	0.000	0.291 (0.149–0.566)	0.000
30–40	0.673 (0.375–1.208)	0.184	0.550 (0.285–1.06)	0.074
40–50	0.741 (0.409–1.342)	0.323	0.629 (0.331–1.193)	0.156
>50	–	–	–	–
Gender				
Male	0.919 (0.632–1.335)	0.657	1.005 (0.661–1.527)	0.982
Female	–	–	–	–
Marital status				
Single	0.517 (0.184–1.451)	0.210	1.936 (0.578–6.483)	0.284
Married	1.223 (0.435–3.438)	0.703	2.446 (0.790–7.573)	0.121
Divorced	0.480 (0.135–1.701)	0.256	0.870 (0.219–3.46)	0.843
Widow	–	–	–	–
Education level				
Less than high school	0.333 (0.129–0.859)	0.023	0.355 (0.123–1.023)	0.055
High school	0.309 (0.149–0.638)	0.002	0.412 (0.185–0.916)	0.030
Diploma	0.296 (0.113–0.774)	0.013	0.436 (0.155–1.226)	0.115
Bachelor	0.454 (0.225–0.917)	0.028	0.566 (0.266–1.203)	0.139
Postgraduate	–	–	–	–
Relation to patient				
Relative of patient	0.709 (0.335–1.5)	0.369	0.552 (0.238–1.281)	0.166
Work with patient	–	–	–	–
Live with patient				
Yes	1.299 (0.976–1.729)	0.073	1.348 (0.966–1.882)	0.079
No	–	–	–	–
Started taking care of patient since				
Less than 6 months	0.513 (0.345–0.763)	0.001	0.571 (0.323–1.009)	0.054
6 months–1 year	0.707 (0.423–1.183)	0.187	0.863 (0.434–1.714)	0.673
1–5 years	0.992 (0.662–1.487)	0.969	0.789 (0.461–1.351)	0.388
5–10 years	1.048 (0.686–1.6)	0.829	0.842 (0.493–1.438)	0.528
>10 years	–	–	–	–
Started on insulin since				
less than 6 months	1.402 (0.849–2.314)	0.187	1.329 (0.689–2.551)	0.396
6 months–1 year	2.091 (1.159–3.773)	0.014	4.028 (1.9–8.539)	0.000
1–5 years	3.126 (2.02–4.837)	0.000	2.857 (1.712–4.765)	0.000
5–10 years	2.569 (1.637–4.032)	0.000	2.007 (1.209–3.333)	0.007
>10 years	2.225 (1.469–3.373)	0.000	1.842 (1.138–2.984)	0.013
I dont know	–	–	–	–
Diagnosed with DM since				
Less than 6 months	0.972 (0.619–1.527)	0.902	1.930 (0.964–3.863)	0.063
6 months–1 year	0.519 (0.307–0.877)	0.014	0.447 (0.209–0.954)	0.037
1–5 years	1.041 (0.709–1.526)	0.839	0.964 (0.55–1.689)	0.898
5–10 years	1.301 (0.870–1.944)	0.200	1.479 (0.872–2.511)	0.147
>10 years	–	–	–	–

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