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Assessment of Elderly Type 2 Diabetic Patients who Self-adjust Their Insulin Regimen in Al-Qassim Region

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Abstract

BACKGROUND: Type 2 diabetes mellitus (T2DM) is a multifactorial chronic disease. To avoid long-term and short-term complications, good glycemic control must be achieved. The majority of T2DM patients who require insulin therapy have their doses modified by their physicians; this procedure takes time and may not result in the optimal glycemic control.

AIM: This study aims to ascertain whether elderly T2DM patients in Al-Qassim region modify their own insulin regimen and its effect on their glycemic control.

METHODS: This cross-sectional study was conducted in Al-Qassim University Medical City and Diabetic Centers in Buraydah, Saudi Arabia. Data were collected using a questionnaire.

RESULTS: A total of 384 participants were enrolled with a mean age of 70.2 ± 6.0 (61–94) years, majority (53.6%) of whom were females. About half (50.8%) were not educated and two-third (66.1%) giving insulin injections by themselves. Less than half (40.6%) of the participants changed their insulin dose, out of which 8.3% changed the dose by themselves. The mean hemoglobin A1C (HbA1c) level was 8.8 ± 1.9 with a range of 5.2–17. About 30.5% had recent hypoglycemic attacks, majority (47.9%) of whom had only one episode. Diabetic complications were seen among 127 participants with retinopathy as the most common (43.3%) complication. Hypoglycemic attacks and insulin dose adjusting were not found to be significantly associated (p = 0.476). The last HbA1c level was found to be significantly associated with adjusting insulin dose.

CONCLUSION: Self-adjusting insulin dose was found to be rare. Moreover, HbA1c in patients who self-adjust their insulin dose was found to be significantly lower.

Introduction

Type 2 diabetes mellitus (T2DM) is a multifactorial chronic disease. To avoid its long-term and short-term complications, good glycemic control must be achieved by the patient. Good glycemic control in T2DM has been associated with a lower risk of complications [1].

Different medications and regimens are available and used to maintain a good glycemic control. Currently, the clinical practice, for most patients with T2DM on insulin therapy, is to have their insulin doses titrated by their clinicians. This is a time-consuming process, and evidence suggests that it may not provide optimal glycemic management for patients [2]. Among type 1 diabetes mellitus (T1DM) patients, intensified insulin therapy with frequent self-monitoring and self-adjustment of dose improves metabolic control and quality of life by decreasing hypoglycemia. Multiple injection strategies are also used in type 2 diabetes patients. Self-adjustment of insulin dose is an essential component of education programs for type 2 diabetes patients on conventional insulin therapy, and even more so in multiple injection therapy [3].

To improve metabolic control and reduce the incidence of hypoglycemia in people with T2DM, flexible insulin therapy is increasingly being used. People who use flexible insulin strategies can adjust their insulin dose. Structured T2DM treatment and education programs include extensive expert training to provide rules for self-adjustment of insulin dose [4]. Patients are told to adjust their insulin dosage based on self-measured blood glucose levels, carbohydrate intake, and physical activity. Multiple injection therapy is thought to have a significant advantage in terms of self-adjustment, which allows for better customization of therapy to patients' needs.

The self-adjustment of insulin dose is thought to improve metabolic control and prevent hypoglycemia [3]. According to a study conducted by Jena University Hospital in Germany on type 1 diabetic patients, despite being trained to use a factor for correction for insulin dose self-adjustment (ISA) in the event of high premeal blood glucose levels, only half of the patients adjusted their insulin dosage using the complex rules from the

treatment and education program. Patients who formed their ISA based on their feelings had no worse metabolic control [5]. Another study, at Jena University Hospital in Germany, found that only one-fifth of type 2 diabetic patients used the rule taught in the education program to adjust their insulin dose. Most people adjusted their insulin dose based on personal experience or feelings. People in both groups, however, were able to adjust their insulin dose.

Although people who used adjustment rules adjusted their insulin dose more frequently, their hemoglobin A1C (HbA1c) and incidence of hypoglycemia were comparable to those who used personal experience/feeling [4]. Another study found that simplifying insulin regimens in older persons can reduce the incidence of hypoglycemia and disease-related distress while maintaining glycemic control and HbA1c levels may not predict hypoglycemia risk in the elderly and should not be used as the sole parameter for goal setting [6].

The majority of T2DM patients who require insulin therapy have their doses modified by their physicians; this procedure takes time and may not result in the optimal glycemic control. However, there is currently no epidemiological research on the use of self-adjusted insulin in Saudi Arabia. This study aims to ascertain whether elderly T2DM patients in Al-Qassim region modify their own insulin regimen and its effect on their glycemic control.

Methods

We conducted this cross-sectional study at Al-Qassim University Medical City and Diabetic Centers in Buraydah, Kingdom of Saudi Arabia, during the period of January 2023–March 2023. We included elderly patients from both genders with diagnosed T2DM being managed by insulin regimen. Patients with age more than 60 years were defined as elderly patients, while patients of other diseases, T1DM, T2DM patients not on insulin regimen, and patients not fulfilling age requirement were excluded from the analysis.

For data collection, a validated questionnaire was created after reviewing the existing evidence with the same objectives. The draft questionnaire was reviewed by endocrine consultants and by research committees. The created questionnaire was shared among the included patients who answered the questionnaire on their own. The questionnaire collected demographic characteristics: Sex, age, education, employment, marital status, Hba1c level, and T2DM duration, and clinical details: What kind of insulin they use, how often they use it, how they store it, whether they are taking any other medications, how many patients adjust their own insulin dosage, their most recent HbA1c levels, their history of hypoglycemic episodes, and whether they have any diabetic complications.

For statistical analysis, the statistical package for social science version-23, an IBM product in Chicago - USA, was used. Categorical variables were demonstrated as frequency and percentage (%), while parametric parameters were demonstrated as mean ± standard deviation (SD), as well as minimum and maximum values. The Chi-square test was used to compare glycemic control between self-adjusted and non-adjusted patients and Fisher's exact test was used when Chi-square test's conditions were not met. $p = 0.05$ or lower indicated statistical significance.

We got ethical approval from the Qassim Region Research Ethics Committee to conduct this hospital-based research. Informed consent was taken prior to data collection. Complete anonymity of the research participants was maintained.

Results

A total of 384 diabetic patients with T2DM were included. The mean age was found to be 70.2 ± 6.0 (61–94) years (Table 1). Majority of our participants (53.6%) were females while the rest (46.4%) were males. Of educational details, 195 (50.8%) were not educated, 105 (27.3%) were found to be of primary school level, 35 (9.1%) were with secondary school level, 22 (5.7%) were with high school level, and 27 (7%) were at university level. Of 384, 254 (66.1%) were found to be giving insulin injections by themselves. The type of injection was insulin pen for the majority (89.3%) of the participants and insulin syringe for 41 (10.7%) of the participants. Most (84.4%) of the participants store insulin in the refrigerator whereas 60 (15.6%) of the participants were found to be storing it in room temperature. A total of 290 (75.5%) participants were found to be having an insulin injection twice daily whereas 94 (24.5%) were taking it more than 2 times daily (Table 1).

A total of 156 (40.6%) of the participants have changed their insulin dose; of these, about

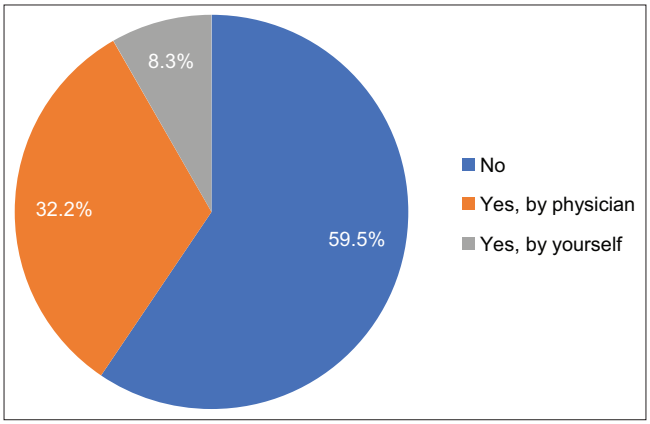

Figure 1: Have you changed your insulin dose recently and is it by you or by the physician?

Table 1: Demographics characteristics of the patients (n = 384)

Variable	Overall n (%)
Age (in years): Mean ± SD (min-max)	70.2 ± 6.0 (61–94)
Gender:	
Male	178 (46.4)
Female	206 (53.6)
Educational level:	
None	195 (50.8)
Primary school	105 (27.3)
Secondary school	35 (9.1)
High school	22 (5.7)
University	27 (7.0)
Who give you the insulin injections?	
Yourself	254 (66.1)
Others	130 (33.9)
What is the type of insulin?	
Insulin syringe	41 (10.7)
Insulin pen	343 (89.3)
How do you store the insulin?	
In the refrigerator	324 (84.4)
In room temperature	60 (15.6)
How frequent do you take your insulin injections?	
2 times daily	290 (75.5)
More than 2 times daily	94 (24.5)

32 (8.3%) changed the dose by themselves and 124 (32.3%) changed insulin dose by physician and the rest 228 (59.4%) did not changed the dose (Figure 1).

About 255 (66.4%) were found to be using other medications than insulin (Table 2). The most reported medications were drugs of treatment of hypertension as mentioned by 144 (56.5%) of the participants, 77 (30.2%) were taking cholesterol-lowering drugs, 56 (22%) were taking aspirin, 42 (16.5%) were found to be taking cardiac drugs, 23 (9%) were taking diuretics, 18 (7.1%) were taking vitamins, 11 (4.3%) were taking thyroid medications, another 11 (4.3%) were also taking metformin, gastric medications and prostate medications were taken by 6 (2.4%) of the participants each, and 52 (20.4%) were taking other drugs. The mean HbA1c level was found to be 8.8 ± 1.9 with a range of 5.2–17. About 117 (30.5%) have recent hypoglycemic attacks. Of those who have recent hypoglycemic attacks, 56 (47.9%) have one hypoglycemic attack, 32 (27.4%) have 2 hypoglycemic attacks, 13 (11.1%) have 3 hypoglycemic attacks, 9 (7.7%) have 4 hypoglycemic attacks, and 7 (6%) have 5 or more hypoglycemic attacks.

Table 2: Other medications, HbA1c levels, history of hypoglycemic episodes, and diabetic complications

Variable	Categories	Overall
Do you use other medication?	Yes	255 (66.4)
	No	129 (33.6)
Other used medications (n = 255)	Metformin	11 (4.3)
	Aspirin	56 (22.0)
	HTN medications	144 (56.5)
	Heart drugs	42 (16.5)
	Cholesterol drugs	77 (30.2)
	Diuretics	23 (9.0)
	Thyroid medications	11 (4.3)
	Gastric medications	6 (2.4)
	Vitamins	18 (7.1)
	Prostate medications	6 (2.4)
	Asthma drugs	3 (1.2)
	Anticoagulants	4 (1.6)
	Oral hypoglycemic	7 (2.7)
	Other	52 (20.4)
What is your last HbA1c?	Mean ± SD (range)	8.8 ± 1.9 (5.2–17)
Are there any hypoglycemic attacks recently?	Yes	117 (30.5)
	No	267 (69.5)
If yes, how many?	1	56 (47.9)
	2	32 (27.4)
	3	13 (11.1)
	4	9 (7.7)
	5 or more	7 (6)
Do you have any diabetic complications?	Yes	127 (33.1)
	No	257 (66.9)
If yes what is the complication? (n = 127)	Nephropathy	14 (11)
	Amputation	2 (1.6)
	Cataract	17 (13.4)
	Diabetic foot	5 (3.9)
	Retinopathy	55 (43.3)
	Hypertension	13 (10.2)
	Hyperlipidemia	7 (5.5)
	Coronary artery disease	9 (7.1)
	Neuropathy	16 (12.6)
	Diabetic macular edema	5 (3.9)
	Kidney disease	4 (3.1)
	Other	17 (13.4)

HbA1c: Hemoglobin A1C.

About 127 (33.1%) have diabetic complications whereas the rest (66.9%) were with no diabetic complications. The most frequently reported diabetic complication was retinopathy which was found in 55 (43.3%) participants followed by diabetic cataract which was reported in 17 (13.4%) participants, then diabetic neuropathy in 16 (12.6%) participants. Diabetic nephropathy was found in 14 (11%) participants. Thirteen (10.2%) participants had hypertension, 9 (7.1%) had coronary artery disease, 7 (5.5%) had hyperlipidemia. Diabetic macular edema was found in 5 (3.9%) participants and kidney disease was found in 4 (3.1%) participants whereas other complications were found in 17 (13.4%) of the participants.

Hypoglycemic attacks and insulin dose adjusting were not found to be significantly associated (p = 0.476) (Table 3). The number of hypoglycemic attacks was not found to be significantly associated with insulin dose-adjusting regimen. Diabetic complications and insulin dose adjusting were not found to be significantly associated (p = 0.843). The last HbA1c level was found to be significantly associated with adjusting insulin dose (p = 0.001) wherein mean HbA1c level was found to be lower in patients with self-adjusting dose than the others.

Discussion

Adjusting insulin dose among elderly diabetic patients needs assessment, especially those who self-adjust their doses. This behavior could result in serious complications ranging from acute complications such as hypoglycemia and chronic complications which results

Table 3: Association between self-adjusting regimen and hypoglycemic attacks, HbA1c, and diabetic complications

Variable	Categories	Insulin dose change		p-value
		By yourself	By physician	
		n (%)		
Are there any hypoglycemic attacks recently?	Yes	13 (40.6)	42 (33.9)	0.476
	No	19 (59.4)	82 (66.1)	
No. of hypoglycemic attacks	1	7 (53.8)	16 (38.1)	0.722[F]
	2	4 (30.8)	15 (35.7)	
	3	0 (0)	5 (11.9)	
	4	1 (7.7)	4 (9.5)	
	5 or more	1 (7.7)	2 (4.8)	
Do you have any diabetic complications?	Yes	13 (40.6)	48 (38.7)	0.843
	No	19 (59.4)	76 (61.3)	
		mean ± SD		
Last HbA1c level		8.24 ± 1.35	9.37 ± 2.13	<0.001[T]*

p-value calculates using Fisher's exact test (F), Independent samples t-test (T), and Chi-square test. With p < 0.05 as significant. HbA1c: Hemoglobin A1C.

from poor control of diabetes [7]. Our study aimed to ascertain whether elderly T2DM patients in Al-Qassim region modify their own insulin regimen and its effect on their glycemic control.

The mean age was found to be around 70 years while more than half (53.6%) were females, and the rest (46.4%) were males. About half (50.8%) of the participants were not educated. Two-thirds (66.1%) of the participants were found to be giving insulin injections by their selves. The type of injection was insulin pen in the vast majority (89.3%) of the participants. Furthermore, the majority (84.4%) of the participants store insulin in the refrigerators. Similar findings were found in the parallel study conducted by Netere *et al*. in which 56.6% of the participants were also found to be storing insulin at low temperature [8]. More than two-thirds (75.5%) of the participants were found to be having insulin injections twice daily. This finding was found to be contradictory to the findings reported in the study carried out by Janež *et al*. in which most of the participants reported 3 doses of prandial insulin in addition to 1–2 doses of basal insulin [9].

Less than half (40.6%) of the participants have changed their insulin dose, out of them 8.3% changed the dose by themselves and nearly one-third (32.3%) changed insulin dose by a physician, and the rest (59.4%) did not change the dose. Meanwhile, literature shows a higher prevalence of insulin self-adjusting in a congruent study conducted by Kramer *et al*. in which (74.5%) were adjusting insulin dose by themselves (feeling or experience) whereas 22.1% were adjusting it by physician rules [5].

About 66.4% were found to be using other medications than insulin. The most (56.5%) reported medications were drugs of treatment of hypertension followed by cholesterol-lowering drugs in nearly one-third (30.2%) of the participants, then 22% were taking aspirin, and 16.5% were found to be taking cardiac drugs. These findings agree with a study conducted by Akın *et al*., in which hypertension and hyperlipidemia were the most common comorbidities with diabetes mellitus [10]. The mean HbA1c level was found to be 8.8%, this was similar to a report by Alshwikh *et al*. in which HbA1c was reported to be 8.03% among the participants [11].

Nearly one-third (30.5%) of the participants have recent hypoglycemic attacks. Nearly half (47.9%) of those who have recent hypoglycemic attacks have one hypoglycemic attack, less than one-third (27.4%) have 2 hypoglycemic attacks and the rest were with more than 2 hypoglycemic attacks and this was found to be consistent with the findings of the parallel study carried out by Tsalikian *et al*. in which 65% of the participants had at least one hypoglycemic episode [12]. One-third (33.1%) of the participants were found to be having diabetic complications. The most reported diabetic complication was retinopathy which was found in less than half (43.3%) of the participants followed by diabetic cataract and diabetic neuropathy. While a study conducted by Papatheodorou *et al*. reported neuropathy as the most common complication [13].

The last HbA1c level was found to be significantly associated with adjusting insulin dose with mean HbA1c level found to be lower in patients with self-adjusting dose than the others. Diabetic complications and insulin dose adjusting were not found to be significantly associated. No statistically significant association between hypoglycemic attacks and insulin dose adjusting was consistent with the findings reported of the congruent study conducted by Silva and Bosco in which no association was found between hypoglycemia and adjusting insulin dose among the participants [14].

Conclusion

Self-adjusting insulin dose was found to be rare as most of insulin dose adjustments among most of the participants is ruled by a physician. Diabetic retinopathy is the most frequently reported complication and hypertension is the most important comorbidity. HbA1c in patients who self-adjust their insulin dose was found to be lower and hence their diabetic control is better than the others. This study warrants increased awareness about the importance of insulin dose adjustment and the rules of the proper adjustments. This could be attained through augmentation of physician role in educating his patients and distribution of knowledge through various strategies including media and others.

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