Original

Evaluation of therapeutic education in diabetic patients in the city of Kenitra (Morocco): A cross-sectional study

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ABSTRACT

Background: In the field of health, therapeutic education has emerged as a fundamental tool enabling patients to gain greater autonomy, improve their personal management of their illness, while taking into account their needs, resources, values, and approaches.

Objective: This study aimed to analyze the curative elements mentioned in the accounts of members of a group of diabetic patients, as well as to assess the current state of practices related to injection techniques among these patients on insulin.

Methods: This cross-sectional study was conducted with 100 diabetic participants from the city of Kénitra. Each patient answered questions on the injection technique questionnaire.

Results: 70.8% of participants were type 2 diabetic patients, compared to 23.6% who have type 1. Two modes of insulin injection were reported, one is subcutaneous, the other is intramuscular, with 66.0% and 28.3% respectively. A very high proportion of participants reported that they vary their insulin injection sites, at 84.9%. Regular cleaning of the injection site is only reported by 25.5%, compared to 68.9% who do it sometimes, and the adjustment of insulin dosage according to meals shows only a low proportion.

Conclusion: This article highlights the essential importance of therapeutic education in the management of diabetes, thus contributing to better health. It supports patients in acquiring self-care skills, managing diabetes, and controlling their blood sugar levels. Health authorities are required to regularly organize training sessions and appropriate evaluations in order to improve the knowledge, attitudes, and behaviors of diabetic patients regarding insulin administration.

Keywords: Patient education, Glycemic control, Insulin, Diabetes.

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INTRODUCTION

Diabetes mellitus is positioned as one of the major public health challenges on a global scale,[1] thus affecting hundreds of millions of individuals worldwide and resulting in significant morbidity, mortality, and financial burden for healthcare systems.[2]

Its complex nature as a multisystem metabolic disorder characterized by hyperglycemia leads to complications that reduce quality of life and increase mortality.[3] This requires comprehensive management approaches beyond pharmacological treatment.[4] Indeed, therapeutic education emerges as a fundamental strategy in the management of diabetes. It is a structured process aimed at enabling patients to acquire or maintain the skills and knowledge necessary to effectively manage their condition.[5] Therapeutic education goes beyond the simple dissemination of information. It encourages behavior changes, stimulates patient independence, and supports commitment to treatment plans through individualized and continuous learning tailored to personal requirements and contexts.[6] This type of teaching encompasses medical, psychological, and social aspects, in accordance with contemporary standards of patient-centered care.

The objective of this research work is to explore the crucial importance of therapeutic education for individuals living with diabetes on one hand, and to highlight its indispensable contribution to diabetes care on the other hand. The significance of this study lies in informing healthcare professionals, decision-makers, and stakeholders about best practices and advocating for the integration of therapeutic education as a standard component in diabetes management frameworks.

METHODOLOGY

Study Setting: The study was conducted at the My Hassan health center in the prefecture of Kenitra (Morocco) during April 2024.

Study Design: A descriptive cross-sectional survey was conducted.

Study Population: This study targeted people with diabetes who frequent the My Hassan health center in the prefecture of Kenitra (Morocco) during April 2024.

Sampling: One hundred people took part in this survey. Participants were randomly selected to ensure the representativeness of the sample. It should be noted that this questionnaire is composed of two parts. The first part concerns personal characteristics, while the second part addresses the practice of insulin use and hygiene.

Validity and reliability of the questionnaire: The validity of the questionnaire was confirmed by submitting it to a group of members of the physicians at the Moulay El-Hassan primary health center in the Kénitra region in 2024, in order to gather their opinions and comments regarding the completeness of the dimensions of the questionnaire, the representativeness of the statements in relation to the axes and dimensions addressed, their relevance, as well as the clarity of each statement. Subsequently, the rates of agreement on each of the statements were calculated. As a result, some statements were eliminated while others were modified and rephrased.

Calculation of the reliability of the questionnaire is shown in table 1.

Table 1. Reliability Statistics for 32 items

Cronbach's Alpha	Number of Items
0.701	32

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Table 2. Total item statistics

item	Average of the scale in case of removal of an element	Variance of the scale in case of removal of an element	Complete correlation of the corrected elements	Cronbach's alpha if the item is deleted
Item 1: Do you know the difference between rapid insulin and slow insulin?	50,9667	30,240	0,232	0,694
Item 2: Injection mode	50,8000	31,269	0,042	0,705
Item 3: Do you always use the same needle?	50,8000	29,545	0,357	0,686
Item 4: Do you wash your hands before giving the insulin injection?	50,8333	30,626	0,156	0,699
Item 5: Do you change the injection site?	50,9000	34,369	-0,482	0,735
Item 6: Do you clean the injection site with a disinfectant product?	50,9667	33,964	-0,423	0,731
Item 7: Do you purge the air bubbles before injecting?	50,9667	29,895	0,296	0,690
Item 8: Do you pinch the skin during injection?	50,9000	28,231	0,606	0,670
Item 9: Do you adjust your insulin dose based on your meals?	50,7000	29,114	0,279	0,690
Item 10: Do you ever skip an injection?	50,7333	29,099	0,457	0,680
Item 11: What do you do if you forget an insulin injection?	50,6667	29,816	0,339	0,688
Item 12: What do you do in case of hypoglycemia?	50,7333	32,409	-0,160	0,716
Item 13: What do you do in case of hyperglycemia?	50,7667	29,564	0,359	0,686
Item 14: How do you store your insulin?	50,8000	29,476	0,370	0,685
Item 15: How do you manage unforeseen events (travel, meals at a restaurant, etc.)?	50,5333	27,154	0,450	0,672
Item 16: Have you ever encountered difficulties in managing your insulin treatment?	50,4333	30,599	0,127	0,701
Item 17: Who will administer the insulin injection to you?	51,0000	29,172	0,443	0,681
Item 18: What are the positive aspects of this treatment?	51,0667	29,237	0,457	0,681
Item 19: What are the negative aspects of this treatment?	51,0000	31,310	0,038	0,705
Item 20: Do you experience difficulties in managing your diabetes on a daily basis?	50,5000	27,431	0,496	0,670
Item 21: How often do you see your primary care physician or your endocrinologist?	50,2000	29,131	0,234	0,694
Item 22: Do you check the expiration date of the bottle?	50,8667	29,154	0,427	0,682
Item 23: Have you ever used insulin vials or cartridges after the expiration date?	50,8000	31,752	-0,044	0,710
Item 24: Before injecting, do you shake the insulin bottle?	50,9333	32,892	-0,240	0,721
Item 25: If you use the pen needle/syringe, do you use them more than once?	51,0667	28,685	0,572	0,674
Item 26: Do you inject yourself through your clothes?	50,5000	32,603	-0,245	0,714
Item 27: Do you label the bottle/cartridge with the date of opening?	51,0000	33,724	-0,388	0,729
Item 28: Do you use a syringe/pen?	50,9000	30,921	0,103	0,702
Item 29: Have you noticed any bleeding or bruising (blue marks) at the injection site?	50,8667	27,982	0,654	0,667
Item 30: blood glucose monitoring	51,0000	30,138	0,256	0,693
Item 31: How often do you inject insulin?	50,2333	25,633	0,703	0,647
Item 32: Do you know the precautions to take to avoid infections at the injection site?	50,6333	27,620	0,427	0,676

The reliability coefficient was determined using Cronbach's alpha coefficient to evaluate the reliability of each dimension of the questionnaire as well as that of the questionnaire as a whole, as shown in Tables 1 and 2.

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The search for the reliability of this questionnaire shows a Cronbach index of 0.701. This value is acceptable and is close to 0.7, indicating a reasonable reliability of the questionnaire. Note that the software used is SPSS in its free version 26.

RESULTS

Sociodemographic determinants

Table 3: Sociodemographic characteristics of the participants

Variable	Categories	Frequency	Percentage %
Sex	Man	30	28,3
	Woman	70	66,0
Total		100	94.3
	Over 60 years	40	37,7
	Between 40 and 60 years	29	27,4
Age	Between 20 and 40 years	21	19,8
	Under 20 years	10	9,4
Total		100	94.3
	Type 1	25	23,6
Type of diabetes	Type 2	75	70,8
Total		100	94.3
Knowledge of different insulins	Yes	27	25.5
	No	73	68.9
Total		100	94.3
	Semi slow pre-mixed	75	70,8
	Semi slow pre-mixed + fast	10	9,4
Type of insulin used	Semi slow + fast	8	7,5
	Fast	7	6,6
Total		100	94,3
Frequency of glycemic self-management	Rarely	69	65.1
	Regularly	31	29.2
Total		100	94,3

Table 3 shows the sociodemographic characteristics of the participants. It is noted that women have higher proportions compared to men, at 66% and 28.3% respectively. Similarly, it is noted that 37.7% of the studied population is over sixty years old, while a small proportion is under 20 years old. As for the types of diabetes, the results obtained show that 70.8% are affected by type 2 diabetes, compared to 23.6% of type 1. Regarding the type of insulin used, participants report that they use premixed semi-slow insulin at 70.8%, while premixed semi-slow + rapid insulin, semi-slow + rapid, and rapid insulin are used by only small proportions of participants, at 9.4%, 7.5%, and 6.6% respectively. It should be noted that there are missing values (n=6), which accounts for 5.7%.

Practice of insulin use and hygiene

Table 4. Practice of insulin use and hygiene

Variable	Categories	Frequency	Percentage %
	Subcutaneous	70	66.0
Injection method	Intramuscular	30	28.3
Total		100	94.3
	Yes	90	84,9
Variation of injection sites	No	10	9,4
Total		100	94.3
	Yes	24	22,6
Use of the same needle	No	76	71,7
Total		100	94.3

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	Yes	70	66.0
Purge of air bubbles	No	30	28.3
Total		100	94.3
Pinching of the skin	Yes	87	82.1
	No	13	12.3
Total		100	94.3
	Occasionally	73	68.9
Site cleaning	Always	27	25.5
Total		100	94.3
	Yes	86	81.1
Hand washing	Rarely	14	13.2
Total		100	94.3
	Yes	6	5.7
Adjustment of insulin dose	No	65	61.3
according to meals	Rarely	29	27.4
Total		100	94.3
checking the expiration date of	Yes	83	78.3
the insulin	No	17	16.0
Total		100	94.3
	No	93	87.7
Injection through clothing	Rarely	7	6.6
Total		100	94.3

Table 4 summarizes the participants' responses. It is noted that 66.0% (n=70) report that insulin injection is done subcutaneously. Additionally, 84.9% (n=90) varied the injection sites. Furthermore, 71.7% (n=76) state that they do not use the same needle. Moreover, 66.0% of participant's report that they purge air bubbles, and 82.1% of participants pinch their skin during insulin injection.

As for the cleaning of the insulin injection site, only 25.5% of participant's report that they always do it, compared to 68.9% who do it rarely. Regarding hand washing before insulin injection, 81.1% of participants reported that they do it.

Regarding the adjustment of insulin dosage according to meals, 61.3% report that they do not adhere to the insulin dosage according to meals, while 27.4% say they do so rarely. The remaining 5.7% adjust the insulin dosage according to meals.

As for injecting through clothing, the majority of participants, 87.7%, state that they do not use this method, compared to 6.6% who report that they do so as needed.

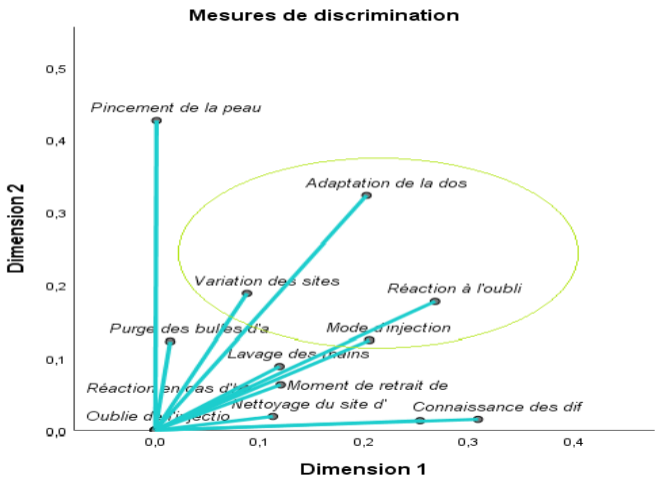

Figure 1. Results of the discrimination

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Figure 1 shows the results of the discrimination measurements; indeed, the variables furthest from the center are the most significant. These include the adaptation of the dose and the variation of injection sites on one hand, and the reaction to missed injections and the mode of insulin injection on the other hand. On the other hand, the other variables do not play a significant role

DISCUSSION

The study we conducted focused on a sample of 100 respondents. Among these participants, 70.8% were type 2 diabetic patients, compared to 23.6% who had type 1. Furthermore, 66% (n=70) were female, results comparable to those of the study conducted by Dankoly et al. (2023)[7] in the Oujda region. Additionally, 37.7% (n=40) were over 60 years old, while 9.4% (n=10) were under 20 years old.

As for the duration of insulin use, we found that the duration of insulin use is almost equal at 27.4%, 26.4%, and 26.4% for durations of less than 5 years, between 5 and 10 years, and from 10 to 20 years, respectively. Furthermore, only 14.2% of participant's report that the duration of insulin use exceeds 20 years.

Understanding diabetes and its management: Numerous research studies, including those by Noor et al. (2017)[8], show that understanding diabetes and knowledge of its management are two fundamental elements in diabetes therapeutic education. Indeed, type 1 diabetes results from the autoimmune destruction of pancreatic beta cells, leading to an absolute insulin deficiency, and generally manifests during childhood or adolescence.[9] On the other hand, type 2 diabetes is defined by insulin resistance, dysfunction of pancreatic β cells, and persistent hyperglycemia.[10] It is a widespread persistent metabolic complication, associated with a multifactorial origin, that has reached a global health crisis, affecting millions of people worldwide.[11]

On the pathophysiological level, numerous studies including those by Stehouwer (2018)[12] and González et al. (2023)[13] show that hyperglycemia triggers a series of metabolic imbalances and vascular injuries. Indeed, persistently high glucose levels can lead to microvascular complications such as retinopathy, nephropathy, and neuropathy, as well as macrovascular effects such as cardiovascular conditions.[14-15] These complications cause morbidity and mortality among diabetic populations, highlighting the crucial need for adequate blood glucose control and management of risk factors.[16-17]

Conventional diabetes management encompasses a multidimensional strategy aimed at regulating blood sugar levels, lipid profiles, and blood pressure.[18,19] In general, therapy combines medication treatments, such as insulin and oral hypoglycemic agents, with lifestyle changes including nutrition, physical exercise, and weight management.[20,21] Monitoring blood glucose levels and glycated hemoglobin through self-measurement is a crucial aspect of clinical follow-up.[22] Despite advancements, the traditional approach is often inadequate to meet the overall needs of patients, especially in terms of sustaining behavioral changes in the long term.

Therapeutic Education: Therapeutic education is a structured and ongoing approach aimed at providing patients suffering from chronic diseases such as diabetes with the knowledge, skills, and behaviors necessary for effective self-management.[23,24] It is not limited to the simple transmission of data, but incorporates theories on behavior change and psychological structures to encourage patient empowerment, independence, and commitment to complex treatments.[25] Moreover, as several research works have pointed out, including those of Ramsamy et al. (2024)[26], therapeutic education focuses on the active engagement of patients, the formulation of tailored objectives, and the adjustment to specific sociocultural contexts. This approach considers patients as allies in managing their health, capable of guiding their health journey through informed choices and self-care skills.[27]

Our research highlights that the prevalence of type 2 diabetes is significant within the examined population. Several risk factors may be involved, such as aging associated with a lack of physical activity, as well as an unbalanced diet high in saturated fats and sugars.[28] This situation results from the gradual shift of the population towards a transformed dietary lifestyle over the past few decades. Our results corroborate those of a cross-sectional analytical study on the predictive factors of knowledge level, attitudes, and quality of life of type 1 and type 2 diabetic patients in Tunisia, which highlights a predominance of type 2 diabetes with a rate of 81.5%, compared to 18.5% for diagnosed cases of type 1 diabetes.[29]

Effects of therapeutic education on diabetes-related outcomes

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Therapeutic education has a major impact on the experience of people with diabetes,[30,31,32] producing measurable outcomes on clinical indicators, mental health, and the burden on the healthcare system.[33-34-35] These multiple advantages strengthen its integration into the overall management of diabetes.[36-37-38] Indeed, studies involving patients with diabetes have reported serum HbA1c levels as the primary outcome.[39] Another research work conducted by Belhaj et al. (2024)[40] showed that therapeutic education had a positive impact on therapeutic adherence and diabetes-related distress.

During our study, it was observed that 65.1% of diabetic patients rarely monitor their blood sugar levels. This situation reflects a deficit in therapeutic education and awareness, as patients do not measure the importance of regular blood sugar monitoring in managing their diabetes, nor do they recognize the signs of hypoglycemia or hyperglycemia. Our results are consistent with those of a retrospective descriptive study conducted by Yuan et al. (2014)[41] among diabetic patients, which reported that a low proportion of patients practiced blood glucose self-monitoring.

Regarding the knowledge of the different types of insulin, it appears that the majority of participants (68.9%) do not have adequate information on this subject. This situation could be attributed to a lack of therapeutic education as well as communication difficulties. These results are consistent with another study conducted by Jasper et al. (2014)[42], which also reports a lack of knowledge about the types of insulin and their differences.

Regarding the type of insulin used, the results obtained showed that the most commonly used type of insulin is ready-to-use semi-fast insulin, with a percentage of 70.8%. The use of this type of insulin is mainly explained by its advantages, ease of administration, and the combination of fast and semi-fast insulin.[43]

Regarding the duration of insulin use, it is noted that the majority of diabetics have been using it for a long time. This can be explained by the lack of awareness and education about diabetes and its symptoms. Furthermore, our study addresses the method of insulin administration. The results obtained reveal that 66.0% of diabetic patients adopt the recommended good practices for insulin use regarding the injection method. However, the most reliable technique remains subcutaneous injection, which allows for a gradual release of insulin while ensuring safe and easy administration. This can be explained by a more or less low level of education on the injection practice.[44]

Furthermore, the results obtained during this scientific study reveal that nearly half of the participants change injection sites when administering insulin. This situation is explained by the high level of therapeutic education and increased awareness within this population regarding site rotation, as well as by the understanding of the importance of this practice to prevent any issues related to the injection site.

Regarding the reuse of the same needle, the results obtained show that 71.7% of participants do not do so. Indeed, several studies, including that of Mehrabbeik et al. (2022)[45], indicate that the repeated use of the same needle for insulin injections is a common practice. However, after several uses, the needle may undergo significant deformation, which is likely to increase complications related to injections, particularly the risk of lipodystrophy at the injection site as well as the risk of infection.[46]

Regarding the adherence to hygiene rules when using insulin, the majority of diabetics wash their hands before the injection (81.1%). This shows that aseptic rules are being followed: the population is aware of hygiene rules and their importance in preventing infections at injection sites.[47] However, we found that most diabetics do not clean their injection sites. This may reflect a lack of education on infection prevention at the injection site. Similarly, the results of our study confirm that most diabetics remove air bubbles, which suggests that this point should be considered in awareness efforts, as even slight and repeated under-dosing can lead to hyperglycemia. This complicates diabetes control and increases the risk of long-term complications.

Our study also focuses on adjusting the insulin dose based on meals. According to the results obtained, nearly half of the participants (61.3%) do not adjust their diet according to the administered insulin dose. Indeed, several research studies, including those by Krzymien et al. (2019)[48], indicate that various factors can influence the increase in blood sugar levels after a meal, which leads to significant difficulties in determining the appropriate dose of insulin to administer during meals. The insulin doses intended for the treatment of diabetic individuals must take into account not only the pre-meal blood sugar level but also the quantity and composition of the foods consumed. Therefore, this adjustment contributes to effective diabetes management.[49,50]

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Regarding the verification of the expiration date of insulin, the results obtained indicate that a very high proportion of participants, 78.3%, carry out this verification. Consequently, the use of expired insulin remains low (16.0%). This situation reflects a clear caution regarding the consumption of expired insulin.
Although the administration of insulin through clothing may seem convenient in certain circumstances[51], this method is generally discouraged due to the irregular absorption of the medication, the risk of needle damage, as well as the possibility of contamination and infection.[52]

Strengths and limitations of the study

This study aims to determine the prevalence of diabetic patients who have benefited from Therapeutic Patient Education (TPE) in Kénitra. It also allows for the assessment of their level of disease self-management. Furthermore, it could highlight significant correlations between TPE and various variables such as glycemic control (HbA1c), adherence to hygienic and dietary recommendations, as well as the socio-economic and educational level of the patients.
However, this study is limited to patients regularly monitored within public health facilities in Kénitra, thus excluding those who have discontinued their follow-up or are being treated in the private sector, which may result in a partial representation of the overall diabetic population.

Implications of the findings of the study

Therapeutic patient education efforts for diabetic patients in Kénitra should be redirected and specifically targeted at patients with a low level of education, as well as elderly people and housewives whose knowledge and practices remain limited.
Similarly, the study highlights the need to decentralize therapeutic patient education for diabetics (ETP) from specialized hospital centers to public healthcare facilities, making therapeutic education more accessible to the local population as well as the national population. It is also necessary to conduct a longitudinal study to follow patients benefiting from therapeutic patient education (TPE) and compare them with those who do not benefit from it.

CONCLUSIONS

Therapeutic awareness offers tangible benefits, including rigorous management of blood sugar levels, improvement in mental and psychological health, strengthening of self-care habits, and a reduction in the use of health services. According to the results of this study, the sample studied appears to be sufficiently aware of the risk of diabetes-related complications, which is why they strive to maintain stable blood sugar levels. However, some lack attention to disinfecting the insulin injection site and daily blood sugar monitoring, highlighting the need to remind and raise awareness about the importance of this glycemic control and cleaning the insulin injection site due to potential infections it could cause.

Declarations

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Conflict of interest - None

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