Original Article

Evaluation of the incidence of errors and related factors in the use of blood glucose control medications in an elderly population with type 2 diabetes

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Abstract

Context: The pace of population aging is increasing around the world. Medication errors are more common among the elderly for a variety of reasons and can lead to serious complications.

Aims: The aim of this study was to determine the incidence of errors and related factors in the use of blood glucose control medications in a diabetic elderly population in Qom, Iran.

Setting and Design: This descriptive, correlational study was conducted on the elderly with type II diabetes, who were referred to the diabetes centers of Qom. The sample size was measured to be 200, based on the available sampling method.

Materials and Methods: Data were collected using a demographic questionnaire, as well as a researcher-made Medication errors questionnaire.

Statistical Analysis Used: SPSS version 20 was used to analyze the data.

Results: Overall, 69% of the samples were female, and the mean age of the participants was 63.59 ± 4.84 years. The incidence of medication errors was 69% among older patients. There was a significant relationship between medication error and polypharmacy ($P < 0.001$), comorbidities ($P < 0.025$), duration of diabetes ($P < 0.026$), and use of aids ($P < 0.038$). Forgetfulness (26.33%) and lack of drug information (12.61%) were the most common causes of medication errors in patients.

Conclusion: The results showed that the incidence of medication errors, which was influenced by various factors, was high among the elderly. Therefore, to prevent and reduce the incidence of medication misuse, proper measures should be taken.

Keywords: Aged, Diabetes mellitus, Hypoglycemic agents, Medication errors

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INTRODUCTION

Diabetes mellitus is one of the most common chronic diseases, which has an increasing prevalence with advancing age. Among different types of diabetes, the elderly are more susceptible to type II diabetes,[1,2] as glucose intolerance and insulin resistance are higher in the elderly in comparison with younger people.[3,4] Therefore, type II diabetes is one of the main diseases associated with aging.[1] The prevalence of diabetes in the Iranian elderly population has been estimated at 14%, which is expected to significantly increase due to improvements in the life expectancy index, followed by an increase in the aging population of the community.[5] The use of medications for disease treatment is inevitable, and experts believe that proper use of medications plays an effective role in controlling the disease. Today, correct and rational use of medications is one of the goals of the World Health Organization and is the main policy of the health care system in each country.[6,7] Previous studies have shown that the use of blood glucose medications is associated with a high error rate, and half of these errors have serious and life-threatening consequences.[8,9]

Researchers have classified medication errors into three categories of prescription (physician error), distribution (e.g., pharmacist's error), and medication user; overall, the most frequent type is the medication user error.[10]

The elderly are considered a vulnerable group in the community.[9,11] The prevalence of various diseases increases medication use, polypharmacy, and age-related physiological changes at advanced age, exposing the elderly to medication errors. In fact, medication errors and reactions constitute 17% of hospital admissions in the elderly above 66 years.[12]

In a study by Mira *et al*., 75% of the elderly reported at least 1 medication error.[13,14] Therefore medication therapy and prevention of medication errors should be taken into account in aged people more than any other age group. However, in Iran, organizational attention to the prevention of medication errors is low.[15] Similar to other countries, reports are mostly related to intra-hospital errors, while many errors occur at home from the time the medication is purchased from the pharmacy until it is consumed; in fact, the extent of errors is unknown due to lack of relevant studies. In general, the incidence of medication errors is higher than the speculated figure. It is estimated that 98000 deaths per year occur due to medication errors in the United States, which is higher than the number of deaths from accidents, cancer, or AIDS in the country.[10,15,16] Elderly patients with diabetes are more exposed to medication misuse and complications due to their special conditions (e.g., loneliness, reduced physiological and functional capacity, and cognitive and vision disorders).[7,17] Considering the significant increase in the elderly population of Iran and the high prevalence of diabetes in this population, the present study evaluated the incidence of medication errors in an elderly population with diabetes.

MATERIALS AND METHODS

This descriptive, correlational study was conducted on 200 elderly patients with type II diabetes, who were referred to a diabetes clinic and Qom Diabetes Association in 2019 Using available sampling, elderly people ≥60 years with physician confirmed diabetes were selected in the study; at least 6 months had passed since the initial use of blood glucose control medications.

Researcher-made questionnaires were used for collecting the data. The data collection questionnaires in this research included a demographic-disease questionnaire and a researcher-made questionnaire for the elderly medication errors. The demographic-disease questionnaire included questions about the demographic characteristics, such as age, gender, educational level, and insurance coverage, while questions about diabetes, including the history of diabetes, type of blood glucose control medications, number of medications, and use of sensory aids, were completed in regular visits to physicians.

There searcher-made questionnaire was designed, based on the review of different studies.[1,8,13,15,18,19] It included questions about different aspects of medication errors due to the use of blood glucose control medications in the elderly. To evaluate the validity of the questionnaire, face validity and content validity were measured. The questionnaires were presented to 10 qualified experts and researchers in the field of diabetes, as well as 10 elderly people with diabetes for evaluation of clarity, simplicity, and content; the necessary changes were made according to the experts' comments. To verify the reliability of the questionnaire, internal consistency was measured in 20 samples, with a Cronbach's alpha coefficient of 0.81.

To analyze the descriptive data, mean and standard deviation were calculated, while for inferential statistics, Chi-square and Fisher's exact test were used. Furthermore, *t*-test was applied to determine the correlation of parametric variables. Data were analyzed using SPSS version 20 (SPSS, Inc., Chicago, IL, USA).

The Ethics Committee of Shahid Beheshti University of Medical Sciences approved this study. All participants were assured of the confidentiality of their information and were asked to sign an informed consent form. They were informally instructed that they could refuse to answer any question or discontinue participation in the study at any time.

RESULTS

In a total of 200 elderly participants, 69% were female, and the rest were male. Table 1 presents the distribution of participants in terms of age, sex, education level, and insurance coverage. The average duration of diabetes after diagnosis was 13.61 ± 7.7, and 87% of patients reported having other diseases, such as cardiovascular disease, hypertension, and renal disease. Overall, 56% of the diabetic elderly population reported taking 2–5 medications. The average number of used medications in patients was 5.19 ± 2.9. Based on the findings, 70% of the population used aids, such as eyeglasses and hearing aids. Furthermore, 65% of patients only used oral blood glucose medications. Table 2 presents these variables.

In total, 69% of the diabetic elderly had medication errors in the use of blood glucose control medications. Furthermore, 52% of the participants had 1–3 medication errors. As the findings revealed, 87.7% of the elderly realized their medication errors after taking the medication. In addition, 52% of the elderly had taken actions to prevent errors in the use of blood glucose control medications. As presented in Table 3, forgetfulness in taking medications, unavailability, and errors at the time of medication use (in hours) were the most common errors among the elderly. The most common causes of medication errors among the elderly were forgetfulness, inefficiency or lack of medication information, and medication termination in their opinion.

The results of Chi-square and t-tests indicated no significant relationship between medication error and individual factors, such as gender ($P < 0.924$), age ($P < 0.710$), and education level ($P < 0.683$). Regarding the disease-related factors, such as polypharmacy ($P < 0.001$), comorbidities ($P < 0.025$), duration of diabetes ($P < 0.026$), and use of sensory aids ($P < 0.038$), a significant relationship with the incidence of medication errors was reported. There was a significant inverse relationship between medication error and regular physician visits ($P < 0.012$), while there was no significant relationship between the type of blood glucose control medication and incidence of medication error ($P < 0.818$).

Table 1: Characteristics of the elderly with diabetes in the study

Variables	Absolute frequency	Relative frequency
Average age (years)	63.59±23.46	
Gender		
Male	62	31
Female	138	69
Level of education		
Illiterate	71	35.5
Elementary	87	43.5
High school	35	17.5
Academic	7	3.5
Insurance coverage		
Yes	179	89.5
No	21	10.5

Table 2: Disease-related variables in the elderly with diabetes

Variables	Absolute frequency	Relative frequency
Duration of diabetes (years)	13.61±7.7	
Comorbidities		
Yes	174	87
No	26	13
Sensory aids		
Glasses	129	64.5
Hearing aids	4	2
Others	7	3.5
None	60	30
Type of blood glucose control medication		
Oral	130	65
Injectable	31	15.5
Oral and injectable	39	19.5
Regular referral to physician		
Regular	109	54.5
Irregular	91	45.5
Number of medications consumed		
1	8	4
2-5	113	56.5
6-9	60	30
>10	19	9.5

The results of statistical analysis showed a significant relationship between error incidence and prevention of medication errors ($P < 0.001$). The highest incidence of error (40.5%) was related to the elderly, who did not prevent the incidence of medication errors. There was a significant relationship between the incidence of medication errors and the following parameters: Decreased visual acuity ($P < 0.04$), forgetfulness ($P < 0.001$), unconsciousness during treatment ($P < 0.001$), lack of medical information ($P < 0.001$), lack of training by the health care staff ($P < 0.001$), drug form similarities ($P < 0.022$), medication unavailability or termination ($P < 0.001$), drug name similarities ($P < 0.013$), lack of treatment insurance and high medication costs ($P < 0.002$), in adequate time ($P < 0.007$), self-medication and medication use without physician's prescription ($P < 0.022$), and other causes ($P < 0.001$).

Table 3: Distribution of absolute and relative frequencies of type and cause of medication errors in the elderly with diabetes

Variables	Absolute frequency	Relative frequency
Distribution of absolute and relative frequencies of medication errors		
Unwillingness to use medication	52	14.24
Unavailability of medication	83	22.73
Use of wrong medication	14	3.84
Use of the wrong dosage	9	2.47
Forgetfulness in taking medication	106	29.04
Wrong time of medication use	60	16.44
Errors in the frequency of medication use	9	2.47
Errors in the use of medication	27	7.40
Others	5	1.10
Distribution of absolute and relative frequency of causes of medication errors		
Reduced vision	9	2.57
Forgetfulness	94	26.33
Lack of motivation for treatment	34	9.52
Insufficient physical strength to inject or take medication	5	1.40
Lack of medication information	45	12.61
Inadequate information by treatment staff	37	10.36
Inattention to the label of medication	4	1.12
Similarities in the name of medications	4	1.12
Similarities in the shape of medications	11	3.08
Polypharmacy and inability to separate medications	8	2.24
Running out of medicines	40	11.20
Lack of treatment insurance and high cost of medications	19	5.32
Inadequate time	15	4.20
Self-medication	11	3.08
Others	21	5.88

DISCUSSION

This study was conducted to determine the incidence of medication errors and related factors in the use of blood glucose-lowering medications in aged people with type II diabetes. The results indicated that the incidence of medication errors was 69% in elderly patients with diabetes. Moreover, in a study by Field *et al*.,[8] the rate of error in blood glucose control medications was 28.7% among the elderly in the United States. Furthermore, in a study by Cassidy *et al*. in Ireland,[10] the rate of medication errors was reported at 91%, including medication errors at home and those reported personally by the patients.

A study by Mira *et al*.[20] from Spain reported that the incidence of error was 70% among the elderly with at least 1 medication error. Regarding the incidence of medication errors, in a review study by Mira *et al*.[11] between 1990 and 2014, the error rate ranged from 19% to 59%, and the elderly were one of the most vulnerable groups. The discrepancy between the present study and previous research may be attributed to the extensive interval of errors and differences in the type of medications.

Based on the results of the present study, there was no significant relationship between the age, sex, and education level of patients and incidence of medication errors; this finding is consistent with the results of studies by Field *et al*.[8] and Mira *et al*.[11] However, the influence of education and literacy on the proper use of medications cannot be justified. In the study community, older people with different education levels had errors in medication use. In fact, in older people with high levels of education, other factors, such as dementia, forgetfulness, and physical disability overcame the effects of education level leading to medication errors.

The results of the present study showed that concomitant diseases in the elderly had a significant relationship with the incidence of medication errors. In a study by Delshad Noghabi *et al*.,[13] the relationship between polypharmacy, caused by the multiplicity of morbidities, and consequences of complications was described. In this study, there was no significant association between the type of blood glucose-lowering medication (including the type of drug and insulin) and medication error. It can be argued that medication error is not dependent on the type of blood glucose control medication, and there is a possibility of error in the use of each type of medication. By the introduction of insulin pens into the market, insulin-dependent diabetic patients feel safe about the use of their medications. However, it should be noted that the Latin numbers on insulin pens can be problematic for older people, who are illiterate or less educated. Moreover, the high price of insulin pens as imported products and lack of full insurance coverage by some companies cause difficulties for older people in

many cases. Furthermore, many older people with visual impairments face problems, as it is impossible to print units more clearly on the body of insulin syringes due to their small size. Older people who use oral pills for diabetes control also face problems, such as similarities in drug name and shape. The results of this study showed a significant relationship between regular physician visits and the incidence of medication errors. In other words, medication errors decreased with regular physician visits. The study by Mira *et al*.[14] also confirmed this finding. It is obvious that medication errors decrease in patients who receive continuous care and treatment and are willing to continue treatment.

There was a significant relationship between medication errors and the use of sensory aids, such as glasses. In older people, who used aids such as glasses for taking medications (because of diminished sight), medication errors occurred due to lack of access to sensory devices or proper aids. The results of this study are consistent with the study by Delshad Noghabi *et al*.[13] therefore, the possibility of medication error is higher in the elderly who use sensory aids.

In the present study, there was a correlation between the duration of diabetes and the incidence of medication errors. An increase in the duration of diabetes led to an increase in the incidence of medication errors. The increased rate of medication error can be due to the negative effects of diabetes on various body organs and the reduction of functional capacity. Moreover, the occurrence of many other diseases as a result of an increase in the number of consumed medications was associated with a loss of motivation or desire to follow the diet, besides the increased cost of treatment.

In a study by Tabatabaei Malazy *et al*.,[5] there was a significant relationship between the increased duration of diabetes and reduced quality of care in the diabetic elderly. In this study, there was a significant positive relationship between the number of medications and the incidence of medication errors. In a study by Field *et al*.,[8] polypharmacy in older people was one of the effective factors in the incidence of medication errors. In the study by Mira *et al*.,[14] 75% of the elderly over 65 years, who consumed more than 5 different medications, had at least 1 medication error. Moreover, in the study by Delshad Noghabi *et al*.,[13] there was a significant relationship between polypharmacy and adherence to medication orders and medication use problems. Moreover, Slabaugh *et al*.[21] in their study showed that polypharmacy caused an increase in the risk of negative medication reactions.

In this study, according to the data analysis, forgetfulness, inaccessibility of medications, medication time errors (hours), and unwillingness to take medications were the most common errors in the elderly with type II diabetes. Moreover, errors in the method of medication use, use of medications other than blood glucose control agents, wrong medication dosage, and errors in the frequency of medication use were among other types of medication errors in older people. According to the data collected from the samples, the most common causes of medication errors were as follows: Forgetfulness, lack of medication in format information by the treatment staff, and lack of ion, unavailability of medication or incomplete use of medication, inadequate information by the treatment staff, and lack of motivation for treatment, respectively. Lack of treatment insurance and high cost of medications, inadequate time, self-medication, medication similarities, reduced vision (visual impairment), polypharmacy, lack of attention to medication labels, and similarities in medication names are the other causes of common medication errors among the elderly. Considering the advancing age and forgetfulness, Alzheimer's disease and lack of medication reminders by caregivers, the most common cause of the error was forgetful use of medications. In the study by Delshad Noghabi *et al*.,[12] reduced vision, wrong time of medication use, motor problems, polypharmacy, and similarities in drug form were mentioned as significant factors in failure to follow medication orders. In a study by Simonson and Feinberg,[17] polypharmacy, adverse reactions, and economic factors were noted as medication problems in the elderly. Ebrahimi and Abdollahi[15] in their study noted various causes of medication misuse in patients, admitted to the emergency cardiac department: Inaccessibility of medications, financial problems, negligence in the preparation and administration of medications, lack of knowledge about the names of medications, inability to separate cardiac medications, and lack of knowledge about the dose and time of cardiac medications. In a study by Gholamaliei *et al*.,[18] lack of knowledge about the correct use of medications, high number of medications, forgetfulness, unwillingness, lack of medical insurance, high cost of medications, side effects of medications, traveling, and lack of time were investigated as effective factors. Moreover, in a study by Zhao *et al*.,[19] similarities in the form and name of drugs were mentioned as significant factors for medication errors and reduced patient safety in diabetic patients.

In this study, there was a significant relationship between prevention of medication errors and incidence of medication errors among older people; in fact, the elderly who had taken actions for prevention were less likely to

have a medication error. The results of this study are consistent with the findings reported by Hughes and Ortiz[9] on the prevention of medication errors. Moreover, in the study by Mira *et al*.,[20] women were more concerned about diabetes control and prevention of medication errors in comparison with men and were less likely to be exposed to medication errors.

CONCLUSION

The results of this study showed that the incidence of medication errors was high among the elderly with diabetes and was associated with various factors, such as forgetfulness, lack of medication information, similarities in the name and form of medications, and unavailability of medications. Overall, the following measures and guidelines are recommended to reduce medication errors in the elderly: Improvement of training quality by the care staff; increasing governmental support from relevant associations; prescription of medications in accordance with the economic level of the patient; prescription of medications for patients according to their previous medication history to prevent polypharmacy; use of a single form and name for producing a medication by pharmacies; implementation of follow-up systems after discharge in hospitals; and use of reminders such as pharmacy boxes. Therefore, it is necessary to reduce the incidence of medication errors in the elderly in the follow-up and treatment programs.

Conflicts of interest

There are no conflicts of interest.

Authors' contribution

All authors contributed to this research.

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