The Description of Health Literacy, Knowledge, and Skills of Elderly People with Diabetes Mellitus Using Insulin Injections at Public Health Centers in Makassar City

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Abstract

Objective: To assess the health literacy, knowledge, and skills of older adults with Diabetes Mellitus using insulin injections at Public health centers in Makassar City in 2024.

Methods: This study is a quantitative research with a descriptive design using a cross-sectional approach. The sample selection employed non-probability sampling, expressly incidental sampling, involving 200 elderly individuals with Diabetes Mellitus who use insulin injections. Data was collected using the HLS-EU-SQ10-IDN and a knowledge and skills questionnaire on insulin use. The questionnaires were adapted into Indonesian and tested for validity and reliability.

Results: The study found that out of 200 elderly respondents, 97.0% were aged 60-74 years, with a mean age of (65.70). The majority were female (59.0%), retirees (44.5%), and had completed high school (49.5%). About 67.0% had suffered from Diabetes Mellitus for 5 years or more, with a mean of 7.17 years. Half of the respondents (50.0%) used Novorapid FlexPen® insulin, while 70.0% were on the additional antidiabetic drug Metformin. Blood glucose levels (GDP) were in the prediabetic range (100-125 mg/dl) for 50.5% of respondents, with a mean of 142.57 mg/dl. Most had comorbid hypertension (80.5%) and a normal BMI (56.0%). The health literacy level was sufficient for (70.5%) of respondents, with 98% showing good knowledge and (93.5%) demonstrating good skills.

Conclusion: Most showed sufficient health literacy and demonstrated good knowledge and skills. These findings highlight the importance of comprehensive health support for elderly individuals with diabetes.

Keywords: Health Literacy, Knowledge, Skills, Elderly with DM, Insulin Pen.

Introduction

Diabetes is one of the leading chronic conditions worldwide, with a high prevalence, and it has become a major global health issue. Diabetes is ranked as one of the top 10 causes of death and disability globally. Approximately 537 million people aged 20-79 years worldwide are living with Diabetes Mellitus (DM), which equates to 1 in 10 people, or a prevalence of 9.3% of the total population in this age group (IDF, 2021). Indonesia ranks fifth in the world with 19.47 million people suffering from diabetes, or 10.6%, a nearly two-fold increase in just two years compared to 10.7 million in 2019 (Kemenkes RI, 2020). The inability of elderly individuals to produce sufficient insulin to meet the body's

needs is one of the main reasons for the high prevalence of diabetes among older adults (Rusiana et al., 2021).

Cases of diabetes are commonly found among the elderly, with 50% of sufferers being over the age of 65 (Suprapti et al., 2018). Older adults are at a higher risk of failing to receive proper therapy, diet, and treatments that could save their lives (Widiastuti, 2019). Further meta-analysis studies have revealed that adequate health literacy is significantly associated with better diabetes outcomes, such as glycemic control, knowledge, and self-care (Marciano et al., 2019). Health literacy (HL) has been shown to impact health status significantly.

Achieving high levels of health literacy (HL) is important in preventing and managing chronic diseases (Nutbeam et al., 2018). Adequate HL empowers individuals to engage in informed decision-making and make the most of healthcare services (Asharani et al., 2021). On the other hand, inadequate HL has been linked to a higher incidence of chronic diseases, increased utilization of healthcare services, and lower levels of disease knowledge, self-care, and medication adherence (Wang et al., 2015). Low HL is commonly found in minority populations, those with lower income and education levels, individuals with health issues, and elderly communities (Al Sayah et al., 2013).

Elderly individuals in Indonesia generally have a low level of education, equivalent to elementary school (SD) or lower. This low level of education affects their ability to read and write (Nisak et al., 2021). Health literacy (HL) for the elderly is not only limited to reading and writing skills but also includes the ability to search for, evaluate, process, and access health information and services to make decisions related to their health (Nana et al., 2022). Low HL has been consistently associated with poorer diabetes knowledge, lower awareness of healthy living, and poor adherence to oral hypoglycemic drugs (OHO), which can lead to complications and often require insulin therapy.

The use of insulin therapy is expected to increase as the number of DM patients grows globally. In 2018, it was reported that 516.1 million insulin units were used per year, projected to rise to 633.7 million units per year by 2030 (Herlina Semi et al., 2021). The most commonly used insulin therapies are mixed insulins, such as Novorapid Flexpen® and Levemir Flexpen® (Vonna et al., 2021). A study conducted at a primary hospital in Northwest Ethiopia revealed that residence, how insulin is obtained, and injection techniques significantly influenced the knowledge of elderly patients. Of the 194 patients encountered, 166 completed the survey, yielding a response rate of 85.6%. More than half of the respondents (54.8%) were male. Patients' overall knowledge and practice regarding insulin storage and handling techniques were adequate, with 64.3% and 55.4% of participants demonstrating sufficient knowledge and practice, respectively. Regarding skills assessment, 94.6% correctly identified the injection site, 70% showed correct rotation, and 60.75% practiced rotation of the injection site (Netere et al., 2020).

Based on gender and age, it was found that 58% of respondents were female, and 77.3% were elderly, with 97.7% of them making errors in insulin pen injection techniques (Vonna et al., 2021). Research findings also revealed that more than half of the elderly had low literacy when seeking health information, with 72 participants (74.2%) exhibiting this limitation (Mandasari et al., 2023). Health literacy (HL) is considered a powerful tool for empowering diabetic patients, helping them recognize the symptoms of diabetes, prevent complications, and manage their condition effectively (Bailey et al., 2014). The elderly population is at high risk of experiencing limited HL, which can significantly affect their health (Azizah Weningsih, 2018). Therefore, HL can serve as an indicator of how well individuals understand and manage their health conditions.

In South Sulawesi, data from the Health Office shows an increase of 54,007 cases yearly (Herald, 2023). Focusing specifically on Makassar City, data from the Makassar City Health Office indicates that there were 25,980 cases of diabetes in 2023. By January-May 2024, the number of cases had risen to 26,713. The Makassar City Health Office oversees 47 Public health centers, with the 5 Public health centers having the highest number of diabetes cases being Public health centers Kassi-Kassi (1,505 cases), Kalukubodoa (1,373 cases), Sudiang (1,229 cases), Tamalate (1,081 cases), Paccerakang (1,065 cases). Based on the data above, the researcher aims to conduct this study to understand the health literacy profile of elderly individuals with Diabetes Mellitus and their knowledge and skills, particularly those who self-administer insulin injections at home.

Methods

Design

This study is quantitative research with a descriptive design using a cross-sectional approach, as this design is considered appropriate for providing an overview or describing the conditions that occur (Agus Subagyo, 2023). Data collection will be conducted in a single meeting with the respondents. Statistical testing will not be performed in this study as the objective is not to prove the relationship between variables but to present percentages only.

Respondents

This study was conducted in Public health centers Kassi-Kassi, Kalukubodoa, Sudiang, Tamalate, and Paccerakang in Makassar City working areas from August 19 to October 12, 2024. The sampling method used was non-probability sampling with incidental sampling involving 200 elderly respondents. The inclusion criteria were elderly patients with DM using insulin injections undergoing outpatient treatment and elderly individuals who can communicate effectively. The exclusion criteria set were elderly individuals with cognitive disorders (Dementia, hearing and vision impairments) and respondents who refused to be interviewed. Data were collected using the HLS-EU-SQ10-IDN questionnaire, which has a Cronbach's alpha of 0.7 (Rachmani Enny., 2020); this instrument is a simplified version of the European Health Literacy Study Project (HLS-EU). The simplification aims to provide a validated measurement instrument for Asian countries, including Indonesia. The questionnaire simplification project took place from 2013 to 2015. Previously, the simplification process had been carried out starting from the initial HLS-EU-47Q version with a Cronbach's alpha value >0.9 (Duong et al., 2017), consisting of 47 questions, which was then shortened to HLS-EU-16Q, HLS-EU-12Q with a Cronbach's alpha value of 0.7 (Pelikan et al., 2022). However, this development took place outside Indonesia, so it may not be suitable for measuring health literacy in Indonesia and a knowledge and skill questionnaire for insulin use with a Cronbach's Alpha value of 0.9 (Vonna et al., 2021). The questionnaires were adapted into Indonesian and tested for validity and reliability.

Data Collection

Data collection was conducted in two stages. The first stage involved filling out demographic data (age, gender, occupation, education, duration of diabetes, type of insulin, oral antidiabetic drugs (OAD), fasting blood glucose (FBG), comorbidities, and body mass index (BMI)). The second stage involved completing the HLS-EU-SQ10-IDN questionnaire, which included 10 questions, a knowledge questionnaire with nine questions (including a negative question, number 6), and a skills questionnaire with 11 questions. Data was collected during outpatient visits, posbindu (community health posts), and prolanis (program for elderly patients) at the Public health centers.

Data analysis
After the data were collected, the researcher processed the data using IBM SPSS version 23 to obtain the percentage for each variable.

Ethical Considerations
Ethical approval for this study was granted by the Health Research Ethics Committee of the Faculty of Nursing, Hasanuddin University, Makassar, Indonesia, with letter number 1658/UN4.18.3/TP.01.02/2024 and protocol number UH2408174. In this study, the researcher applied ethical principles of consent, anonymity, and confidentiality (Mappaware, 2016).

Results

Table 1. The Research Results show that the elderly aged 60-74 years (97.0%) with a mean value of (65.70), female gender (59.0%), retired occupation (44.5%), high school/vocational education (49.5%), duration of suffering from diabetes mellitus ≥ 5 years (67.0%) with a mean value of (7.17), insulin used Novorapid flexpen® (50.0%), antidiabetic medication Metformin (70.0%), glucose levels in the prediabetes range of 100-125 mg/dl (50.5%) with a mean value of (142.57), comorbidities of hypertension (80.5%), and BMI in the normal range (56.0%).

Table 2. The research results show that 141 individuals (70.5%) have sufficient health literacy.

Table 3. Shows the results of sufficient health literacy. The majority of respondents found it easy to find information related to health, especially about disease symptoms (55.5% quite easy, 44.5% straightforward) and actions in case of an emergency (84% quite easy). However, there were challenges in understanding vaccination information, with 19.0% of respondents reporting difficulty. Additionally, 23.0% of respondents faced barriers in assessing the impact of community and environment on their health. Overall, 92.5% of respondents could make health decisions effectively, indicating they are quite independent in managing their health conditions.

Table 4. The results show that the overall knowledge level of respondents is excellent, with almost all respondents having good knowledge, that is, 196 people (98%).

Table 5. This shows that respondents' knowledge is good, especially in insulin function, preparation, timing of rapid-acting insulin injection, and storage. However, there is a question that needs attention: understanding lipohypertrophy, with only 63% of respondents aware of it. Therefore, further education on rotating injection sites to avoid complications such as lipohypertrophy is necessary.

Table 1. Demographic Characteristics of Respondents Using Insulin Injections at the Public health centers in Makassar City

Variable	Mean ± SD	f (n=200)	%
Age			
Elderly: 60-74 years	65,70 ± 4,804	193	97,0
Old Age: 75-85 years.		7	3,0

Gender			
Male		82	41,0
Female		118	59,0
Occupation			
Retired		89	44,5
IRT		82	41,0
Entrepreneur		17	8,5
Unemployed		10	5,0
Laborer		2	1,0
Education			
Elementary school		8	4,0
Junior high school		14	7,0
Senior high school/Vocational high school		99	49,5
Diploma		25	12,5
Bachelor's Degree		52	26,0
Master's Degree		2	1,0
Duration Of DM			
< 5 Years	7,17 ± 2,910	66	33,0
≥ 5 Years		134	67,0
Types of Insulin			
Novorapid flexpen®		100	50,0
Levemir flexpen®		52	26,0
Combination novorapid/levimer		48	24,0
OAD			
Metformin		140	70,0
Glimepiride		23	11,5
None		37	18,5
Fasting blood sugar			
< 100 mg/dl	142,57 ± 45,042	1	0,5
100-125 mg/dl		101	50,5
≥ 126 mg/dl		98	49,0
Comorbidities			
Hypertension		161	80,5
Asthma		1	0,5
Neuropathy		32	16
CHF		3	1,5
Ulcer		3	1,5
BMI			
< 18,4 Underweight		17	8,5
18,5-25 Normal		113	56,0
25,1-27 overweight		39	19,5
> 27 Obesity		31	15,5

Table 2. Health Literacy of Elderly with Diabetes Mellitus Using Insulin Injections at the Public health centers in Makassar City

Health literacy	**f (n=200)**	**%**

Excellent	5	2,5
Sufficient	141	70,5
Problematic	54	27
Insufficient	0	0

Table 3. Evaluation of Health Literacy Questions Asked to Research Respondents (n=200)

No	Questions	Very difficult		Quite difficult		Quite easy		Very easy	
		f	%	f	%	f	%	f	%
1.	Can you find information about the symptoms of the disease that concerns you?	0	0	0	0	111	55,5	89	44,5
2.	How do you find information on what to do in a medical emergency?	0	0	1	0,5	168	84,0	31	15,5
3.	How do you assess the reliability of health warnings such as smoking, lack of exercise, and alcohol consumption? For example, smoking can cause cancer.	0	0	6	3,0	163	81,5	31	15,5
4.	How do you assess the vaccinations that you need?	0	0	38	19,0	156	78,0	6	3,0
5.	How do you decide how to protect yourself from illness based on advice from family and friends?	0	0	0	0	190	95,0	10	5,0
6.	Can you find information about activities that are good for your mental health? (For example, meditation, exercise, walking, yoga, etc.)	0	0	8	4,0	177	88,5	15	7,5
7.	How do you search for information about political changes that could affect health? (For example, policies, the latest health screening programs, changes in government, changes in the healthcare service structure, etc.)	0	0	9	4,5	174	87,0	17	8,5
8.	How do you understand health advice from family or friends?	0	0	10	5,0	171	85,5	19	9,5
9.	Can you assess how your community and environment affect your health and well-being? (For example, home environment, social environment)	0	0	46	23,0	151	75,5	3	1,5
10.	How do you make decisions to improve your health?	0	0	0	0	185	92,5	15	7,5

Table 4. Knowledge Level of Elderly with Diabetes Mellitus Using Insulin Injections at the Public health centers in Makassar City

Knowledge	f (n=200)	%
Good	196	98
Sufficient	4	2
Poor	0	0

Table 5. Evaluation of Knowledge Questions Asked to Research Respondents (n=200)

No	Questions	True		False	
		f	%	f	%
1.	Insulin is a hormone that functions to control blood sugar levels.	200	100	0	0
2.	Is it necessary to remove the insulin pen needle immediately after injecting it?	195	97,5	5	2,5
3.	If you forget to inject insulin, should you inject it immediately if the next dose is not too close?	190	95,0	10	5,0
4.	Does rubbing the insulin between both hands before use help equalize the insulin's temperature with body temperature and ensure it is well-mixed?	200	100	0	0
5.	Is it true that prolonged use of insulin in the injection site can cause swelling (lipohypertrophy)?	126	63,0	74	37,0
6.	Should the insulin pen be injected after meals?	68	34,0	132	66,0
7.	Should rapid-acting insulin be injected 10-30 minutes before meals?	195	97,5	5	2,5
8.	Should an unused insulin pen be stored in the refrigerator but not the freezer?	169	84,5	31	15,5
9.	Should an already-used insulin pen be stored at room temperature?	195	97,5	5	2,5

Table 6. Skills of Elderly with Diabetes Mellitus Using Insulin Injections at the Public health centers in Makassar

Skills	F (n=200)	%
Good	187	93,5
Sufficient	13	6,5
Poor	0	0

Table 7. Evaluation of Skills Questions Asked to Research Respondents (n=200)

No	Questions	True		False	
		f	%	f	%
1.	Wash your hands first before injecting insulin	200	100	0	0
2.	Clean the injection site with a cotton ball soaked in alcohol and allow it to dry.	183	91,5	17	8,5
3.	Rub the insulin pen using both palms.	187	93,5	13	6,5

4.	Remove the air bubbles inside the insulin pen (cartridge).	200	100	0	0
5.	Turn the dose selector to choose the number of units needed for the injection.	200	100	0	0
6.	Inject the dose into the subcutaneous tissue at the injection site, pinch the fatty area, then hold the insulin pen with four fingers and press with the thumb, pushing the needle in at a 90° angle (perpendicular to the area of the body to be injected).	200	100	0	0
7.	Keep the needle under the skin for at least 6 seconds, then remove it.	200	100	0	0
8.	Clean the skin at the injection site with a cotton ball soaked in alcohol	145	72,5	55	27,5
9.	Clean the insulin pen needle with alcohol	102	51,0	98	49
10.	Reattach the first needle cap and the second needle cap, twist them on, and then remove them	200	100	55	27,5
11.	Close the insulin pen and then store it	200	100	0	0

Table 7. Shows that overall skill levels among respondents are good. Important steps in the insulin injection procedure, such as washing hands (100%), removing air bubbles (100%), selecting the correct dose (100%), injecting at a 90° angle (100%), and waiting at least 6 seconds after the injection (100%) show very high levels of adherence. This indicates that participants know how to prevent infection and ensure the correct insulin dose. However, there are a few questions that need attention, such as cleaning the skin at the injection site with alcohol after the injection, which showed an adherence rate of 72.5%. Most respondents may understand that cleaning before the injection is more important, leading many to skip post-injection cleaning. Cleaning the insulin pen needle with alcohol had only a 51% adherence rate.

Discussion

Health literacy overview of elderly with Diabetes Mellitus who use insulin injections at Makassar City Health Center

The study results show that most elderly (70.5%) have an adequate level of health literacy (HL). Adequate HL in respondents indicates that they have a sufficient understanding of medical instructions related to diabetes management with insulin but still require further improvement to support their independence in managing their diabetes. However, 27% of respondents have problematic HL, which reflects that although elderly individuals receive health information from healthcare providers, their understanding and application of this information still need improvement. The decline in cognitive and sensory abilities in older adults may affect their understanding of complex health information (Wang & Lo, 2021). The low health literacy levels in some elderly individuals show difficulties in understanding health information, practicing self-care, and adhering to medical instructions (İlhan et al., 2021). This finding is consistent with a study conducted in Turkey, which found that 41.3% of type 2 diabetes patients had problematic HL (İlhan et al., 2021).

In addition, health literacy (HL) is also significantly associated with age, where elderly individuals tend to experience a decline in HL as they grow older due to a reduction in cognitive and sensory abilities (Wang & Lo, 2021). This decline affects the elderly's ability to access, understand, and apply health information, as well as make decisions related to their healthcare. Therefore, continuous interventions are needed that focus not only on providing information and practical training to enhance understanding and skills in insulin use.

The majority of respondents in this study (97%) were in the age range of 60-74 years, which aligns with a study conducted at Saskatoon Hospital in Canada, where the majority of elderly individuals were also aged 60-74 years (Shahid et al., 2022). Although elderly individuals in this age group are still quite active and capable of visiting healthcare facilities, the decline in physical and mental health and the risk of cognitive decline associated with aging affect their health literacy levels (Suyasa et al., 2021). Therefore, it is important to ensure that health information provided to this elderly group is tailored to accommodate potential cognitive limitations they may experience.

This study shows that the respondents' highest level of education is closely related to their health literacy (HL) level. Most respondents had completed high school (49.5%), which supports their ability to seek and understand health information. The relationship between education and HL is also consistent with findings from a health literacy study in Europe, which demonstrated that higher education levels are positively associated with HL (İlhan et al., 2021). Higher education provides the necessary skills to read, search for health information, and use the internet for health-related purposes.

A sufficient level of health literacy (HL) among the elderly allows them to follow most medical instructions. However, the problematic literacy level found in 27% of respondents poses a risk to optimal diabetes management. Elderly individuals with low HL often struggle to understand medical warnings and follow treatment instructions, which can increase the risk of diabetes complications (Nutbeam et al., 2018b).

The health center (Public health centers) is crucial in improving health literacy (HL) through community- and family-based education programs. Repeated education with a participatory approach is essential to help patients and their families understand how to use insulin properly and reduce dependence on healthcare professionals. With the right health education approach, elderly individuals with adequate or problematic HL can be empowered to manage their condition independently, reduce the risk of complications, and improve their quality of life.

Overview of Knowledge of Elderly with Diabetes Mellitus Who Use Insulin Injections at Makassar City Health Center

This study shows that most elderly individuals with diabetes at the Public health centers in Makassar have good knowledge (98%). The high percentage indicates the effectiveness of health education programs at the Public health centers in improving the elderly's understanding of the importance of managing diabetes with insulin. The comprehensive educational program includes information on how to use insulin, potential side effects, dietary management, and physical activity, positively impacting patient compliance (Netere et al., 2020). However, there is a concern regarding understanding lipo hypertrophy, which only 63% of respondents know. Therefore, further education on injection site rotation to prevent complications like lipohypertrophy is needed. Various factors, such as the effectiveness of the health education program or support from healthcare professionals, could influence this. Health education for diabetes patients, especially the elderly, is crucial in improving their knowledge. Counseling and training

on insulin usage, side effects, and managing diet and physical activity can enhance understanding and adherence to treatment.

These findings are consistent with similar research results, such as at the Primary Hospital in Ethiopia, where most respondents (62.3%) had good knowledge about insulin use (Netere et al., 2020). At RSUDZA, it was also found that most respondents (56.8%) had good knowledge about insulin pen usage (Vonna et al., 2021). At RSU Cut Meutia, 80% of respondents had good knowledge about insulin (Syahla F, 2024). Good knowledge can promote more effective self-management, such as insulin dosage adjustment and better blood glucose control (Netere et al., 2020).

The majority of respondents in this study have the highest education level of high school/vocational school (49.5%), significantly contributing to their knowledge. Education has been shown to influence health knowledge strongly; the higher a person's education level, the easier it is for them to receive and understand new health information (Azizah Weningsih, 2018). Education enables older adults to be more receptive to information from healthcare providers and actively seek additional health information sources. This study is consistent with similar research conducted at Bhayangkara Hospital in Bengkulu Police, where the majority of respondents (34.92%) had a high school education and demonstrated good knowledge (Rikomah et al., 2024). There is a relationship between education and knowledge level, with the highest percentage of good knowledge observed in patients with higher education levels. Education significantly impacts knowledge; the higher a person’s education level, the easier it is for them to receive information. The more information they receive, the easier and quicker it is for them to update their knowledge and form a solid cognitive foundation on a given topic (Azizah Weningsih, 2018).

In addition to education, the duration of diabetes also plays an important role in the respondents' level of knowledge. The majority of respondents (67%) have been living with diabetes for ≥ 5 years, giving them more time to understand the self-management of diabetes. This finding aligns with research by Netere et al. (2020) in Ethiopia, which found that patients using insulin for longer had better knowledge, mainly due to their direct experience managing diabetes complications and the consequences of suboptimal practices. This personal experience factor provides a deeper practical understanding of the impact of proper insulin management.

Work also influences respondents' knowledge, particularly among retirees and homemakers, who comprise 44.5% and 41% of the total sample. In the work environment, individuals are often exposed to new knowledge, both directly and indirectly, which can expand their understanding of health (Shahid et al., 2022). This study also highlights the importance of practical training programs to enhance the skills and understanding of elderly individuals regarding insulin administration techniques. Training that includes verbal instructions and hands-on practice has been shown to help patients more easily understand and remember the correct way to administer insulin (Netere et al., 2020).

This study shows that the elderly's knowledge about insulin use at the Public health centers Kota Makassar is categorized as good. However, there is still a need for further development in the form of more comprehensive training. With a comprehensive and continuous educational approach, elderly patients with diabetes are expected to maintain their health and quality of life.

Description of the skills of older adults with Diabetes Mellitus who use insulin injections at the Makassar City Health Center

This study shows that most older adults with diabetes at the Public health centers Kota Makassar have good skills (93.5%). The high percentage of good skills indicates the success of the education and training programs provided. Elderly participants in the educational programs demonstrated a better understanding and ability to perform insulin injection procedures, including choosing the correct injection sites, proper insulin storage techniques, and correct injection skills (ADA, 2014). These skills are crucial for maintaining blood sugar control, preventing complications, and supporting the quality of life of the elderly. Contributing factors to these skills include training from healthcare providers, family support, and practice opportunities. According to Notoatmojo's theory (2018), a supportive environment and sufficient practice repetition will improve an individual's skills in performing health procedures.

Additionally, according to Netere et al. (2020), factors such as education level, occupation, duration of therapy, length of time with diabetes, and level of patient knowledge also influence skills in insulin usage. However, there are a few areas of concern, such as cleaning the injection site with alcohol after the injection, which showed only 72.5% compliance. Most respondents may understand the importance of cleaning before the injection so that they may overlook post-injection cleaning. The cleaning of the insulin pen needle with alcohol showed only 51% compliance. Some respondents may not be fully aware of the importance of keeping the needle sterile after use to reduce the risk of contamination during storage. Further education can be focused on the steps of needle cleaning and the importance of maintaining sterility throughout each stage to optimize the safety and effectiveness of insulin use.

For comparison, a study conducted in Surabaya showed consistent results with a significant improvement in skills after an educational intervention, with a mean rank value of (22.93) (Astuti et al., 2023). This result emphasizes that educational programs and straightforward guidance are effective in increasing the confidence and skills of the elderly in performing insulin injections. However, a different result was found in a study at RSUDZA, where (97.7%) of respondents still made errors in using the insulin pen, particularly in aseptic techniques or cleanliness (Vonna et al., 2021). This suggests that although patients may have basic skills in injection techniques, important aspects are often overlooked, such as the aseptic technique, which is essential in preventing infection. This failure may occur due to insufficient emphasis on aseptic techniques during education or limited frequency of practice repetition. These findings highlight the importance of thoroughly incorporating aseptic techniques into educational programs and the need for increased monitoring and regular guidance, especially for patients more vulnerable to infections.

Insulin injection skills in the elderly can be improved through a comprehensive education program and support from various factors, including a conducive environment and ample practice opportunities. At the same time, focusing on specific technical aspects, such as aseptic techniques, is crucial to ensure that the skills acquired are optimal, minimizing the risk of complications. Regular practice, reinforcement of correct techniques, and consistent monitoring can significantly enhance the safety and effectiveness of insulin therapy for elderly patients, thereby improving their overall health outcomes.

Limitations

This study has several limitations, including the inaccuracy of data regarding insulin use among the elderly at Public health centers, which required a significant amount of

time to identify suitable respondents. Some respondents refused to fill out the questionnaire because they wanted to return home quickly, which affected the sample size. Additionally, respondents' low understanding of the questionnaire content required the researcher to explain each question repeatedly, leading to a more extended data collection period.

Contribution to global nursing practice
Overall, nursing practices should emphasize a repeated and adaptive educational approach involving families and communities and using appropriate educational tools to improve the health literacy (HL) of the elderly. Interventions focusing on empowering the elderly and providing family support will help them become more independent in managing their diabetes, thus improving their quality of life and reducing the risk of complications.

Conclusion
Based on the study of 200 elderly respondents with diabetes mellitus using insulin injections at the Public health centers Kota Makassar, it can be concluded that the characteristics of the respondents include ages between 60-74 years, predominantly female, retired, with an education level of high school/vocational school, having diabetes for 5 years or more, using Novorapid Flexpen® insulin and Metformin OAD, with a fasting glucose level (GDP) between 100-125 mg/dL, comorbidity of hypertension, and a normal BMI. The majority of elderly respondents have a sufficient level of Health Literacy. Most respondents also demonstrate sound knowledge and skills in insulin injection techniques. So, the three are interrelated, with health literacy as the basis for improving individual health knowledge and skills.

Author Contribution
Manuscript compiler: Akbar collected and processed data and compiled the manuscript.

Research assistant: Nuurhidayat Jafar provided direction, instructions, input, suggestions, and improvements in the preparation of the manuscript.

All authors have taken responsibility for the entire contents of the manuscript and approved its submission.

Conflict of interest
The authors state no conflict of interest.

Confession
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Ethics Statement
Ethical approval was granted by the Health Research Ethics Committee of the Faculty of Nursing, Hasanuddin University, Makassar, Indonesia, with the letter number 1658/UN4.18.3/TP.01.02/2024 and Protocol Number UH2408174. Before completing

the questionnaire, the respondents signed a consent form as voluntary participants after receiving an explanation.

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