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Diabetes mellitus control among elderly patients at geriatric polyclinic of Karangasem District Hospital, Bali, Indonesia: A preliminary study

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ABSTRACT

Background: The increasing number of elderly populations also increases the number of chronic degenerative diseases, including diabetes mellitus (DM). Therefore, diabetes control is needed to prevent various complications and improve the health quality of the elderly patient. This study aims to obtain preliminary information about diabetes control in elderly patients in the geriatric clinic of Karangasem District Hospital to provide appropriate management to improve diabetes control.

Method: This research is a cross-sectional study and consecutive sampling of 46 DM patients who seek treatment at the geriatric clinic of Karangasem District Hospital in the period May-July 2019. Inclusion criteria were DM patients aged ≥60 years. We exclude diabetes person with acute infection and end-stage renal disease. The criteria for DM control used in this study is body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting plasma glucose (FPG), postprandial glucose (PPG), and HbA1c levels. Data were analyzed using SPSS version 25 for Windows and depicted descriptively.

Results: Among 46 samples, there were 23 (50.0%) male and 23 (50.0%) female enrolled in this study. We find median of each, BMI was 23.2856 kg/m^2, SBP 120 mmHg, DBP 70mmHg, 153.5 mg/dl for FPG, 238 mg/dl for PPG, and 7.8% for HbA1c. In this study, patients who met target of diabetes control is 34.8% for BMI, 53.8% for SBP, 76.9% for DBP, 43.5% for FPG, 17.4% PPG, and 28.3 % for HbA1c levels.

Conclusion: In this study, it was found that DM control in elderly patients in our Hospital is not optimal on the parameters of BMI, SBP, DBP, FPG, PPG, and HbA1c levels. Better results were obtained in systolic and diastolic blood pressure control.

Keywords: diabetes mellitus, control, elderly, geriatric polyclinic

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INTRODUCTION

The success of development in the health sector has resulted in an increase in life expectancy due to the increasing population of the elderly population. The life expectancy of the Indonesian population (male and female) rose from 70.1 years in the 2010-2015 period to 72.2 years in the 2030-2035 period. The five provinces with the highest population percentage of 65 years and over in 2035 were Central Java at 14.9%, East Java at 14.1%, DI Yogyakarta 14.0%, Bali 12.1%, and North Sulawesi 12 0%. In other words, the population of 65 years and over in this province has reached more than 10%. So these five provinces, by 2035, could already be categorized as an ageing population province.[1]

However, the increasing number of elderly populations also increases the amount of chronic degenerative diseases including diabetes mellitus (DM).[2] The prevalence of DM in elderly patients aged ≥65 years is around 22-33%. DM in the elderly is associated with an increase in DM complications, both acute and chronic.[3]

DM is a chronic disease that does not cause death directly but can be fatal if the management is inappropriate. Inappropriate management of DM causes the patient's blood glucose to be challenging to control and can lead to various complications, such as diabetic neuropathy, diabetic nephropathy, stroke, blindness, and diabetic ulcers that affect the quality of life of the patient.[4] Therefore, DM control is needed in the patient. Diabetes mellitus control criteria used include Body Mass Index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting plasma glucose (FPG), postprandial glucose (PPG), HbA1c levels, LDL cholesterol, HDL, and triglycerides. The definition of well-controlled DM is when blood glucose, lipid, and HbA1c levels reach the expected level, as well as nutritional status and blood pressure according to the specified target.[5]

Appropriate DM control is associated with decreased diabetes complications. Diabetes Control and Complication Trial (DCCT) results show that better DM control can reduce DM chronic complications between 20-30%.[6] Even the results of The United Kingdom Prospective Diabetes Study (UKPDS) show that a 1% reduction in HbA1c will

reduce the risk of complications by 35%, reduce the incidence of DM-related deaths by 21%, myocardial infarction by 14%, microvascular complications by 37% and vessel disease peripheral blood by 43%.[7]

The absence of study about the diabetes mellitus control in geriatric clinic at Karangasem District Hospital is the main reason to provide baseline data of diabetes especially in elderly. Baseline data including Body Mass Index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting plasma glucose (FPG), postprandial glucose (PPG), and HbA1c levels. Long term evaluation needed to implements strategy to achieve optimal diabetes control to reduce future complications.

MATERIALS AND METHODS

This study is a cross-sectional study and sample selection by a consecutive sampling of the elderly population suffering from DM aged ≥60 years who undergo outpatient treatment at the geriatric polyclinic at the Karangasem District General Hospital between May to July 2019. The study conduct in these three months only as the initial research to know how diabetes control among elderly DM patient. Glycemic control such as A1C evaluated in next three month to observe its proper target reduction.

Inclusion criteria were DM patients aged ≥60 years. We exclude diabetes person with acute infection and end-stage renal disease that may alter blood glucose. Data collected by interview using comprehensive medical evaluation and assessment based on Standards of Medical Care in Diabetes 2019.[8] That instrument contains past medical and family history, lifestyle factors, medications, technology use, behavioural and diabetes self-management skills, physical examination, and laboratory evaluation.[8] From that instrument, data obtained including age, sex, duration of illness, height, weight, body mass index (BMI), blood pressure, FPG, PPG, HbA1c levels, diagnosis and diabetes treatment.

The variables in this study were diabetes mellitus (DM), DM control target, and the elderly. DM was described as fasting plasma glucose examination ≥126 mg/dl in a condition of no-calorie intake of at least 8 hours or plasma glucose examination ≥200 mg/dl 2-hours after the Oral Glucose Tolerance Test (OGTT) with a 75-gram glucose load or a plasma glucose examination. DM was diagnosed If blood glucose was ≥200 mg/dl with classic complaints or HbA1c examination ≥6.5% using a standardized method by the National Glycohaemoglobin Standarization Program (NGSP).[5] Well-controlled DM is assessed when blood glucose, lipid, and HbA1c levels reach the expected level, as well as nutritional status and blood pressure according to the specific target. The targets were BMI 18.5-23 kg/m^2, systolic blood pressure (SBP) <140 mmHg, diastolic blood pressure (DBP) <90 mmHg, fasting plasma glucose (FPG) 80-130 mg/dl, postprandial glucose (PPG) <180 mg/dl, and HbA1c levels <7%.[5] Elderly patients in this study were residents 60 years or older.[2]

The researcher measured the patient's blood pressure using a calibrated ABN blood pressure gauge. The measurement of HbA1c was carried out using a Quo A1c EKF test tool, while examination of FPG and PPG used an AutolyserDialab at the Clinical Pathology Laboratory in Karangasem District General Hospital.

In this study, the data obtained will then be analyzed using Statistical Program for Social Science (SPSS) software for windows version 25.0, including Kolmogorov-Smirnov to asses the normality of data, descriptive statistics to calculate the median, minimum, and maximum in numerical data while for categorical data with using frequency calculations.

RESULTS

In this study we enrolled 46 subjects, 23 person (50%) male and 23 (50%) female. A total of 6 (13%) patients were underweight (BMI <18.5 kg/m^2), 16 (34.8%) normal weight (BMI = 18.5 - 22.9 kg/m^2), 12 (26, 1%) excessive weight with risk (BMI = 23 - 24.9 kg/m^2), 10 (21.7%) obesity I (BMI = 25 - 29.9 kg/m^2), and 2 (4.3 %) obesity II (BMI ≥30 kg/m^2). A total of 13 people from 46 geriatric subjects (28.3%) with diabetes found also had a history of hypertension. The duration of patients suffering from DM varies in which 30 (65.2%) patients had DM for less than 5 years, 8 (17.4%) for 6-10 years, and 8 (17.4%) had more than 10 year (Table 1).

Among the subjects, 15 people (32.6%) used oral antidiabetic drugs, 1 person (2.2%) used basal insulin injection, 23 people (50%) used a combination of basal-bolus insulin injection, and the rest 7 people (15.2%) used a combination of oral antidiabetic drugs and insulin (Figure 1).

The data collected then assessed for normality using Kolmogorov-Smirnov by SPSS version 25.0. The results were the characteristic of elderly DM patients not normally distributed. The characteristics of the research subjects can be seen in Table 1.

We found a median age of the patient is 60 which vary between 60-90 years old. Diabetes onset varies between 1-33 years (the median 2.5). The median weight of the patient is 56.50 kg starts from 33 kg to 78kg. The median height of patient is 1.565m

Table 1 The characteristics respondents in the geriatric polyclinic of Karangasem District Hospital during May-July 2019 period

Variable	Median (Min-Max)
Age (years)	66 (60-90)
Onset of DM (years)	2.5 (1-33)
Weight (kg)	56.50 (33-78)
Height (m)	1.565 (1.38-1.67)
BMI (kg/m^2)	23.285 (15.62-30.85)
Blood pressure (mmHg)	
Systolic	120 (95-190)
Diastolic	70 (60-100)
FPG (mg/dl)	153.5 (69-557)
PPG (mg/dl)	238 (128-528)
HbA1c (%)	7.8 (5.5-15)

Table 2 A DM control target evaluation at Karangasem District Hospital during May-July 2019 period

	Criteria	
Parameter	**Good (%)**	**Bad (%)**
Body Mass Index (BMI)	16 (34.8)	30 (65.2)
Systolic Blood Pressure (SBP)	7 (53.8)	6 (46.2)
Diastolic Blood Pressure (DBP)	10 (76.9)	3 (23.1)
Fasting Plasma Glucose (FPG)	20 (43.5)	26 (56.5)
Post Prandial Glucose (PPG)	8 (17.4)	38 (82.6)
HbA1c	13 (28.3)	33 (71.7)

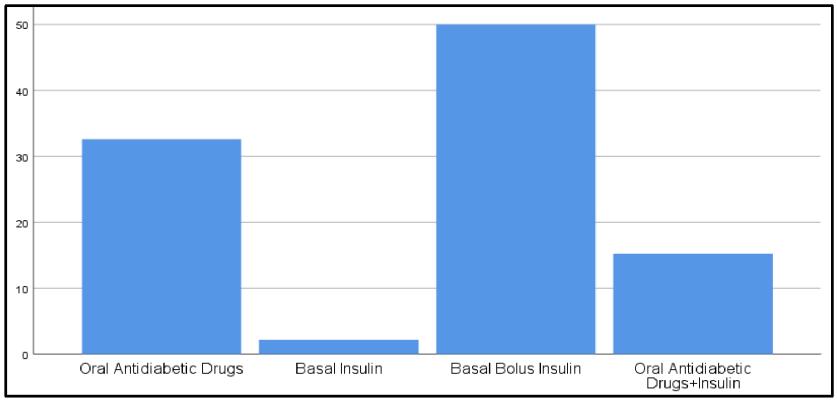

Figure 1 The characteristic of DM Therapy Type among Geriatric Patients at Karangasem District Hospital during May-July 2019 period

varies from 1.38-1.67m. The BMI of patient quite varies between 15.62-30.85kg/m^2 (the median 23.2856kg/m^2). The median of systolic blood pressure is 120mmHg, while the median of diastolic blood pressure is 70mmHg. The median of fasting plasma glucose is 153.5mg/dl while the median of prandial plasma glucose is 238mg/dl. The HbA1c varies among 5.5-15 with the median 7.8% (Table 1).

In this study, the percentage of patients who had met the DM control target was 34.8% for the Body Mass Index (BMI). When compared with all subjects, the number of patients whose systolic blood pressure had met the standard was 87%. However, when compared with DM patients who have comorbid hypertension, the percentage of systolic blood pressure control only reaches 53.8% because 6 out of 13 DM people with hypertension have systolic blood pressure ≥ 140mmHg (Table 2). Patient's diastolic blood pressure met the target better where 93.5% of all subjects had diastolic blood pressure <90mmHg. However, when compared to DM patients who do have comorbid hypertension, the percentage of diastolic blood pressure control is 76.9% because 3 out of 13 people who suffer from DM and hypertension (23.1%) have diastolic blood pressure ≥90mmHg (Table 2).

Blood sugar control in subjects in the three criteria still did not reach the expected results where the percentage that met the target was only 43.5% for Fasting Plasma Glucose (FPG), 17.4% for Post Prandial Glucose (PPG), and 28.3% for HbA1c levels (Table 2).

DISCUSSION

This cross-sectional study was carried out on 46 elderly patients with DM consisting of 23 (50%) male and 23 (50%) female. This result is slightly different from the results of DiabCare Asia 2008 study which percentage higher in female 55.16% compare in male (43.3%), and DiabCare Asia 2012 with a slight preponderance to the female gender (58.6%). This difference could be due to the different number of the patient which only 46 in this study compare with 1,832 patients in Diab Care Asia 2008 study or 1,967 patients inDiabCare Asia 2012. Both DiabCare study use sample from several centres in Indonesia which represented the population of Indonesia.[9,10]

The longer a person has diabetes, the higher the risk of complications. In this study, we found 30 people (65.2%) had DM for less than 5 years, 8 people (17.4%) for 6-10 years, and 8 people (17.4%) had more than 10 years. The median duration of diabetes in this study was 2.5 (1-33) years. Compare with the median duration of diabetes in DiabCare Asia 2012 was 6.0 (0.1–47.0) years. With our findings, if followed by proper management, it could be possible to reduce future complication.[9,10]

Regarding diabetes treatment, 15 people (32.6%) used oral antidiabetic drugs, 1 person (2.2%) used basal insulin injection, 23 people (50%) used multiple basal-bolus insulin injections, and the 7 people (15.2%) used a combination of oral

antidiabetic drugs and insulin. This finding differs from the 2008 Diabcare Asia study where 81.32% used oral antidiabetic drugs (± insulin) while 37.7% used insulin (±oral antidiabetic drugs), or Diabcare Asia 2012 where 84.2% of patients used oral antidiabetic medications while 34.7% used insulin. DiabCare Asia 2008 obtained all samples in Indonesia, while DiabCare Asia 2012 obtained the majority of samples in Indonesia (99.6%).[9,10] What caused this difference is likely the average age of patients who were sampled whereas in DiabCare Asia 2008 the average sample age was 58.93 (±9.57) and DiabCare Asia 2012 the average age was 58.4 (± 9.5) years while in this study the elderly subjects were taken with a median age of 66 (60-90) years. The characteristics of DM in the elderly are slightly different from young adults where beta cell function decreases so insulin resistance increases. This is also accompanied by a decrease in the function of other organs such as the heart and kidneys which have caused complications in the elderly, causing more therapeutic choices using insulin in this study due to higher HbA1c in this elderly patient.

A total of 6 (13%) patients were underweight (BMI <18.5 kg/m^2), 16 (34.8%) within normal body weight (BMI = 18.5 - 22.9 kg/m^2), 12 (26, 1%) overweight with risk (BMI = 23 - 24.9 kg/m^2), 10 (21.7%) obesity I (BMI = 25 - 29.9 kg/m^2), and 2 (4.3%) with obesity II (BMI ≥30 kg/m^2). Of the 6 underweight people, 2 were male, and 4 were female. While from 16 with normal body weight, the proportion of male and female is the same, respectively 8. Of the 12 people who have more weight with risk, 9 of them are male and the remaining 3 are female. For type 1 obesity, 3 people are male, while 7 are female. For type 2 obesity 1 is male and 1 other is female. This is slightly different from the results of previous studies conducted by Ludirdja JS, et al who obtained results as follows: total of 1 (3.3%) patients underweight (BMI <18.5 kg/m^2), 12 (40%) normal body weight (BMI = 18.5 - 25 kg/m^2), 13 (43.33%) were overweight (BMI = 25 - 30 kg/m^2) and 4 (13.3%) were obese (BMI > 30 kg/m^2).[11] This different may due to the different category of BMI that used in these two study. In this study we used the guidance of managing diabetes mellitus in Indonesia (PERKENI 2015)[5] which classified BMI into 5 classes instead of four classes in the studies conducted by Ludirdja JS, et al. The advantage using these five classes is it can increase the awareness of patient, community, and healthcare provider about BMI control inpatient to prevent related metabolic disease like DM and improve diabetes control especially in BMI for patient who already had DM.

In this study, the percentage of patients who had met the DM control target was 34.8% for the Body Mass Index (BMI), where the expected BMI target ranged from 18.5 to <23.6. From patients who met the BMI target, the ratio between male and female are the same, every 8 people. Likewise, for patients who have not met their BMI targets (both BMI less than 18.5 and BMI ≥23) the same number of comparisons between male and female patients (15 each). This result is different from the previous study by Pardede et al. in which a better BMI target was achieved in male patients because physical activity in male was more significant than in the female.[12] This difference may due to subjects in that study were not limited to elderly patients, while in this study conducted in elderly patients where the activities of both male and female did not differ much.

Obesity has an important relationship with DM so that in managing DM, obesity is one of the factors that must be controlled. In obesity, adipose makes and releases adipocytokines to maintain energy balance. Tumour necrosis factor α (TNF-α) is one example of cytokines released as an early sign of inflammation that can induce insulin resistance in muscle tissue and adipose through glucose transporter 4 (GLUT 4) so that it can cause an increase in the release of free fatty acids due to lipolysis that occurs. Increased free fatty acids for a long time can suppress insulin secretion by interfering with β cell response to glucose. Besides, free fatty acids can activate protein kinase (PKC) which can damage the formation of insulin signals. Other adipocytokines that play a role are retinol-binding protein 4 (RBP4) which is thought to damage glucose uptake that stimulates insulin in the muscles and increases hepatic sugar production, causing insulin resistance.[12]

In addition, insulin resistance is also influenced by low adiponectin. Adiponectin is an adipokine that has insulin-mimetic properties. Low adiponectin counts are also found in obese individuals. The process of lipolysis in obesity is high which causes the amount of oxidative stress produced is also high. Increased Reactive Oxygen Species (ROS) can reduce mitochondrial function resulting in accumulation of fat in muscles and liver. This will generate insulin resistance phenotype which is an initial phase of metabolic abnormalities until the occurrence of glucose intolerance.[13]

Among DM patients who are overweight or obese with poor glycemic, blood pressure and cholesterol control, lifestyle changes that result in weight loss, clinically proven to have an impact on reducing blood sugar, HbA1C, and triglycerides. More significant weight loss results in greater improvements including decreased blood pressure, improvement in LDL cholesterol and HDL, as well

as a decrease in the need for drugs to control blood sugar, blood pressure and fat levels.[14]

But keep in mind, in elderly BMI to determine obesity is a less precise index because it does not show fat distribution, decreased muscle mass, and the calculation becomes less accurate due to the shortening of the spine or the changing shape of the spine. Weaknesses in the elderly also cause difficulties in measuring the weight and height of the elderly. To predict the health condition of the elderly, it is more appropriate to use the waist circumference as a reference because it is highly correlated with total and intraabdominal fat which plays an important role in metabolic disorders including DM. Obesity in the elderly increases the risk of metabolism, physical disability, impaired quality of life, sexual dysfunction, decreased cognitive impairment and dementia. On the contrary, weight loss is done deliberately through lifestyle modification in the form of a combination of exercise and calorie restriction and not because of accidental reasons such as illness, bringing many health benefits for the elderly. Weight loss of 5-10% has been shown to improve cardiovascular risk. According to the research of Lean et al., There was an increase in life expectancy in weight loss carried out by the elderly with DM using a simple diet method.[15]

However, weight loss does not only have an impact on decreasing fat mass but also can reduce non-fat mass (muscle) and bone mineral mass. So we need to do weight training and diet exercises to prevent femoral fractures in obese patients. However, this weight training is recommended in people with DM without contraindications such as osteoarthritis, uncontrolled hypertension, retinopathy, and nephropathy. Systemic analysis by McTigue et al. showed a weight loss of 3-4 kg over 1-3.3 years through lifestyle modification resulting in improvements in glucose tolerance and physical function, reducing the incidence of new DM and combination of hypertension or cardiovascular as well as reducing bone density. This can occur because of the increased sensitivity of insulin receptors in the muscles and the increasing number of receptors that are active due to capillaries that open during exercise.[16]

In the Diabetes Prevention Program where obese patients up to age 84 years (average age 50.6 years, average BMI 33.9 kg/m^2), weight loss is obtained with moderate physical activity programs at least 2.5 hours/week and a reduction in total fat diet to <25% of calories, accompanied by lifestyle counselling every week for 16 curriculum sessions followed by 2 times a month. The result is that every 1 kilogram of weight loss through diet and exercise decreases 16% incidence of DM over 3.2 years.[17] The moderate physical activity is a physical exercise which reaches 50-70% maximum heart rate (maximum heart rate is 220-age patients) such as brisk walking, relaxed cycling, jogging, and swimming.

In the elderly, the purpose of weight loss is to improve physical function and quality of life. Lifestyle changes are as effective in older individuals as younger individuals. Weight loss of 5-10 kg with a conventional diet and exercise program, brings a significant reduction in intra-abdominal fat and improvement of metabolism. However, weight loss programs in the elderly must be adjusted for each individual to provide a balanced diet, adequate calorie consumption as well as physical activity and duration of therapy.

Control of systolic and diastolic blood pressure are two parameters which results are quite good in the target of DM control in this study, which when compared with all subjects, the number of patients whose systolic blood pressure had met the standard was 87%. However, when compared with DM patients who do have comorbid hypertension, the percentage of systolic blood pressure control only reaches 53.8% because 6 out of 13 DM people with hypertension still have systolic blood pressure ≥ 140mmHg. Patient's diastolic blood pressure met the target better, where 93.5% of all subjects had diastolic blood pressure <90 mmHg. However, when compared to DM patients who do have comorbid hypertension, the percentage of diastolic blood pressure control is 76.9% because 3 out of 13 people who suffer from DM and hypertension (23.1%) have diastolic blood pressure ≥90 mmHg. The target blood pressure in DM patients is a systolic blood pressure of <140 mmHg and diastolic blood pressure of <90 mmHg. The number of DM patients diagnosed with hypertension in this study was smaller than the results of DiabCare Asia 2012, where 65.4% of DM patients studied also suffered from hypertension.[10] In another study, Pardede et al. obtained blood pressure control on target at 60.8% while those are not on target (either systolic, diastolic or both) amounted to 39.3%.[12]

Management of blood pressure is crucial to be done in DM patients altogether with DM control. Because DM in the long term and being uncontrolled can result in hypertension that can have implications for other macroangiopathy risks such as coronary heart disease, stroke, and peripheral Vascular Disease (PVD). Managing blood pressure starts from lifestyle modifications in the form of losing weight, increasing physical activity, stopping smoking and alcohol and reducing salt consumption. If the target of blood pressure has not been achieved with lifestyle modification, pharmacological therapy can be given in the form of angiotensin

II receptor blockers, ACE inhibitors, low dose selective beta receptor blockers, low dose diuretics, alpha-receptor blockers and calcium antagonists. In patients with blood pressure> 120/80 mmHg lifestyle changes are required, while patients with systolic blood pressure> 140 / 80mmHg can be given direct pharmacological therapy. Combination therapy is given if the therapeutic target cannot be achieved with monotherapy.[5]

This study shows that the goal of controlling blood sugar is not yet achieved in short-term blood glucose monitoring as seen from fasting plasma glucose (FPG) and postprandial glucose (PPG), and long-term blood glucose control by examining HbA1c. Examination of HbA1c levels reflects the average blood glucose control in the last 2-3 months. The percentage of achievement achieved by the target is 43.5% for FPG, 17.4% for PPG, and 28.3% for HbA1c levels. All three are still below 50%. Better results were obtained in the 2012 DiabCare Asia study where the percentage of patients with HbA1c <7 reached 30.8%. This shows that blood sugar control is still not optimal in elderly DM patients in the geriatric clinic of Karangasem District Hospital. But this can also due to the principle of therapy in elderly is starts from a low dose with a slow titration (start low go slow) and the target of HbA1c therapy is more flexible because the elderly population is more susceptible to hypoglycemia complications wherein elderly patients the target of HbA1c therapy is between 7.5 -8.5%.[6]

DM therapy in the elderly is slightly different, wherein the selection of therapy can not only by looking at laboratory results but must be assessed the patient's characteristics and overall health condition. In the elderly DM patients with little or no comorbidities, with good cognitive status and good functional status to carry out daily activities, as well as expectations of longevity, target HbA1c <7.5% (58 mmol/mol), FPG 90-130mg / dL (5.0-7.2 mmol / L), blood sugar before sleep 90-150mg / dL (5.0-8.3 mmol/L), blood pressure <140/90 mmHg, and statin administration unless there are contraindications or are not tolerated by the patient. In elderly DM with many comorbid diseases or disturbances in daily activities or having mild-moderate cognitive impairment, and having a risk of falling or hypoglycemia, the HbA1c target is slightly higher at <8.0% (64 mmol/mol), FPG 90-150mg/dL (5.0-8.3 mmol/L), blood sugar before going to sleep 100-180mg/dL (5.6-10.0 mmol/L), blood pressure <140/90 mmHg, and statin administration unless there are contraindications or are not tolerated by the patient. While in elderly DM patients with poor health conditions in the later stages of chronic illness, moderate-severe cognitive impairment, and dependence on daily living activities the HbA1c target is even higher at <8.5% (69 mmol/mol), FPG 100-180 mg/dL(5.6-10.0 mmol/L), blood sugar before bed 110-200mg / dL (6.1-11.1 mmol/L), blood pressure <150/90 mmHg, and considered benefits giving statins as secondary prevention.[18,19]

DM management in the elderly must be individual in which the drug needs, the abilities and desires of patients are important and main components in determining choices to achieve therapeutic targets. These considerations are influenced by several things including patient's age and life expectancy, duration of DM, history of hypoglycemia, comorbidities, cardiovascular complications, and other supporting components (availability of drugs and capability for purchasing). However, more optimal monitoring and efforts are needed to control DM parameters so that we can provide health services that are in line with DM control goals and prevent DM complications in the elderly.

CONCLUSION

In this study, it was found that the control of diabetes mellitus in elderly patients in the geriatric clinic of Karangasem District Hospital was still not optimal in the parameters of BMI, FPG, PPG, and HbA1c. Better results were obtained in controlling systolic and diastolic blood pressure. More optimal efforts are needed to achieve the DM control goals in the geriatric polyclinic of Karangasem District Hospital. Ongoing evaluation is required to assess the effectiveness of DM management in the elderly. Further research with larger sample size is needed to determine the relationship between each DM control parameter and the therapy given.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the manuscript.

ETHICAL CLEARANCE

This research has followed the ethical rules that apply in the Research Ethics Committee of the Faculty of Medicine, Udayana University / Sanglah Hospital.

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AUTHOR CONTRIBUTION

All authors are contributed equally to the content of the study from data preparation, statistical analysis, results, and data synthesis.

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