Physical Exercises Effectiveness in Controlling Diabetes Mellitus in the Elderly Group in Bali - Indonesia

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Abstract Diabetes Mellitus (DM) is a degenerative disease that has a high number of sufferers and is a type of disease that can lead to several complications in the disease. This article is aimed at examining the effectiveness of physical exercises in controlling DM in the elderly group in Sanur Sub-district, Bali-Indonesia. To establish this objective, counseling, training on diet, and exercises were administered to the elder group with DM to control of their blood-glucose levels. The results showed that the results of data analysis showed that physical exercise is able to effectively control and reduce blood glucose in some diabetics of the elderly group up to 14.63%. Building this, it is recommended to the government and health care institutions to grow and develop physical exercises and counseling program on controlling blood-glucose to reduce and prevent the occurrence of DM in the community.

1. Introduction
Diabetes mellitus (DM) is one of the metabolic diseases characterized by elevated blood-glucose levels (hyperglycemia) caused by insulin secretion or insulin process and may also be caused by both factors. The factor of DM occurrence is generally divided into two, namely DM due to absolute deficiency of endogenous insulin resulting from autoimmune destruction in pancreatic beta cells (DM type, I), and DM type II characterized by peripheral insulin resistance and impaired insulin secretion [1].

Degenerative diseases that are touted as urban disease have now penetrated to the villages. Behavioral changes make those who live in rural areas cannot avoid diabetes, non-communicable diseases that trigger this large number of deaths. The cause is the behavior of people who have shifted life. Bali Provincial Health Office reported that the number of cases of diabetics in 2011 recorded 2,210 people spread across all districts/cities in Bali [2]. Among the nine regencies in Bali, a prominent case of diabetes mellitus occurred in Sanur regency, Badung regency, Gianyar regency, and Denpasar city. However, Sanur is selected to be a research location in this investigation as it is also included as an area with tourism area in Denpasar City.

It is known that the prevalence of DM in Bali during last 5 years is more than 6% and it is estimated that this number will continue to increase in line with changes in people's lifestyle and diet. The same case was found in Community Health Center (PUSKESMAS) in South Denpasar sub-district, where the proportion of outpatient DM cases increased from 2008-2012, as in PUSKESMAS I, South Denpasar, the proportion of DM cases in 2008 was 0.3% to 2.1% 2012; in PUSKESMAS II South Denpasar from 0.6% to 0.8%, in PUSKESMAS III South Denpasar from 0.9% to 2.3% and in PUSKESMAS IV South Denpasar from 1.1% to 2.4%. Sanur area is under the area of Public Health Center (PUSKESMAS) II
South Denpasar. The report on health obtained from Health Center II South Denpasar in 2016 stipulated that diabetes mellitus is position 30 of the highest number of diseases [3].

Partner issues obtained are:

- Lack of understanding about the appropriate diet for the community with DM.
- Understanding of the role of exercise (exercise) for people with diabetes is still low.
- Lack of physical activity in the form of exercises that can help control blood glucose levels.
- Lack of understanding of the importance of controlling blood glucose levels.

1.1. Solutions and output

Increasing the understanding in the application of diet and exercise independently for partners so as to have an impact in the reduction of blood glucose levels.

Increasing knowledge and skills in monitoring blood glucose independently. Studies on the cases of patients with both DM1 and DM2 have resulted in great interests to scholars, experts, and those who are interested in health care to improve and develop the effort in overcoming the bad effects resulted from DM to society. Duarte et al compared physical activity level (PAL) and care in relation to exercising for adult and insulin-user patients with DM [4]. It was found that exercises and PAL in patients with DM1 are different from those in patients with DM2. Study on the impact of dietary program and physical activity on biochemical markers in patients with type 2 diabetes was also conducted in 2017 [5]. In the results of their study, it was discovered that blood-glucose level improvement is resulted from physical activities, including aerobic, resistance, flexibility and combined exercises), and programs based on a higher intake of vegetables, grains, legumes, fruits, unsaturated fatty acids, as well as consumption of foods with low glycemic index, calorie restriction, intake of probiotics, vitamin D supplementation and educational sessions about diabetes. Female with no formal education or of primary level of education can be the patients of DM in majority. Therefore, health controlling programs should be developed, such as Health-Related Quality of Life to control and avoid patients present late with complications calls of DM [6].

In line with the above three previous related studies on DM patients controlling, there a number of other studies, which are in conjunction with it. Visutyothin and Boonmongkon examined the self-regulation of blood-glucose control in 2017. The action was carried out utilizing governmentality concept through semi-structured in-depth interviews and participatory observation techniques with eight diabetic women as the informants. It was found that diabetic woman’s thoughts and directed their health practices were dominated by their medical knowledge power [7]. Self-regulations obtained were the surrender of their thoughts, and bodies became docile and accepting medical knowledge to manage their lives intensively; negotiation in the form of disciplinary power exercised more to control their bodies when the diabetes treatments were uncertain; resistance in diabetes regulations because of lifestyles and cultural limitations in their roles as housewives; and conducts of conduct women were learning and sharing among themselves ways to control their blood-glucose level and live their usual lives.

Wang et al explored the role of exercise on gestational diabetes mellitus of both type 1 and type 2 in women with pregnancy form the perspective of reducing the insulin resistance. They found that healthy can be best maintained and formed throughout pregnancy for women[8].

Similarly, the objective of the recent study is to examine the effectiveness of physical exercises, dietary program, training, and counseling in controlling diabetes mellitus. However, the specific focus of this study lies in objectives, in which it sees the effectiveness of physical exercises, counseling, training, and dietary programs on controlling diabetes mellitus in elderly around tourism area.

2. Method

To realize the purpose of the analysis, in this investigation, there are several methods that have been employed, among others, namely:
2.1. Counseling
This activity is done by gathering members of the diabetes group and health workers to follow the counseling about diabetes, diet and exercise it. Some of the materials to be given include: diabetes, its management, the role of diet and exercise in lowering blood glucose levels, the importance of controlling blood glucose levels and how to measure blood glucose independently.

2.2. Exercises/training
Procedures of special physical exercises are administered to the patients with diabetes attack. This practice is given to diabetic groups and health workers so that later can be distributed to other community members. Training in the form of muscle tightening with aerobics.

2.3. Practice in using independent blood-glucose measuring devices is provided to the elder group of people with diabetes mellitus. Practice is given to get used in utilizing the tool well to control blood-glucose levels.

2.4. Pre-test and post test
Some pre test and post test questions are administered to DM patients before and after physical exercise. Questions given related to the definition of DM and its management, the role of dietary regulation and the importance of physical exercise in lowering blood-glucose levels.

3. Results and discussion
Training on this program uses a combination of muscle tightening exercises (resistance exercise) with aerobic exercise (endurance exercise) and using the principle of Gradual Progresive Overload (GPO) which means that all the exercises should be done gradually and with the increase in strength and fitness of the body, and then the portion of the exercise should be gradually improved. The physical exercise with this combination method was followed by 6 participants consisting of diabetics and health officer of South Denpasar II. This training activity is assumed beneficial for diabetics and PUSKESMAS officers that will be their provision as an instructor for diabetics in the community health center. From the oral evaluation with the trainees, the majority of participants (70%) said they were happy with the training and expected to be re-enrolled in the event of similar training.

Training activities can be considered successful when viewed from the number of participants who previously planned a number of 6 people and was followed by 10 people. From the observation, 60% of participants can master the technique of physical exercise combination although the performance is not perfect. It is expected that over time, can be further refined and the deficiencies can be eliminated. Apart from the number of participants who exceed the target, the success of the program can also be seen from the implementation of activities on schedule so that the training activities have been running orderly and smooth.

| Patient Sample | Before physical exercise | After physical exercise | % Change |
|----------------|--------------------------|-------------------------|----------|
| Pat 1          | 138                      | 165                     | 19.57    |
| Pat 2          | 96                       | 87                      | 9.38     |
| Pat 3          | 135                      | 162                     | 20.00    |
| Pat 4          | 103                      | 91                      | 11.65    |
| Pat 5          | 331                      | 255                     | 22.96    |
| Pat 6          | 137                      | 163                     | 18.98    |
Table 2. Comparison of pretest and posttest results of participants.

| Participants | Gender | Pretest | Posttest |
|--------------|--------|---------|----------|
| Pat 1        | Male   | 50      | 87,5     |
| Pat 2        | Male   | 37,5    | 87,5     |
| Pat 3        | Male   | 37,5    | 87,5     |
| Pat 4        | Female | 75      | 100      |
| Pat PSN 5    | Male   | 50      | 87,5     |
| Pat 6        | Female | 75      | 100      |

The result of pretest and posttest showed an increase of average participant knowledge by 37.5 points (75%) and blood glucose result showed improvement in some participants (14.63%). Implementation of this training seems too short so that the results obtained are not maximized. Participants consisting of diabetics have memorized the movement, just not maximal on the intensity of the exercise. PUSKESMAS officers who will become instructors will also appear to have not mastered the technique of motion. So the exercise needs to be more organized and in a long time.

Training with this combination method is one of the methods used in training the fitness of people with diabetes mellitus and can maintain the stability of blood glucose levels. This training is also conducted on PUSKESMAS officers so it is expected later to be a provision when a physical exercise instructor in patients with diabetes mellitus in South Denpasar II Health Center.

Prior to the training, the participants got the theoretical material about diabetes mellitus given by the Devotional Team consisting of: Tanjung Subrata, Asri Lestarini and Ni Luh Putu Eka Kartika Sari. Materials given are: a balanced diet for people with diabetes mellitus, the role of exercise (exercise) for people with diabetes mellitus, the influence of exercise on blood glucose control, sports guidance for people with diabetes mellitus, the benefits and use of independent blood glucose measurement tool. The five materials are given for 1 day in the first week. After completion of the presentation of the material followed by discussion and question and answer. It appears that the active participants asked questions during the discussion and were highly motivated to attend the training. From the posttest results obtained all participants have increased knowledge about diabetes diet, exercise and regulation of blood glucose. This demonstrates the enthusiasm and motivation of participants in training and effective material delivery.

Exercise material is given by the Devotional Team who acts as a physical training instructor. Training was done first with giving examples of movement for DM patient, then followed by participant. Participants then re-train individually in their respective homes and then practice in groups at the South Denpasar Health Center every Saturday along with the Servant Team. Seemed enthusiastic participants during group practice, only when asked orally, how about at home, they say rather difficult, lack of enthusiasm and often no time. When observed the quality and intensity of individual movements, it was found that the majority of the movement was already memorized, but the quantity of exercise in the house was lacking. When the observation of independent blood glucose measurements, almost all participants were able to perform the examination by using an independent blood glucose measurement tool contained in the puskesmas. After knowing recognizing blood glucose levels, all patients feel motivated to control blood glucose levels, either by diet regulation, drug regulation and exercise (physical exercise).

Fasting blood glucose levels of the six patients with diabetes mellitus who examined showed improvement (decrease) from the previous 3 participants (50%). This is probably caused by a lack of exercise intensity on a regular basis and not balanced with a diet that is appropriate for people with diabetes. It is hoped that in the future it can be improved to be better with the motivation of puskesmas officers who have also received training on this combination of physical exercises.

In addition to treatment and insulin injections, a pillar of DM therapy to prevent the progression of the disease is physical exercise. According to Sherwood (2001), measurable and regular exercise is
useful in the management of diabetes mellitus because the active muscles of work are not dependent on insulin. Working muscles will absorb and use some of the excess glucose in the blood resulting in a decrease in the need for insulin [9]. Physical exercise is regular and measurable for 6 weeks with a duration of 30 minutes, useful in DM management because it can increase insulin production [10].

According Riyadi and Sukarmin (2008), physical exercise can maintain fitness, lose weight and improve insulin sensitivity, so that it will improve blood glucose control. Regular physical exercise (3-5 times a week for about 30-60 minutes) will keep muscles active. The active muscles will improve the circulation of insulin by increasing the dilatation of cells and blood vessels thus helping the entry of glucose into the cells. In the active muscle, the sensitivity of insulin receptors will increase so that the intake of glucose in blood vessels will increase 7-20 fold [11, 12].

4. Conclusion
Physical exercise with this combination method received a positive response from participants consisting of people with diabetes mellitus and Health Center Officer of South Denpasar II. This training is able to help some people with diabetes mellitus so they can control their blood glucose levels. Training the use of independent blood glucose measuring tool can help people with diabetes mellitus recognize the condition of his body and add motivation to control blood glucose levels.

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