

# Diabetic foot exercise training for diabetes mellitus patients to control blood glucose during the COVID-19 pandemic

Pelatihan senam kaki diabetes bagi pasien diabetes mellitus untuk mengontrol glukosa darah selama pandemi COVID-19

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## ABSTRACT

Physical activity restriction during the pandemic increases the risk of developing diabetic foot ulcers in patients with diabetes mellitus. Community service activities in the form of diabetic foot exercise training aim to increase knowledge and blood glucose control of diabetic mellitus patients during the pandemic. The activities were carried out in the Tlogorejo and Madulegi villages in Sukodadi Primary Health Care for 60 patients with diabetes mellitus who are members of prolanis. Community service activities include health education about diabetes and foot care, foot exercise training and physical examination, and fasting blood glucose testing. Post-test results showed that 80% of the participants had good knowledge, 15% had sufficient knowledge, and 5% lacked knowledge. Most participants could do foot exercises, and the average fasting blood glucose level of the participants after being given counselling and training was 171.60 mg/dL. Foot exercises training can increase participants' knowledge and can be used as a way to control blood glucose during the COVID-19 pandemic.

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## 1. INTRODUCTION

Diabetes mellitus (DM) is one of the severe health problems where DM causes about 4.6 million deaths, and it became the reason dead seventh in 2016 (World Health Organization, 2016). DM is one disease comorbidity that can cause somebody exposed to COVID-19 or increase the risk of worsening prognosis of COVID-19. DMs enhance comorbid diseases like cardiovascular and kidney disease, peripheral neuropathy, vision disorder, and cancer (Bays, 2012; Johnson et al., 2012; Khalil et al., 2012). Based on blood screening on the population over 15 years old, the prevalence of DM in Indonesia in 2018 was 10.9 % (Ministry of Health of the Republic of Indonesia, 2018). In Lamongan, the number of DM

patients is 10,094,403 patients from primary health care of Sukodadi Lamongan and 200 DM patients became prolanis' participants.

The problems experienced by diabetic patients during the pandemic are decreasing physical activity. It can impact microvascular and macrovascular complications, enhancement risk of neuropathy peripheral, and more carry-on could contribute to Diabetic Foot Ulcer (DFU) (Tran & Haley, 2021). The risk of developing DFU is due to dysfunctional microcirculation, abnormal plantar pressure, increased hardness of plantar tissue, and peripheral neuropathy (Ren et al., 2021). Diabetic foot ulcers, infection, gangrene and amputation are related to an increased mortality risk and poor prognosis in DM patients (Graciella & Prabawati, 2020).

There are five pillars of managing DM patients: diet, exercise, medication, blood glucose monitoring and education. Physical exercise or foot exercise in DM patients aims to increase blood circulation and blood glucose in muscle tissues and control blood glucose levels (Ratnawati et al., 2019). Management DM patients use the five pillars in their health facilities at the first level (puskesmas) implemented through the chronic disease management program (Prolanis). Its activity includes medical consultation, prolanis club, home visits, and health screening (Meiriana et al., 2019).

Foot exercise is non-pharmacological therapy that can be used to prevent neuropathy peripheral. Foot exercise is a manageable activity, conducted anytime and needs a short duration. Regular exercises could prevent and reduce symptom neuropathy peripheral. Foot exercise supports the function of microvascular and lipid oxidation by reducing oxidative stress and increasing neurotrophic factors. Foot exercise can increase perfusion, preventing worsening neuropathy in patients with DM (Graciella & Prabawati, 2020). Foot exercise can increase the regulation of blood glucose, ABI (Ankle Brachial Index), cardiovascular endurance and muscle strength (Ren et al., 2021).

Preliminary study related to the effect of leg exercises on symptom neuropathy Peripheral and blood glucose levels fasting in DM patients shows no significant relationship between foot exercises and neuropathy symptom and blood glucose levels. Foot exercises can decrease neuropathy symptoms based on The Michigan Neuropathy Screening Instrument (MNSI) assessment. Foot exercise carried out in the study focused on range motions at the ankles and knees performed for one month (Graciella & Prabawati, 2020). Lepesis et al. (2022), in the research mention that the physical factors contributing to obedience DM patients in doing exercise are exercise can increase mobility and flexibility of the feet and joints of the feet; exercise can reduce pain and improve participation DM patients in daily life (Activity Daily Living). While the psychological factors that influence obedience towards practice are exercise as not enough pretty moral responsibility that must be done, contributing to research and help DM patients in the future as well as gain self-trust with involved as a participant in study (Lepesis et al., 2022)

The increase of COVID-19 in the District Lamongan makes the government stricter in running health protocol. Prevention conducted to reduce COVID-19 transmission is hand washing, wearing a mask, physical distancing, limited physical activity, and avoiding crowded. In the era of a pandemic, no all prolanis activity could be done because primary health care (Puskesmas) gives service under guidelines service during the COVID-19 pandemic (Ministry of Health of the Republic of Indonesia Directorate General of Health Services, 2020). During the pandemic, no exercise could be conducted together at the same time. Based on preliminary survey results, activities prolanis as a program undertaken by the government to control chronic DM are not included in carrying out exercise (Gabarron et al., 2018).

The primary health care of Sukodadi Lamongan has many participants' prolanis, especially DM in the Lamongan District. There are about 200 DM patients who have become active prolanis participants program at Sukodadi Lamongan Primary Health Care. Based on the results of the interview with Head Primary Health Care Sukodadi Lamongan, an activity which could be held during pandemic COVID-19 for program prolanis is the physical examination, laboratory (blood glucose, lipids profile, kidney and heart function), as well as education provided by a health provider at the moment of the examination.

Implementation prolanis held in several sessions to minimize amount patients which come, one of implemented at the Madulegi Sub-branch Health Center and Tlogorejo Village Hall. Several usual activities implemented during a pandemic becomes not done are exercise and counselling in a group.

Based on the description from chairman group prolanis-DM, they no could do exercise together during the pandemic. Neither do they get counselling, usually conducted by the group. Exercise is one of activity important which needs to be undertaken by patients with DM. Patients say that most of their activities are done at home during the pandemic so that activity becomes limited. Government recommendation to the public for a stay in a house can cause a decreased level of activity significantly. Reducing physical activity and the abolition of exercise on patient DM are risky for increasing the ineffectiveness of blood glucose control inpatient (Tison et al., 2020).

Community service purpose of initiating education and foot exercise training for controlling blood glucose and preventing DM complications during the COVID-19 pandemic with permanent application protocol COVID-19 health. Foot exercises are carried out by DM patients to prevent diabetic foot ulcers, repair blood circulation and strengthen muscles in tiny feet (Kusumahati et al., 2018). The management of diabetes mellitus aims to increase the quality of life and lower morbidity and mortality of diabetics. In a short period, the management aims to remove complaints and reduce acute and chronic complications risk. The long-term goal was to prevent and hinder progressive complications of microangiopathy and macroangiopathy. This community service aims to increase knowledge and skills of foot exercise in participants' DM prolanis to control blood glucose during the COVID-19 pandemic.

## 2. METHODS

Community service implemented in the work area Sukodadi Lamongan Primary Health Care, specifically Madulegi and Tlogorejo Village Hall, in September and October 2021. Activity partners devotion public as many as 60 participants Prolanis DM. The method used in this community service activity is through education and training, which includes education for patients with DM, training in foot exercises and physical examinations and also blood glucose levels in patients with DM. Media used in education are PowerPoint and leaflet. For diabetic foot exercise training using newspapers and chairs. Inspection physical performed on the patient covers pressure blood and blood glucose levels. Blood pressure was checked using a sphygmomanometer, and blood glucose was capped with a glucometer via a finger stick. After activity education and training, evaluation knowledge was conducted by spreading questionnaires to the participant.

**Table 1.** Implementation activity community service diabetic foot exercise training for participants prolanis at the Sukodadi Lamongan Health Center: Effort blood glucose control of diabetes mellitus patients during the COVID-19 pandemic

Stages	Implementation	Destination	Executor
Education on Diabetes Mellitus	September and October 2022	Increase knowledge among participant about diabetes mellitus	Team of community service
Diabetic foot exercise training	September and October 2022	Increase Skills participant in do leg exercises	Team of community service
Physical examination and blood glucose check in patients with diabetes mellitus	September and October 2022	To do evaluation condition physical and laboratory participant post action	Team of community service and health care staff of Primary health care Sukodadi Lamongan

### Education Diabetes Mellitus

Diabetes Mellitus (DM) patients require qualified knowledge about the disease and its management. Increasing patient knowledge by providing education about DM. Instruction is given in the form of group counselling in DM patients who are members of prolanis. During a pandemic, teaching is carried out in each region (each village) with the aim of not too many gathered residents. Counselling is carried out by the community service team in collaboration with doctors at the Sukodadi Lamongan Public Health Center. The topic of counselling is related to DM patients' management and foot care. Education is conducted to promote healthy living and prevent DM complications in patients.

### Foot Exercise Training

After being given education about the management and foot care of DM patients, the next meeting was to provide training in foot exercise to prolanis DM participants. Primary health care Sukodadi Lamongan. Activity given by direct through two stages, first demonstrated by the team community service, stage second made group small where every participant prolanis follow exemplified movements. After practice, the team evaluates to check the ability of the participant to do foot exercises. During practice, the team corrected the wrong movements and gave praise to the participants who were able to perform the movements well.

### Physical and Blood Glucose Examination of Patient with Diabetes Mellitus

Activity devotion community carried out by the team will evaluate success by doing physical and laboratory examination on patient's participant DM which follow foot exercise training. The physical examination covers the measurement of height and weight and measurements of pressure blood. As for inspection laboratory measures fasting blood glucose levels. Physical and laboratory examinations were conducted by a community service team cooperating with a health care provider at the Sukodadi Lamongan Health Centre.

## 3. RESULTS AND DISCUSSION

### Diabetes Mellitus Education

The first activity is diabetes mellitus education activity which is carried out by providing counseling to prolanis participants at the Sukodadi Lamongan Health Center by Lecturers of the Faculty of Nursing in collaboration with doctors at the Sukodadi Lamongan Health Center. Activity this carried out at the Madulegi Sub-branch Health Center and the Tlogorejo Village Hall with 60 participants (Table 1), with average score age is 57 years old that is age youngest 35 years and age oldest 70 years, as well as almost whole participant manifold sex female. Amount significant DM cases occur in women because of the decrease in the hormone estrogen, especially when women have experienced menopause. Estrogen and progesterone hormones can boost insulin response in the blood (Graciella & Prabawati, 2020)

**Table 1.** Characteristics participant prolanis diabetes mellitus at the Sukodadi Lamongan Health Center

Characteristics Participant	Frequency (f)	Percentage (%)	Average	Minimum - Maximum
Age	-	-	57	35 – 70
Type Gender:				
Man	14	23.3	-	-
Woman	46	76.7	-	-

The activity was carried out in accordance with the Covid-19 health protocol. The material presented on the management and care of the feet of diabetic patients includes understanding, course of the disease, risk factors, signs and symptoms, complications, management, and foot care. Participant DM prolanis looks enthusiastic about listening to counselling and actively asks presenters (Figure 1).



**Figure 1.** Health education about management and foot care of diabetes mellitus patients in participant's prolanis at the Madulegi Sub-branch Health Center and the Tlogorejo Village Hall

Evaluation of that activity conducted by post-test. Post-test results related to knowledge about managing DM and foot care show that mostly (66.7%) of participants with DM prolanis have good knowledge, (25%) of participants with DM prolanis have enough knowledge, and 8.33% of participants with DM prolanis have less knowledge (Table 2). Education in DM aims to promote a healthy life and prevent complications in patients. Education DM patients consist of two parts, early and continued education. Early education is counselling given basis to related DM patients' understanding of the disease's journey, control, and monitoring, complications, pharmacology and non-pharmacology interventions, hypoglycemia and foot care. Education level carries on is a step next thing to do is give education about DM complications, DM conditions, and foot care (Perkeni, 2019). DM education can increase the knowledge of respondents. Education conducted by giving repetitive and precise information could help respondents remember and apply the information provided in life daily (Wahyuni et al., 2019).

**Table 2.** Distribution knowledge post-test frequency participant prolanis diabetes mellitus

Knowledge Post Test	Frequency (f)	Percentage (%)
Lack of Knowledge	5	8.33
Knowledge Enough	15	25.00
Knowledge Well	40	66.70
<b>Total</b>	<b>60</b>	<b>100</b>

### Foot Exercise Training

The next activity is diabetic foot exercise training for DM prolanis participants at the Sukodadi Lamongan Health Center, Madulegi Sub-branch Health Center, and Tlogorejo Village Hall. Training is given by Lecturer Faculty Nursing and Faculty Vocational with prioritizing protocol COVID-19 health. Participant prolanis trained diabetic foot exercise. Training started more formerly with giving theory about diabetic foot exercises then continued with the practice of foot exercise. Participant DM prolanis seen enthusiastic and enthusiastic moment practice of foot exercise (Figure 2 and Figure 3). Evaluation of this activity held for knowing success from training that has been conducted. In accordance with the

**Diabetic foot exercise training for diabetes mellitus patients to control blood glucose during the COVID-19 pandemic**

*Arina Qona'ah, Anestasia Pangestu Mei Tyas, Andri Setiya Wahyudi, Amellia Mardhika*

procedure, there is an increase in the patient's physical activity through foot exercise activities (report of foot exercise activities for one month). Foot exercise can help repair blood circulation, strengthen tiny muscles feet, and prevent happening abnormal foot shape (deformity) (Ministry of Health of the Republic of Indonesia Directorate General of P2P, 2018). Physical activity and exercises like aerobics, strengthening, stretching, and exercise balance are part of self-management. Activity has proven to contribute to the prevention of complications period length in type II diabetic patients, especially in controlling glycemic (Lepesis et al., 2022).



**Figure 2.** Diabetic foot exercise training for prolans diabetes mellitus participants at the Sukodadi Lamongan Health Center

**Figure 3.** Diabetic foot exercise training for prolans diabetes mellitus participants at the Madulegi Sub-Branch Health Center and Tlogorejo Village Hall

**Figure 4.** Physical and blood glucose examination DM prolans at the Sukodadi Lamongan Health Center

**Physical and Blood Glucose Examination in Patients with Diabetes Mellitus**

The last activity is an evaluation with a method of physical and blood glucose examination in prolans participants of DM that follows foot exercise training. Physical examination includes measurement of height and weight and blood pressure. The laboratory measures blood glucose levels by fasting. Physical and blood glucose exams were conducted by a community service team cooperating with a health care provider at the Sukodadi Lamongan Health Centre (Figure 4).

Below are results of physical and blood glucose examination prolans participant DM Health Care Center Sukodadi September and October 2021 is stated in Table 3 and Table 4.

**Table 3.** Examination results participants physical and blood glucose prolans diabetes mellitus at the the Sukodadi Lamongan Health Centre (September 2021)

No.	Height	Weight	Systolic	Diastolic	Fasting Blood Glucose
1	157	60	130	70	101
2	162	54	160	100	130
3	155	56	130	70	89
4	150	46	130	80	121
5	153	60	120	80	113
6	160	70	100	80	223
7	155	40	160	80	111
8	153	50	140	90	120
9	150	40	11	70	473
10	158	50	140	90	229
11	160	70	110	70	114
12	157	50	130	82	122

<b>No.</b>	<b>Height</b>	<b>Weight</b>	<b>Systolic</b>	<b>Diastolic</b>	<b>Fasting Blood Glucose</b>
13	155	53	120	80	322
14	148	50	120	80	209
15	140	52	140	80	120
16	148	45	110	70	124
17	159	60	140	90	229
18	149	55	120	80	96
19	153	55	130	80	119
20	156	55	140	80	123
21	154	60	120	80	119
22	151	55	110	60	200
23	143	62	140	90	116
24	150	56	120	80	110
25	152	55	130	80	237
26	152	77	130	80	102
27	150	44	110	70	205
28	150	52	160	80	118
29	156	53	120	80	314
30	157	55	140	85	256
31	151	51	130	80	123
32	157	50	130	90	282
33	145	71	130	90	104
34	151	60	130	90	94
35	157	70	180	90	95
36	152	46	140	95	128
37	161	89	140	80	101
38	165	84	130	80	222
39	151	56	130	80	217
40	157	56	140	80	99
41	152	60	130	80	128
42	150	42	150	90	117
43	153	54	140	90	113
44	155	60	130	80	232
45	160.5	59	120	80	113
46	167	70	160	90	123
47	146	44	130	80	287
48	174	40	120	80	218
49	153	71	140	80	129
50	148	49	160	90	118
51	151	65	120	80	87
52	155	54	130	80	324
53	152	78	110	80	121
54	150	60	110	70	100
55	167	68	130	90	390
56	153	50	130	90	276
57	154	61	130	80	115
58	148	55	150	80	434
59	151	50	130	80	116
60	143	65	130	80	275
<b>Mean ± SD</b>	<b>153.70 ±6.00</b>	<b>57.13 ±10.44</b>	<b>129.85 ±21.39</b>	<b>81.53 ±7.15</b>	<b>172.43 ±91.19</b>

**Diabetic foot exercise training for diabetes mellitus patients to control blood glucose during the COVID-19 pandemic**

*Arina Qona'ah, Anestasia Pangestu Mei Tyas, Andri Setiya Wahyudi, Amellia Mardhika*

**Table 4.** Examination results participants' physical and blood glucose prolans diabetes mellitus at the Sukodadi Lamongan Health Centre (October 2021)

<b>No.</b>	<b>Height</b>	<b>Weight</b>	<b>Systolic</b>	<b>Diastolic</b>	<b>Fasting Blood Glucose</b>
1	157	60	130	70	101
2	162	56	150	90	106
3	155	56	160	90	105
4	150	46	100	90	292
5	153	60	120	80	213
6	165	70	130	90	238
7	156	45	140	90	88
8	152	65	100	80	119
9	150	43	100	70	379
10	150	52	120	80	104
11	165	74	110	80	103
12	152	50	120	80	116
13	159	55	110	80	333
14	156	50	120	90	104
15	140	50	110	90	215
16	157	46	100	80	108
17	159	60	120	90	98
18	146	60	130	90	92
19	150	55	150	90	118
20	154	56	130	90	108
21	154	60	120	80	119
22	151	55	110	60	228
23	143	66	130	80	249
24	150	52	100	60	111
25	152	58	120	80	115
26	152	77	130	70	115
27	150	44	110	70	203
28	150	55	120	70	113
29	156	53	120	80	314
30	157	55	140	85	256
31	151	51	130	80	123
32	157	49	120	80	369
33	145	70	130	75	94
34	151	63	100	60	89
35	157	67	160	100	239
36	152	46	125	85	120
37	161	89	140	80	127
38	165	83	110	70	273
39	151	57	120	80	121
40	157	65	120	80	128
41	152	53	130	90	120
42	150	40	120	80	129
43	153	59	120	80	106
44	155	40	130	80	102
45	160'5	61	140	90	111
46	167	71	130	90	265
47	146	46	110	80	242



No.	Height	Weight	Systolic	Diastolic	Fasting Blood Glucose
48	174	40	100	80	465
49	153	71	110	80	233
50	148	49	120	80	214
51	151	65	120	80	115
52	155	53	160	90	101
53	152	78	110	80	121
54	150	60	110	70	130
55	167	66	110	80	391
56	153	50	110	80	129
57	151	54	120	80	118
58	148	50	120	80	108
59	151	50	170	90	123
60	143	60	160	90	327
<b>Mean ± SD</b>	<b>153.82 ±6.28</b>	<b>57.33 ±10.56</b>	<b>123.42 ±16.70</b>	<b>81.08 ±8.24</b>	<b>171.60 ±92.53</b>

Examination results of physical and blood glucose patient before conducted DM education and foot exercise training, namely: weight has score mean 57.13 and standard 10.44 deviation, height has score mean 153.70 and standard deviation 6.00, pressure blood systolic have score average 129.85 and standard 21.39 deviation, pressure diastolic blood has score mean 81.53 and standard 7.15 deviation, while blood glucose fast has score mean 172.43 and standard deviation 91.19. Examination results physical and blood glucose patient after conducting DM education and foot exercise training, namely: weight has a score mean 57.33 and standard 10.56 deviation, height has score mean 153.82 and standard 6.28 deviation, pressure blood systolic have score mean 123.42 and standard 16.70 deviations, pressure diastolic blood has score mean 81.08 and standard 8.24 deviation, while blood glucose fast has score mean 171.60 and standard deviation of 92.53 (Table 5).

**Table 5.** Examination results participants' physical and blood glucose prolanis diabetes mellitus before and after diabetic foot exercise training

Examination Results Physical and Blood Glucose	Before		After	
	Average	Standard Deviation	Average	Standard Deviation
Weight	57.13	10.44	57.33	10.56
Height	153.70	6.00	153.82	6.28
Pressure blood systolic	129.85	21.39	123.42	16.70
Pressure blood diastolic	81.53	7.15	81.08	8.24
Fasting blood glucose	172.43	91.19	171.60	92.53

In accordance with the study [Wibisana & Sofiani \(2017\)](#), there is a difference in average blood glucose levels before and after foot exercise. The average value of blood glucose level after doing more leg exercises is low from the score of blood glucose level before doing leg exercises. In research mentioned that foot exercise in type 2 DM patients causes a decline in blood glucose levels by as much as 5.1% ([Sahar, 2020](#)). Holding practice is essential in controlling blood glucose levels by boosting insulin sensitivity, helping dick blood glucose levels, and preventing or postponing development complications due to DM ([Zheng et al., 2020](#)).

#### 4. CONCLUSION AND RECOMMENDATIONS

The activity of community service has produced a number of the outside that is enhancement knowledge and awareness participant in diabetic foot exercises training after given education diabetes mellitus foot management and care, skills participant DM prolanis in do diabetic foot exercises increase after getting foot exercise training, and the drop blood glucose level fasting (in the normal limit) after conducted diabetic foot exercise counselling and training.

Limitations in activity devotion public this is no can conduct the evaluation by direct about activity daily conducted by participants especially in diabetic foot exercise as well as duration short training, so that makes some participants still feel confused moment practising diabetic foot exercises. As an effort for practical training, then on activities devotion public next could involve family at the moment counselling and training, as well as media that can be used for monitor obedience participant in, do leg exercises independent and periodic.

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