



## **Diabetes Foot Exercise Using Tennis Ball on Reducing Blood Sugar Level among Diabetes Patients**

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**Abstract.** Uncontrolled blood sugar is a health problem that tends to occur among the elderly with type 2 diabetes mellitus (T2DM). Foot exercise could be recommended for controlling the blood sugar level. The study aimed to examine diabetic foot exercises using tennis balls on reducing blood sugar levels among the elderly with T2DM. The quasi-experimental study design, one group, pre-test, and post-test without a control group was applied in this study. Fifty-eight samples were involved and obtained from Cisalak Pasar Village, Depok. The implementation of foot exercises by using tennis balls was conducted for 30-60 minutes per session/week. The program consisted of 12 sessions. The results found that after implementation, the blood sugar reduced within 5.1%. It can be concluded that leg exercises using tennis balls positively affect lowering blood sugar among the elderly with T2DM (p-value <0.05; CI 95%). This intervention can be a form of intervention provided in preventive health care for T2DM elderly clients.

**Keyword:** type 2 diabetes mellitus, elderly, foot exercise, blood sugar level



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### **INTRODUCTION**

Type 2 diabetes mellitus (T2DM) is a disease that causes most sufferers to experience a condition of foot neuropathy. It could develop into a diabetic foot ulcer (1-2). Diabetic foot health problems have the second-highest prevalence in North America at 5.5% of the Asian

region (2). As many as 34% of T2DM clients experience neuropathy problems, and 8.7 percent have experienced leg problems in Indonesia (1). Based on the results of interviews with Puskesmas officers in Cisalak Pasar Village, the majority of elderly diabetics who came for health checks to the Puskesmas experienced unstable blood sugar conditions.

Diabetic foot training is part of nursing intervention in exercise therapy: muscle control, a specific exercise activity, or protocol to improve or maintain controlled body movement (3). Another study showed diabetic foot exercises could be done by using tennis balls to give the effect of massage on the soles of the feet to be more effective in improving the health of the elderly's feet (4). This is in line with a previous study reported that diabetic foot exercises performed with Swiss ball aids for 30 to 40 minutes per session in 1 session per week for 12 weeks, proven to reduce 5% fasting blood sugar levels and 0.1% HbA1C in T2DM elderly (5). Also, training using physioball balls can improve people's quality of life with T2DM (6). Another study conducted by Subramanian and Vankatesan (2013) concluded that additional media in the form of balls in exercise activities proved useful for lowering blood sugar in people with T2DM (6).

Implementation of physical exercise or sports activities for older adults with T2DM needs to pay attention to the intensity or form of movement that will be carried out (5). Diabetic foot training activities can be carried out with the principle of flexion, extension, adduction, abduction, and rotation (7). According to Hariharasudhan and Varunkumar (2018), foot exercises for T2DM older adults will be more effective if using tools to stimulate plantar nerve foot function. Also, the provision of training programs for elderly T2DM at home needs to be supported by interactive and informative media passively and actively so that the elderly and families can do the exercises independently (8). Foot training activities for elderly T2DM need to be done with a simple movement using tools to stimulate energy expenditure, accompanied by education so that the elderly and families can control blood sugar independently. This is what makes the writer interested in doing this study. The questionnaires used in this study were the BBAT questionnaire and the observation sheet. The questionnaire on breastfeeding production knowledge was seen from the BBAT (Breastfeeding Assessment Tools), which consists of 4 BBAT items that have been tested for validity with results (Cronbach's alpha = 0.668) and  $p = 0.002$ .

The results of a preliminary study conducted at Pelni Hospital in June 2018 - August 2018 found 46 section patients treated were faced with complaints of pain and swelling around the breasts. On August 31st of 46, Sectio Secaria patients had a fever, swelling, and the milk cannot come out to not breastfeed and increase the loss of hospitalization is getting longer, but the baby's weight decreases gradually. In August 2018-October 2018, 57 patients were undergoing cesarean section, and 42 of them had breastfeeding problems. In October 2018 - November 2018, 52 patients had a cesarean section, and 49 of them also experienced breastfeeding problems. The total number of Sectio Caesaria patients without indication at PELNI Hospital from January 2018 - December 2018 in 180 patients. The increase in breastfeeding in mothers who have had a monthly cesarean section at Pelni Hospital has caused new service quality problems. At Pelni Hospital, no one has used the SPEOS method in patients after sectarian surgery who have difficulty producing milk production and breastfeeding problems.

## **OBJECTIVE**

The study aimed to examine diabetic foot exercises using tennis balls on reducing blood sugar levels among the elderly with T2DM.

## **METHOD**

The study was conducted with an experimental method, one group, pre-test, and post-test without a control group. Fifty-eight older people with T2DM were selected by using the purposive sampling technique in this study.

The inclusion criteria, including 1) elderly without an experience diabetic ulcer, 2) do not experience infection or inflammation in the joints of the legs. Blood sugar was measured based on postprandial blood sugar using a calibrated tool. The respondent's blood sugar data has a normal distribution. The significance test used is the independent t-test.

Foot exercise is carried out on the principle of flexion, extension, adduction, and abduction. Foot exercise using a ball the size of a tennis ball is done to train the leg muscles and foot movement coordination. Before starting a workout, prepare a chair, tennis ball, and mat or mat with soft material. Sit on a chair and place the mat under your feet with the ball between your legs, then do the following movements: 1) First, position your right foot on top of the ball (position on the ball), then move the foot forward and back eight times. Repeat using the left leg. Do two reps; 2) Second, position your right foot on the ball (position on the ball) with your heel flat on the floor. Perform a gripping motion with the ball using your toes 16 times. Repeat using the left leg. Do two reps; 3) Third, position your right foot on the ball (position on the ball) with your heels flat on the floor. Do a right and left shaking motion eight times. Repeat using the left leg. Do two reps; 4) Fourth, position your feet on the ball (position on the ball) with your heels flat on the floor. Perform the movement of passing the ball from the right foot to the left foot and vice versa, using the sole without lifting the heel. Do the exercise eight times and repeat the movement for two reps; 5) Fifth, position your right foot on the ball (position on the ball) with your heel, not on the floor. Make a circular motion in a direction and counterclockwise eight times. Repeat using the left leg. Do two reps; 6) Sixth, position your right foot on the ball by stepping on the ball using your heel. Bend the back of your leg in 8 times. Repeat using the left leg. Do two reps; 7) Seventh, position your right foot on the ball by stepping on the ball using your heel. Perform the bending of the back of the foot outward until the toes touch the floor eight times. Repeat using the left leg. Do two reps; 8) Eighth, put the ball between the legs. Pinch the ball using the inside front of your right and left foot. Perform the movement to lift the ball with your heels still on the floor eight times. Do two reps; 9) Ninth, position both feet on the ball with the inside of both feet attached/stepping on the ball. Move both legs forward and back eight times. Do two reps.

Tenth, place the ball on the floor between your legs. Position the feet with the heels touching each other. Perform a gripping motion and release using both feet simultaneously eight times.

## RESULTS

The study results concluded that there were significant differences between blood sugar values before and after the intervention ( $p < \alpha$ ;  $\alpha = 0.05$ ). Changes were shown by a decrease in the mean value of blood sugar by 319.19 mg / dL to 302.84 gm / dL or down by 5.1%.

Variable	Before intervention Mean (SD)	After intervention Mean (SD)	<i>p</i> - value
Blood sugar values	319,19 (18,658)	302,84 (15,996)	0,0001

## DISCUSSION

This study's results are in line with the previous study found that foot training programs with a range of motion movements carried out for four weeks can reduce HbA1C levels in diabetics (9). Another study found that foot exercises using balls in 30-40 minutes

for 12 were shown to decrease 5% fasting blood sugar levels of T2DM clients (5). Physical activity in the form of sports can trigger the work of the heart and lungs to cause aerobic metabolism in the way of glycogenesis and increase the work of pancreatic beta cells in producing insulin so that glucose in the blood can be converted into energy in the form of Adenosine Triphosphate (ATP) (10).

Foot training is an activity recommended for diabetics (11). Elderly T2DM is recommended for physical activity and moderate to moderate exercise levels, such as leg exercises. High activity will cause T2DM elderly to experience fatigue and even enter hypoglycemia (12). The movement of the foot training contains an element of moving pressure using a hardball media. The activity of leg exercises that include controlled massage or suppression elements can stimulate energy expenditure in diabetic clients (4). It can be concluded that foot exercises with a range of motion coupled with pressure movements using a tennis ball aid media can control blood sugar in elderly T2DM.

Picture 1. Diabetic foot exercise



The condition of hyperglycemia in diabetes mellitus clients occurs due to the pancreatic beta cells' inability to produce the hormone insulin to process glycogenesis due to damage to the pancreatic beta cells of the body experiencing excess glucose intake (13). Glucose levels can be examined by assessing fasting blood sugar, postprandial blood sugar, or blood sugar 2 hours after meals, when blood sugar, and HbA1c, according to the National Glycogen Standardization Program (NGSP) standard. HbA1c has better inspection accuracy, but few laboratories can conduct this assessment because the costs are quite expensive. The examination done is fasting blood sugar or postprandial blood sugar because the accuracy is quite good. Postprandial blood sugar checks are more often done in groups of diabetic clients in the community because the cost and method of the examination are more accessible without performing specific procedures such as having to fast at least 8 hours (14).

Nursing interventions are arranged based on the diagnosis of NANDA 2018-2020 and refer to Nursing Outcomes Classification (NOC), Nursing Intervention Classification (NIC), and Evidence-Based Practice (EBP) (15-16). Before an exercise activity or procedure is

carried out, clients and families are given education and training media. Check blood sugar levels using a calibrated glucometer.

The preparation stage for implementing foot training is that the client prepares football balls, chairs, mattresses, clothes, and a comfortable and safe environment. Implementing leg exercises using tennis balls is that the client performs ten kinds of exercise movements where each movement is done eight times with two repetitions. The total duration of the activity required is 30-40 minutes in one session, and the training session is carried out in one week for 12 weeks.

The series of movements is. First, the ball's step is to position the right foot above the ball (the position of stepping on the ball), then the foot's direction forward and back as much as eight times. Repeat using the left foot. Do as many as two reps. Second, the ball's grip is to position the right foot above the ball (the position on the ball) with the position of the heel attached to the floor. Perform a ball holding motion using your toes 16 times. Repeat using the left foot. Do as many as two reps. Third, the foot's rocking motion is to position the right foot on the ball (the position of stepping on the ball) with the position of the heel attached to the floor. Do the foot shake to the right and left as much as eight times. Repeat using the left foot. Do as many as two reps. Fourth, the passing movement is to position the foot on the ball (the position of stepping on the ball) with the heel's position attached to the floor. Do the pass from the right foot to the left foot and vice versa, using the sole without lifting the heel. Make eight movements and repeat two repetitions. Fifth, the foot rotates' movement to position the right foot on the ball (the position of stepping on the ball) with the position of the heel not sticking to the floor. Perform circular motions in the direction and counterclockwise eight times. Repeat using the left foot. Do as many as two reps. Sixth, the movement of bending the back of the foot inward is to position the right foot on the ball by stepping on the ball using the heel. Do the movement of flexing the end of the foot inward as much as eight times. Repeat using the left foot. Do as many as two reps. Seventh, the movement of bending the back of the foot outward is to position the right foot on the ball by stepping on the ball using the heel. Do the bending of the end of the foot outward until the toes touch the floor eight times. Repeat using the left foot. Do as many as two reps. Eighth, the movement of pinning the ball is to place the ball between the two legs. Pinch the ball using the front side of the right and left legs. Perform a ball lifting motion with the position of the heel remaining on the floor eight times. Do as many as two reps. Ninth, the movement of grinding the ball is to position both feet on the ball with the inside of both feet attached/stepped ball. Movement of both legs forward and back as much as eight times. Do as many as two reps. Tenth, the ball gripping motion that is placing the ball on the floor between the legs. Adjust the position of the feet with the heels touching each other. Do the ball gripping movement and release using both feet simultaneously eight times. Do as many as two reps. Foot exercises using tennis balls have an impact on decreasing blood sugar in elderly T2DM.

## **CONCLUSION**

Exercise therapy: muscle control in leg exercises using tennis balls that reduce postprandial blood sugar in elderly T2DM.

## **RECOMMENDATION**

Public health nurses need to get training in conducting exercise therapy: muscle control in leg exercises using tennis balls to prevent elderly diabetes health. Further identification activities in assessing the effectiveness of foot training interventions using tennis balls to reduce blood sugar can be done using the experimental research method or randomize clinical trial (RCT)

## CONFLICT OF INTEREST

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## REFERENCES

- (1) InfoDatin. (2015). Situasi dan analisis diabetes. Kementerian kesehatan: Pusat data dan informasi kementerian kesehatan republik Indonesia
- (2) Zhang, P., Lu, J., Jing, Y., Tang, S., Zhu, D., and Bi, Y. (2016). Global epidemiology of diabetic foot ulceration: a systematic review and meta-analysis. *Annals of Medicine*. Vol 49(2): 106-116. Doi: <http://dx.di.org/10.1080/07853890.2016.1231932>
- (3) Bulechek, G.M., Butcher, H.K., Dochthermanm J.M., and Wagner, C.M. (2013). *Nursing Intervention Classification (NIC)*. Singapore: Elsevier inc
- (4) Hanphitakphong, P., and Poomsalood, S. (2017). The immediate effect of foot self-massage in combination with exercise using on balance performance in community-dwelling older adults. *Journal of Associated Medical Sciences*. Vol 50(1). Doi: 10.14456/jams.2017.9
- (5) Hariharasudhan, Ravichandran., & Varunkumar, Vivekanandan. (2015). Effect of Swiss ball exercise in type II diabetes mellitus. *Soudi Journal of Sports Medicine*. Vol 15. Doi: 10.4103/1319-6308.146347
- (6) Subramanian, S.S., Julius, A., Hariharasudan, R. (2014). Effect of physioball exercises on glycemic control and quality life of type II diabetic patients. *Biosciences Biotechnology Research Asia*. Vol 11:325-328. Doi: dx.doi.org/10.13005/bbra/1275
- (7) Francia, P., Gulisano, M., Anichini, R., and Seghieri, G. (2014). Diabetic foot and exercise therapy: step by step the role of rigid posture and biomechaniscs treatment. *Diabetic Foot and Eercise Therapy*. Vol 10: 86-99. Bentham Science Publishers
- (8) InfoDatin. (2015). Situasi dan analisis diabetes. Kementerian kesehatan: Pusat data dan informasi kementerian kesehatan republik Indonesia
- (9) Cerrahoglu, L., Kosan, U., Sirin, TC, and Ulusor, A. (2016). Range of motion and plantar pressure evaluation for the effects of self-care foot exercises on diabetic patients. *Journal of the Ametican Podiatric Medical Association*. Vol 106 (3): 189-200
- (10) Morisawa, T., Tamaki, A., Nagai, K., Tsukagoshi, R., Nozaki, S., Miyamoto, T., Mori, A., Kaya, M., and Fujioka, H. (2017). Effects of increased physical activity on body composition physical punction, vascular functions, HR-QOL, and self-efficacy in community-dwelling elderly people. *The Journal of Physical Therapy Science*. Vol 29: 152-157. IPEC Inc
- (11) International Diabetes Federation. (2017). *IDF Diabetes Atlas*. 8<sup>th</sup> edition. Online version of IDF Diabetes Atlas
- (12) Touhy, TA, and Jett, K.F. (2014). *Gerontological Nursing and Health Aging*. 4<sup>th</sup> edition. United States of American: Mosby
- (13) PERKENI. (2015). Konsensus pengelolaan dan pencegahan diabetes melitus tipe 2 di Indonesia. Perkumpulan Endokrinologi Indonesia
- (14) diabetes mellitus: a 90-year perspective. *Postgrad Medical Journal*. 1-7. Doi:10.1136/postgradmedj-2015-133281
- (15) Hardman, T. Heather. (2018). NANDA-I Diagnosis Keperawatan: Definisi dan Klasifikasi 2018-2020. Edisi 11 alih bahawa. Penerbit Buku Kedokteran EGC: Jakarta
- (16) Bulechek, G.M., Butcher, H.K., Dochthermanm J.M., and Wagner, C.M. (2013). *Nursing Intervention Classification (NIC)*. Singapore: Elsevier inc.