The Effect of Resistance Exercise on Blood Glucose and HbA1C of Patient with Type 2 Diabetes Mellitus: Systematic Review

by Kusnanto Kusnanto

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The Effect of Resistance Exercise on Blood Glucose and HbA1C of Patient with Type 2 Diabetes Mellitus: Systematic Review

Rizky Meuthia Pratiwi1, Kusnanto2, M.Hasinuddin3
1Magister of Nursing Student, 2Faculty of Nursing Airlangga University, 3Stikes Ngudia Husada Madura
Faculty of Nursing, Airlangga University Campus C Mulyorejo Surabaya 60115
Email : rizky.meuthia.pratiwi-2016@fkp.unair.ac.id

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Abstrak: Increasing the number of DM patients becoming one of the global health threats (Perkeni, 2015) and 70% DM cases are mostly in developing countries including Indonesia (Tot et al., 2016 in Tristiana et al, 2016). The American Diabetes Association (ADA) and the Indonesian Endocrinology Society (PERKENI) recommend resistance exercise to improve blood glucose for patients with type 2 diabetes.Analyze the effect of resistance exercise on blood glucose and HbA1C in patients with type 2 diabetes mellitus.We identified articles through databse searching: Sage, Proquest, Science Direct, Springerlink, and EbscoHost, published between (2008-2018).Seven articles were analyzed and selected from 65 journal articles found for this systematic review. The studied evaluated that the resistance exercise intervention are recommended for patient with type 2 diabetes mellitus.

1 BACKGROUND

Diabetes mellitus disease (DM) is a non-communicable disease that continues to increase from year to year (Putri & Isfandari., 2013). Increasing the number of DM patients becoming one of the global health threats (Perkeni., 2015) and 70% of DM cases are mostly in developing countries including Indonesia (Tot et al., 2016 in Tristiana., 2016) and predicted increases in the number of DM patients in Indonesia from 8.4 million in 2000 to about 21.3 million by 2030. International Diabetes Federation (IDF) predicts an increase in the number of DM patients in Indonesia from 9.1 million in 2014 to 14.1 million by 2035 (Perkeni., 2015). Complications of DM can be long-term in the form of microvascular and makrovaskuler that can cause death. Microvascular complications include retinopathy, nephropathy and neuropathy whereas macrovascular damage includes coronary artery disease, cerebral blood vessel damage and also peripheral vascular limb damage commonly referred to as diabetic foot (Lewis, Dirksen, Heitkemper, Bucher, & Camera, 2011; Waspadji, 2014 in Wahyuni &Arisfa., 2016). The occurrence of diabetic foot starting from high glucose will damage the peripheral blood vessels of the early leg of ischemia that can also cause Peripheral Artery Disease (PAD). Physical exercise that can be done by DM patients is resistance exercise. The American Diabetes Association (ADA) and the Indonesian Endocrinology Society (PERKENI) are resomendation resistance exercise for patients with type 2 diabetes. Resistance exercise is a muscle group exercise against the burden in one effort (Irianto, 2006 in Putri., 2014). This exercise will involve many muscles that is actively moving. In the active muscle moves an increase in the need for glucose, but insulin levels do not increase. Active muscle moves will increase blood flow so that more open capillary network. The opening of the capillary mesh causes more insulin receptors and receptors to become more active (Soebardi; Sudoyo, 2006 in Putri., 2014).

2 METHOD

The literature searches were conducted in major databases such as Proquest, Sciencedirect, Spingerlink, Sagepub, and EbscoHost by including intervention, resistance, blood glucose, HbA1C,

fasting blood glucose, glycemic control, diabetes mellitus type 2. The year limit used is 10 years (year 2008-2018). Inclusion criteria articles are: Intervention resistance exercise / training, in the form of all the duration of exercise, exercise repetition, age diabetic patients and a combination of exercises that affect the blood glucose and HbA1C levels. All articles use english. Articles are excluded if the article is a systematic review. The search results conducted on the basis of these criteria obtained seven selected journal articles from 65 journal articles found. As research on this intervention is lacking, all types of research designs are included in this review. In this systematic review, the journal used is intervention resistance exercise against HBA1C and blood glucose levels although the journal measured various variables but discussed in this systematic review only focus on HBA1C and blood sugar (GDA and GDP) only.

3 RESULTS

Research conducted by (Luh Inca & Agustini, 2017) with design one group pretest post test design using rubber band resistance exercise intervention. Intervention was given to 15 respondents who met the inclusion criteria. Data were collected in March 2017 by using questionnaires and observations of blood sugar levels. Observations were made to see pre-hypertension levels prior to intervention and post after intervention. Materials and equipment used consisted of a needle, adjustable lancing devices, 70% alcohol, cotton, Glico Dr Strip, blood glucose test and Glico Strip as reagent. The Blood is taken from the peripheral blood to the fingertips. Intervention is done within 30 minutes every day for 1 week (210 minutes). The results obtained are there was statistically significant decrease the level of blood sugar within group before exercise (M = 176.47, SD = 88.19), t (14) = 2.02, p <0 , 05 (two-tailed). The mean decrease in blood sugar level was 25.43. The eta squared statistics (.28) indicated a large effect size. Research conducted by (Misra et al., 2008) with design prospective study design is using Progressive resistance training intervention. This intention was given to 30 respondents of type 2 DM who were selected from the medical outpatient department and diabetes clinic. Respondents were selected according to the inclusion criteria. Before the intervention, the respondents first performed pretest on the short insulin tolerance test (SITT) and the last post test was 72-96 hours after exercise at the end of 12 weeks (3 months), Biochemical examination by checking the sample content fasting blood glucose prior to intervention. Interventions were carried out in duration 3hari a week for 12 weeks. The results obtained were fasting blood glucose from 10.07 ± 2.0 to decreased 7.4 ± 1.2 P <0.001 and HbA1C from 7.7 ± 0.5 to 7.2 ± 0.3 P <0.001 This proved that moderate-intensity PRT for 3 months resulted in significant improvemnet HbA1C and fasting blood glucose in patients with type 2 diabetes. Research conducted by (Bweir et al., 2009) with the design of controlled trial study with parallel group design and matched subjects using intervention resistance exercise training. This intervention was given to 20 respondents with diabetes mellitus according to inclusion and exclusion criteria divided into two groups: groups with tredmill intervention and resistance exercise intervention group. Prior to treatment, responders were monitored for glycemic control and treatment changes for 12 weeks initially including HbA1c measurements. Blood glucose measurements were recorded before and after the training sessions. Intervention is done for 3 times a week in 10 weeks. The results obtained for plasma glucose levels before and after exercise were decreased in both groups of P (<0.05), a significant decrease was seen at weeks 1.6 and 10. At 10 weeks, plasma glucose levels dropped to the normal 140mg / dl category in the intervention group resistance exercise as much as 80% of the respondents while the group following a tredmill intervention of only 20% of respondents who achieved normal glucose values. There was a significant increase in mean HbA1C yields before and after exercise in both groups (p <0.001), but greater decrease was recorded in the resistance group exercise and in the last 10 weeks HbA1C levels were lower than in the group received a treadmill (p <0.006). Both groups were actually effective in reducing blood glucose and HbA1C levels but exercise resistance exercise significantly decreased HbA1C (p <0.05) compared to tredmill exercise. Research conducted by Ng et all (2010) by design this randomized trial research using intervention progresive resistance exercise. This intervention was given to 60 people with type 2 diabetes mellitus with glycosylated hemoglobin (HbA1c) between 8% and 10% in the past month. HbA1c was measured using 10 ml of blood taken from the fasting respondent at least 10 hours from the previous night and analyzed in the Laboratory of Biochemistry Pathology Department at the Singapore General Hospital by a laboratory assistant who was also unaware of the project. HbA1c was measured using high performance liquid

chromatography with a variation coefficient (CV) of 2.4% at 5.1% (HbA1c) and CV of 1.9% at 9.6% (HbA1c). Intervention is done 2-3 practice sessions per week consisting of 10 minutes of warming followed by about 50 minutes of exercise. Each group is scheduled to complete 18 sessions over an 8-week period. The results showed that resistance training group experienced a decrease in HbA1c by 0.4% (SD 0.6) and had a greater decrease in waist circumference. It can also be seen in the table showing that at the beginning of intervention group HbA1C value is 8.9 after intervention for 8 weeks to 8.4 while the glucose level at the beginning showed the value of 10.4 after intervention for 8 weeks to 10.1.Research made by (Jin,Park, & So, 2015) with this randomized controlled trial using elastic band resistance exercise intervention. Interventions were given to 16 respondents who met the inclusion criteria then divided into two intervention groups and the control group. Before blood collection, more than 12 hours of fasting is needed to minimize the effects of diet. Blood collection for pretest was completed 48 hours before exercise and post test was done 2 hours after 12 weeks of intervention completed. The medical technic used was single-use syringe in antecubital vein to collect 10ml of blood and blood sample kept at evacuated site, tube blood samples were given EDTA solution (ethy diamine tetra acetate; EDTA) further to analyze blood glucose, all blood was inserted into plain vacutainer (vacutainer sterile) and left at room temperature for 30 min and then centrifuged 10 min at 3,000 rpm, and serum separated. become standard and empty; 20 ulplasma are classified into specimens, and 20 ul, standard reagents are classified into the standard. The color of 20 ml Reagents is mixed into each specimen, and they are left in the water at 37 ℃. Then, the absorbance is measured in wavelength 505 nm. Intervention was performed for 60 minutes (10 minutes of warm-up, 40 minutes of exercise and 10 minutes of cooling) and this exercise was done 3 times week for 12 weeks (3 months). The results obtained were changes in blood glucose levels before and after the intervention ie in the treatment group with blood glucose level before was 122.28 ± 2.45 blood glucose levels after intervention 103.12 ± 4.56. In this study, blood glucose ($p < 0.021$) proved to decrease (significant). Therefore this exercise has a positive effect on blood glucose levels. Research conducted by (Church et al., 2010) with research design A Randomized Controlled Trial with 262 respondents age 30-75 yrs with DM type 2 (HbA1C 6.5% -11%) and subsequently selected according to inclusion and exclusion criteria. This study used the HART-D method of 9-month training interventions that were randomly divided into 3 groups: aerobic group, resistance group and combination group and control group given stretching and relaxation exercises per week and respondents were asked to do this for 9 months. Resistance training participants exercised 3 days per week with each session consisting of 2 sets of 4 upper body exercises (bench press, seated row, shoulder press, and pull down), 3sets of 3 leg exercises (leg press, extension, and flexion) 2 sets of abdominal crunches and back extensions. The result is that the absolute mean change in HbA1c in the combination exercise group is -0.34% (95% confidence interval "CI", -0.64% to -0.03%; P = .03). The mean changes in HbA1c were not statistically significant in either endurance training (-0.16%; 95% CI, -0.46% to 0.15%; P = 0.32) or aerobic (-0.24% ; 95% CI, - 0.55% to 0.07%; P = .14) group compared with the control group. Only combined exercise groups increased maximum oxygen consumption (mean, 1.0 mL / kg per minute, 95% CI, 0.5-1.5, P <.05) compared with the control group. All exercise groups reduced waist circumference from -1.9 to -2.8 cm compared with the control group. Weight loss training group on average fat mass -1.4 kg (95% CI, -2.0 to -0.7 kg, P <.05) and training group combined average loss -1,7 (-2 , 3 to -1.1 kg, P <0.05) compared with the control group. so it can be concluded that among patients with type 2 diabetes mellitus, the combination of aerobic and resistance exercise compared with the nonexercise control group increased HbA1c levels. This is not accomplished by aerobic or resistance training alone. The study conducted by Baaci et al (2012) with this study design was a randomized controlled trial with a subset of RAED2 research aimed at comparing the metabolic effects of aerobic training and resistance on the subject of type 2 diabetes. This intervention is performed 3 times a week for 4 months with a term of 60 minutes each. In this sub-project, blood glucose is continuously monitored by CGMS over 48-hours, starting with the training sessions. To adequately assess the impact of the two modalities exercises, the CGMS Sensors were implanted in all subjects after at least two months of training, ie when scheduled exercise volumes were achieved and maintained for several weeks. Respondents who have been selected by meeting the criteria and agreed to conduct this intervention are as many as 26 people then divided into 2 groups namely 13 groups of aerobic intervention and 12 groups of resistance exercise. Aerobic groups exercise 3 times a week (treadmill,cyclette and ellipse). During the

initial phase (weeks 1-2), participants train 30-40 minutes later, the duration of the exercise gradually increases to 60 minutes per session and, then, the intensity gradually reaches 60-65% The target training intensity is reached after 5 weeks in all eyes AER group lessons. The heart rate monitor (Polar S810i; Polar Elektro, Kempele, Finland) is used to standardize the intensity of the exercise. The resistance group performed 9 different exercises in a 3-week session using heavy machinery and free weights. During the Learning Stage (Week 1-2) the subjects performed 3 series 10-12 repetitions at 30-50% 1RM. Furthermore, the amount of weight raised increases. All participants are required Perform any repetition in a slow and controlled manner, with a break of 60 seconds between sets. The workload of the training increases after the Subject has successfully reached 12 repetitions with the appropriate technique. The target intensity of the training program (10-12 repetitions at 70-80% 1RM) was achieved after 6 weeks in all subjects of the resistance group exercise. All training sessions are supervised by an exercise specialist. HbA1C changes from the baseline were assessed on this subject at the end of the RAED2 protocol, after 4 months of intervention. HbA1c levels showed similar mean improvements in aerobics and resistance groups (20.4860,14 vs 20.3960,16%, p = 0.70).

4 DISCUSSION

The first discussion is a journal that discusses blood glucose levels. There are three journals that discuss about random blood glucose levels and one journal that discusses fasting blood glucose levels. The journal which discusses the random blood glucose level is the journal from (Luh, Inca,& Agustini., 2010) with the design of one pretest post test study using the respondent as many as 15 people, the duration used in this research is 30 minutes in 7 days (210 minutes) the results obtained is the change in pre and post glucose levels as evidenced by previous exercise (M = 201, SD = 100.15) and after exercise (M = 176.47, SD = 88.19 t (14) = 2.02, p <0.05 (two-tailed) .This exercise is considered short enough to do only one week, but the excess is this exercise is done regularly every day to produce a decrease in blood glucose levels as much as 25 points from Pre 210 and post 176 while the other two journals of Bweir et al., 2009 with a controlled trial design study with parallel group design and matched subjects with 20 respondents and Jin, Park, & So, 2015 with randomized controlled trial design with respondents as many as 16 respondents, these two journals have the same duration of exercise 3 times a week but different is the length of exercise, Bweir et al., 2009 gives exercise for 10 weeks with duration of each exercise 30-35 minutes) while Jin, Park, & So, 2015 provides a 12-week exercise with a duration of 60 minutes each. Blood glucose levels in the journal Bweir et al., 2009 resulted in decreased glucose monitored pre and post (p <0.001) greater decreases recorded in the resistance group exercise and in the last 10 weeks of Week 1 (Pre 310. Post 230 with a decrease of 80 point), Week 6 (Pre 280 Post 210 with a decrease of 70 points),Week 10 (pre 220, Post 120 with decrease of 100 points), the result is more significant that at 10th week that decrease as much as 10 point then blood glucose level in research of Jin, Park, & So, 2015 yield before122.28 ± 2.45 blood glucose levels after intervention 103.12 ± 4.56 with decrease of 19 points. One journal from Misra et al., 2008 that discusses fasting blood glucose with design research design prospective study using 30 respondents Intervention research conducted in duration 3 days a week for 12 weeks (not explained how long duration). The result is before the fasting blood glucose exercise 10.07 ± 2.0, 1 month intervention to 8.7 ± 1.3, 2 months intervention 8.2 ± 1.1 and at 3 months intervention 7.4 ± 1.2 means there is a decrease of 2.67 points. Furthermore, there are 5 journals that discuss about the influence of resistance exercise to HbA1C ie Misra et al., 2008 with prospective study design study and four others with randomized controlled trial design ie Bweir et al., 2009, Ng et al., 2010, Chruch et al., 2010 and Bacci et al., 2012. Research conducted by Bweir et al., 2009 with 20 respondents and Ng et al., 2010 with 60 respondents, they intervene in the period of 3 times a week with duration for approximately 2 months. Results in the Bweir et al journals were significant increases in mean HbA1C yields before and after exercise in both groups (p <0.001), but greater decreases were recorded in the resistance group exercise and in the last 10 weeks HbA1C levels became lower than the group receiving the treadmill (p <0.006). Both groups were actually effective in lowering HbA1C but exercise resistance exercise significantly decreased HbA1C (p <0.05) compared to tredmill exercise (control group) and then the study of Ng et all (2010), can be seen in the table showing that at the beginning of HbA1C intervention group of 8.9 after intervention for 8 weeks to 8.4. Research conducted by Misra et al., 2008 with respondents as much as 30 respondents

and intervention 3 times a week for 12 weeks (3 months) yield HbA1C from 7.7 ± 0.5 to 7.2 ± 0.3 P <0.001 This proves that moderate- intensity PRT for 3 months resultant in significant improvemnet HbA1C in patients with type 2 diabetes. The next journal is a study conducted by Bacci et al., 2012 with respondents as many as 26 people and the intervention done as much as 3 times a week for 4 months with a period of 30-60 minutes each healing. The result obtained is the HbA1C change from the baseline assessed on this subject at the end of the RAED2 protocol, after 4 months of intervention. HbA1c levels showed similar mean improvements in aerobic and resistance groups exercise (20.4860,14 vs 20.3960,16%, p = 0.70). However, there was an insignificant HbA1C result in this study. The last journal was from Chruch et al (2010) with 262 respondents, intervention 3 times a week in 9 months. The results obtained were the mean changes in HbA1c not statistically significant in both resistance training (-0.16%; 95% CI, -0.46% to 0.15%; P = 0.32) or aerobic (- 0.24%; 95% CI, -0.55% to 0.07%; P = .14) group compared with the control group. Only combined exercise groups that increased maximum oxygen consumption (mean, 1.0 mL / kg per minute, 95% CI, 0.5-1.5, P <.05) compared with the control group.

5 CONCLUSION

From the four journals on blood glucose levels, we can see that the journal from Bweir et al., 2009 resulted in a significant decrease in blood glucose levels at week 10 of 100 points. In fact, following resistance exercise at week 10, 80 % of the participants had plasma glucose levels that fell within the normal recommendations after their exercise session. In contrast, only 20% of the participants achieved normal glucose values (post-exercise sessions) in the treadmill group (control group) and type 2 diabetes, consisting of insulin resistance within skeletal muscle, a positive effect on glucose control than aerobic exercise or tredmill exercise. Resistance exercises have been shown to have moderate-intensity PRT for 3 months. 2 diabetes. From the five journals discussing HbA1C it can be concluded that in the intervention conducted for 2 months there was a significant result in resistance exercise intervention in decreasing HbA1C (p <0,05) and from 8,9 to 8,4 there was a decrease 5 points The training duration of 8 weeks was brief compared to the 12-week regimens examined in earlier studies. The 8-week duration was chosen to minimize or avoid the influence of any medication change during the course of the trial. HbA1c levels reflect glycemic control over the preceding 2 to 3 month period (American Diabetes Association 1995-2010), thus the observed change in HbA1c may be adequately reflected in the effects of HbA1c level as compared to treadmill exercise. We propose that an optimal exercise program for individuals with diabetes should include a resistance training component to be effective in improving the overall metabolic profile. In the intervention given for 3 months, it was explained that PRT would improve insulin sensitivity by increasing the lean body mass in Asian Indians with type 2 diabetes. As skeletal muscle is the principle of the area of glucose disposal, increasing muscle bulk does increase insulin sensitivity, increasing muscle bulk by increased muscle strength and muscle strength. mass significance. While varying duration of study and protocols may decrease in intramyocellular triglyceride content, which may lead to an improvement in insulin sensitivity. Baaci et all there were results that were not much different from the control group (20.4860,14 vs 20.3960,16%, p = 0.70) it was seen that resistance exercise experienced a better rate of decline than the control group of the acute effects of single bouts of these exercise types differ. In particular, aerobic exercise lowers blood glucose concentrations to the exercise session, carrying a higher risk of exercise-induced hypoglycaemia. Of particular concern is lateonset hypoglycaemia, especially when the exercise is scheduled in the late afternoon, as this risk occurs in the sleeping nocturnal period. These findings suggest that there is no significant result in Church et al's research that intervenes for 3x a week within nine months. The combination training group improved peak oxygen consumption per unit time compared with the control and the resistance training groups. All groups improved time on treadmill compared with the control group. Work per extension over 30 repetitions increased in the resistance training group compared with all other groups and in the combination training group compared with the control and aerobic groups. At follow-up, the combination training group has a decrease in the mean weight of the comparison with the control and resistance training group. Participants in the resistance training group have reduction in fat mass with the control, whereas the combination training group has a reduction in fat mass with the control and aerobic groups. The mean lean mass in the resistance training group increased compared with the aerobic group and combination

groups. All exercise groups are compared with the control group. The findings from the per-protocol analysis closely matched the intent-to-treat analysis. The conclusions of this study were patients with type 2 diabetes mellitus, a combination of aerobic and resistance training compared with the nonexercise control group improved HbA1c levels. This was not achieved by aerobic or resistance training alone.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6