Research Paper

« The Effect of an Aerobic Exercise on Blood Glucose and Musculoskeletal Among Type 2 Diabetic Patients at North Gaza Health Center UNRWA/Gaza Strip Experimental study »

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Abstract:

Objective: Exercise training programs have emerged as a useful treatment for the management of type 2 diabetes mellitus (T2DM). Majority of the Western studies and others highlighted the effective role of exercise in T2DM.Therefore; the ultimate objective of this study is to discover the effect of aerobic exercises on diabetic patient's type of 2blood glucose (HA1c, fasting blood glucose, body weight) and musculoskeletal pain.

Methodology : Stratified random sample was taken from three teams at North Gaza Health Center, female patients with average ages between 35-70 years, and different weights. Mixed aerobic exercises and therapeutic exercises were given to the patients once weekly. The study continued four-five months, consisting of 16 patients. Pre-test and post-test exams were done for patients on (Fasting blood glucose -HA1c- weights–pain scale).Psychological, diet, and medication advice was given to the patients.

Results: The results show improvement and differences in the measurements of pre –and post-intervention of (HA1c, fasting blood glucose, weights of patients, and musculoskeletal pain.

Conclusions: Physical activity plays an important role in controlling blood glucose besides medication and diet, our findings support the predict intervention of aerobic and therapeutic exercises. These results provide support for encouraging type 2 diabetic individuals who are already exercising at a moderate intensity to consider increasing the intensity of their exercise to obtain additional benefits in both aerobic fitness and glycemic control.

Recommendations: The study advised to implement aerobic exercise and therapeutic exercises with type 2 diabetic patients and enhance the role of physiotherapy in non-communicable diseases.

Keywords: HA1c, Fasting Blood Glucose (FBG), Physical Activity (PA).

Introduction:

Diabetes has become a widespread epidemic, primarily because of the increasing prevalence and incidence of type 2 diabetes. Diabetes is a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action (hepatic and peripheral glucose uptake), or both (Krause,et.al, 2015.

The type 2 form of the disease is associated with obesity and physical inactivity, and the prevalence of this form is increasing in Westernized countries, owing to the increasing prevalence of obesity and sedentary lifestyles.

On the other side physical exercise has been considered as one of the cornerstones in the treatment of diabetes mellitus along with nutrition and medication. However, high-quality evidence on the importance of exercise and fitness in diabetes was lacking until recent years (.Karjalainen et .al, 2015).

Thent, Z. C et .al, 2013, Large cohort studies have found that higher levels of habitual aerobic fitness and/or physical activity are associated with significantly decrease AH1c (HbA1c) of diabetic patients. Exercise plays a major role in the prevention and control of insulin resistance, pre-diabetes, gestational diabetes mellitus, type 2 diabetes, and diabetes-related health complication. Two major goals of diabetic therapy to reduce hyperglycemia and body fat.

The goal of treatment in type 2 diabetes is to achieve and maintain optimal BG, lipid, reduce HbA1c level, and blood pressure (BP) levels to prevent or delay chronic complications of diabetes. Many people with type 2 diabetes can achieve BG control by following a nutritious meal plan and exercise program (Colberg, et.al, 2010).
Although physical activity (PA) is a key element in the prevention and management of type 2diabetes, many with this chronic disease do not become or remain regularly active.(MacMillan et.al, 2014).

Nauck, M. A., Stewart,et.al,2016 High-quality studies establishing the importance of exercise and fitness in diabetes were lacking until recently, but it is now well established that participation in regular PA improves blood glucose control and can prevent or delay type 2 complications, along with positively affecting lipids, blood pressure, cardiovascular events, mortality, and quality of life. Structured interventions combining PA and modest weight loss have been shown to lower type 2 diabetes risk by up to 58% in the high-risk population.

Study-main objective
The ultimate aims of this study to illustrate the role of aerobic exercises and therapeutic exercises on diabetic patients type 2.

Study-specific objectives
To explore the effect of exercises on HA1c with diabetic patients type 2.
To investigate the role of exercises on fasting blood glucose (FBG).
To discover the role of exercises on patients' weights.
To highlight the effect of exercises on pain level with musculoskeletal disorders with diabetic patients type 2.
To enhance the role of Physiotherapy in non-communicable diseases.

Study hypothesis
H1: There are no statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on FBG.
H2: There are no statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on HA1c.
H3: There are no statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on the patient's weight.
H4: There are no statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on the musculoskeletal pain scale.

Methods
Sample: Stratified random sample of 16 female patients was taken from the three teams of diabetic patients type 2 at the clinic. The target group consists of female patients. With average age between 35-70 years and mean average weight of 92 Kg. The patients also suffer from different musculoskeletal problems (low back pain, cervical pain, and knee pain). Relying on the Numeric Pain Rating Scale assessment from (0-10) (Figure 1) the patients were evaluated as the patients with low scores have a low level of pain and the patients with high scores have severe pain (ALexander, Mathi, & Peters, 2007). Some of them have difficulty in the activity of daily living.

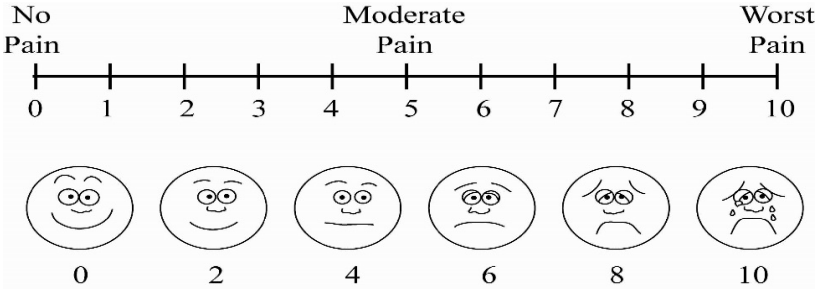

Figure 1: The Numeric Pain Rating Scale

The patients with heart problems were excluded. Pre-intervention measurements of Fasting blood glucose (FBC), (HA1C), weights, and musculoskeletal pain were taken at the beginning of the study and documented.

Intervention: Aerobic exercise and therapeutic exercises were applied.
Duration: each session was sustained from 20 to 60minutes.
Frequency: The sessions were held once weekly.
Intensity: Exercises started with warm exercises. Then mild to moderate aerobic and therapeutic exercises.

On the other side of the study diet and medication pieces of advice have been given to the patients by a medical officer and health educator. Psychological support was applied to the target sample. Post-intervention measurement was taken at the end of the period (Table 1).

No.	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Item	FBG	FBG	HA1c	HA1c	Wt.	Wt.
1	103	102	6.5	6.2	83	81
2	128	118	6.2	6.7	83	82
3	157	150	5.5	5.3	135	125
4	236	198	7.1	7.5	88	93
5	124	126	6.8	6.6	93	88
6	176	190	9	7.9	85	84
7	97	128	8	8.5	100	104
8	134	129	7.2	6.3	100	94
9	152	81	10.3	8.2	79	78
10	212	244	12.3	11.4	84	84
11	192	176	7.3	7.1	87	85
12	334	296	9.2	7.5	105	96
13	165	179	9.4	8.6	92	90
14	160	121	7.4	7.1	63	61
15	171	157	9.1	7.9	73	72
16	166	157	7.2	NA	84	86

Table 1: Pre and Post-Intervention Measurements
Notes: *one patient didn't do the pre-test HA1c because she was abroad soon after the session's completed*.

Statistical analysis
The researcher used data analysis both qualitative and quantitative data analysis methods.The Data analysis made utilizing (SPSS 26). The researcher utilizes the following statistical tools :

1- Shapiro-Wilk test.
2- Descriptive analysis (Mean and SD).
3- Pearson correlation coefficient.
4- Spearman correlation coefficient.
5- Paired Samples T-Test.
6- Wilcoxon Signed Ranks Test.

Period of study
From January 2019 to May 2019, the patients were attended to the clinic one weekly. The treatment session was between 30 to 60 minutes.

Limitations of the study

- General economic conditions prevent more patients to join this study, and difficulties in coming to the clinic.
- Frequencies of electric cut affect the attendance of patients as some of them live at towers.
- Difficulties in collecting data.

Results and discussion

First: Test of normality

Table (2) shows the normality test for all variables for (16) patients between pre and post-Intervention. Shapiro-Wilk test of normality shows that FBG pre and post Intervention are normally distributed, (*P*-value >0.05). Consequently, paired-samples T-test is used to examine the mean difference for FBG between pre and post-intervention. For the other variables (HA1c, weight, musculoskeletal pain) are not normally distributed, (*P*-value < 0.05). Consequently, the Wilcoxon Signed Ranks test is used to examine the mean difference for these variables between pre and post-intervention**.**

Table 2: Normality test for all variables for the (16) patients between Pre and Post Intervention

Variable	Statistic	*P*-value
HA1c pre intervention	0.896	0.098
HA1c post intervention	0.843	0.018*
FBG pre intervention	0.913	0.176
FBG post-intervention	0.878	0.054
Weight pre intervention	0.666	0.000*
Weight post intervention	0.651	0.000*
Pain pre intervention	0.952	0.589
Pain post intervention	0.829	0.012*

* The data is not normally distributed

Second: Comparison of FBG for the (16) patients between Pre and Post-Intervention

Table (3) shows the result of paired samples T-test for FBG for 16 patients between pre and post-intervention. The Pearson correlation coefficient equals 0.865 with p-value equals 0.000, which means that there exists a statistically significant relationship between FBG in pre and post-intervention.

The mean for FBG in pre-intervention equals 171.06, with SD of 60.31. For the same patients, the mean for FBG in post-intervention equals 154.88, with SD of 56.82. The value of the T-test equals 2.246, with a *P*-value equals to 0.02. This implies that there is sufficient evidence to conclude that mean of FBG is significantly different from pre-intervention to post-intervention. Since the sign of the T-test is positive, then the mean of FBG decreases from pre-intervention to post-intervention. That is, the mean of FBG in post-intervention is significantly smaller than that for FBG in pre-intervention.

In general, the study illustrated deferent measurements in FBG after exercises intervention, the majority of patients have low blood glucose who were regularly come to the class, two cases didn't affect as they were absent because of family reasons 3 weeks, another case has not healthy food.

Table 3: Paired Samples T-Test for FBG for the (16) Patients between Pre and Post-Intervention

Variable	Mean	SD	Test value	*P*-value	Pearson	*P*-value
FBG_ pre	171.06	60.31	2.246	0.020*	0.865	0.000**
FBG_ post	154.88	56.82				

* The mean difference is significant at 0.05 level

** The correlation is significant at 0.05 level

Third: Comparison for HA1c for the (16) patients between Pre and Post-Intervention

Table (4) shows the result of paired samples WilcoxonSigned Ranks for HA1c for 14 patients between pre and post-intervention. Note that data is missing for two patients. The Spearman correlation coefficient equals 0.859 with p-value equals 0.000, which means that there exists a statistically significant relationship between HA1c in pre and post-intervention. The mean for HA1c in pre-intervention equals 7.92, with SD of 1.67. For the same patients, the mean for HA1c in post-intervention equals 7.26, with SD of 1.46. The value of the Wilcoxon test equals 2.926, with a p-value equals to 0.0017. This implies that there is sufficient evidence to conclude that mean of HA1c is significantly different from pre-intervention to post-intervention. Since the sign of the Wilcoxon test is positive, then the mean of HA1c decreases from pre-intervention to post-intervention. That is, the mean of HA1c in post-intervention is significantly smaller than that for HA1c in pre-intervention.

Regarding these results all of the regular patients have low HA1c than the last year, Except for 4 patients one case was abroad for 3weeks, and the other was tired taking (NSAIDs) drugs, one wasn't regular, and the last didn't do the test.

Table 4: Wilcoxon Signed Ranks Test for HA1c for 16 patients between Pre and Post-Intervention

Variable	Mean	SD	Test value	*P*-value	Spearman	*P*-value
HA1c_ pre	7.92	1.67	2.926	0.0017*	0.859	0.000**
HA1c_ post	7.26	1.46				

* The mean difference is significant at 0.05 level
** The correlation is significant at 0.05 level

Fourth: Comparison of weight for (16) patients between Pre and Post Intervention
Table (5) shows the result of paired samples WilcoxonSigned. Ranks for the weight for 16 patients between pre and post-intervention. The Spearman correlation coefficient equals 0.922 with p-value equals 0.000, which means that there exists a statistically significant relationship between weight in pre and post-intervention.The mean for weight in pre-intervention equals 92.31, with SD of 13.25. For the same patients, the mean for weight in post-intervention equals 89.31, with SD of 10.84. The value of the Wilcoxon test equals 3.204, with a*p*-value equals to 0.0007.This implies that there is sufficient evidence to conclude that mean weight is significantly different from pre-intervention to post-intervention. Since the sign of the Wilcoxon test is positive, then the mean of weight decreases from pre-intervention to post-intervention. That is, the mean of weight in post-intervention is significantly smaller than that for weight in pre-intervention. Regarding this result the majority of patients have lost weight, three patients still in the same weight, they have difficulty doing the exercises.

Table 5: Wilcoxon Signed Ranks Test for the weight for (16) patients between Pre and Post-Intervention

Variable	Mean	SD	Test value	*P*-value	Spearman	*P*-value
weight_ pre	92.31	13.25	3.204	0.0007*	0.922	0.000**
weight_ post	89.31	10.84				

* The mean difference is significant at 0.05 level
** The correlation is significant at 0.05 level

Fifth: Comparison of musculoskeletal pain for the (16) patients between Pre and Post-Intervention:
Table (6) shows the result of paired samples WilcoxonSigned Ranks for musculoskeletal pain for 16 patients between pre and post-intervention. The Spearman correlation coefficient equals 0.610 with *p*-value equals 0.006, which means that there exists a statistically significant relationship between musculoskeletal pain in pre and post-intervention. The mean for musculoskeletal pain in pre-intervention equals 0.64, with SD of 0.17. For the same patients, the mean for pain in post-intervention equals 0.17, with SD of 0.17. The value of the Wilcoxon test equals 3.448, with a p-value equals to 0.0003. This implies that there is sufficient evidence to conclude that mean of pain is significantly different from pre-intervention to post-intervention. Since the sign of the Wilcoxon test is positive, then the mean of pain decreases from pre-intervention to post-intervention. That is, the mean of pain in post-intervention is significantly smaller than that for pain in pre-intervention.

Regarding these results all of the patients have decreased (low back pain, Knee pain, and cervical pain), the study illustrated the effect of exercises on decreasing the musculoskeletal pain with patients and improve daily living activity.

Table 6: Wilcoxon Signed Ranks Test for musculoskeletal pain for (16) patients between Pre and Post-Intervention

Variable	Mean	SD	Test valve	*P*-value	Spearman	*P*-value
pain_ pre	0.64	0.17	3.448	0.0003*	0.610	0.006**
pain_ post	0.17	0.17				

* The mean difference is significant at 0.05 level
** The correlation is significant at 0.05 level

There are statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on FBG. There are statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on HA 1c.There are statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on the

patient's weight. There are statistically significant differences at ($\alpha \leq 0.05$) in the responses of the research sample related to exercises on a pain scale.

Conclusion

Taken the whole study and the above finding and results, also depending on previous studies: aerobic exercises which done regularly affect the blood glucose of diabetic patient's type 2 (HA1c, FBG) another effect was on the patient's weight and pain scale. Many studies and research were done and concluded that the important effect of exercises on controlling blood glucose with type 2diabetic patients. Also prevention of more complications and enhance later life span.

Collaboration between the physiotherapy unit and the medical team is needed to managing control diabetic patients to overcome more complications, maintain their blood glucose, lower subsequent cardiovascular and overall mortality, and saving the cost of more medications.

In light of these results, practicing aerobic exercises will lead to reducing the NCDs patients' visits to the clinic to take drugs (anti analgesic), the complication of frozen shoulder, peripheral neuropathy, and diabetic foot. The quality of lifestyle, activity of daily living, and cost-effectiveness will be improved.

The study recommendation

- Enhance the role of physiotherapy in non-communicable diseases.
- Application of exercises on diabetic patients types 2.
- Encourage teamwork between physiotherapy units and the medical team.

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