POSTPRANDIAL EXERCISE IS SUPERIOR TO REGULAR CONTINUOUS EXERCISE IN HBA1C REDUCTION FOR TYPE 2 DIABETICS IN SAUDI ARABIA

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ABSTRACT

BACKGROUND AND OBJECTIVES: Exercise helps people on diet to lose weight, also helps having better Blood Pressure. The aim of the study is to compare the response of glycosylated hemoglobin (HbA1c), body mass index (BMI) and incidence of hypoglycemia to continue running exercise (group A) and intermittent postprandial exercise (group B) for individuals with type 2 diabetes in Jeddah – Saudi Arabia

DESIGN AND SETTINGS: Out of 44 enrolled patients from Jeddah region, 24 patients were group A, who were asked to run daily for 45 minutes at any time of the day, continuous running without stopping -as much as they can, and 20 other patients were group B, who were asked to run 60-90 minutes after main meals for 15 minutes three times daily. The study involves mandatory baseline visit then follow up, once after 12 weeks.

Results: The mean age was 42.1 (2.8) [Mean (SD)] years for group A, whereas it was 43.8 (1.7) years for group B. 17% were males and 83% were females for group A whereas all patients were females for group B. The main BMI was 26.2 (1.2) kg/m^2 (group A), while it was 26.9 (1.0) kg/m^2 (group B).

The mean Postprandial Blood Glucose (PPG) was 150.4 (7.5) mg/dl (group A), while it was 144.5 (11.2) mg/dl (group B). There was no statistically significant difference in the mean PPG between group A and group B ($P > 0.05$).

50 % were house wives (group A), whereas 100% were house wives (group B). There was statistically significant difference in patients' jobs for group A compared to group B ($P < 0.05$ and > 0.01)

All patients on metformin and statin for both groups, and There was no statistically significant difference in Current Medication between group A and group B ($P > 0.05$), but There was statistically significant difference in the mean dose between group A and group B ($P < 0.05$ and > 0.01).The mean time of exercise was 33.6 (14.1) min/day (group A), while it was 33.5 (8.3) min/day (group B). There was no statistically significant difference in time of exercise groups between group A and group B ($P > 0.05$).

Both groups resulted in a decline in HbA1c. However, the mean of HbA1c was dropped from 8 % (at baseline visit) to 7% (at the end of the study. There was a very high statistically significant decrease of 1% ($P < 0.001$) and percent change was -12.5%.for group A, whereas the mean of HbA1c was dropped from 7.9% (at baseline visit) to 6.4% (at end of the study)..There was a very high statistically significant decrease of 1.5% ($P < 0.001$) and percent change was -19.1%for group B.

There was a very high statistically significant difference in HbA1c reduction from baseline visit to end of the study between group A and group B ($P < 0.001$).

At follow up visit after 12 weeks, 12(50%) of group A were controlled (HbA1c < 7%), while 18 (90) % of group B were controlled (HbA1c < 7%). There was high statistically significant difference in controlled patients (HbA1c < 7%) between group A and group B ($P < 0.01$ and > 0.001).

Group A resulted in a decline in mean of BMI which was the percentage decrease in BMI was 1.7% with group A. There was statistically significant decrease in mean BMI from baseline visit to the end of the study for group A of 0.4 kg/m² ($p < 0.05$ and > 0.01), while there was no statistically significant difference for group B ($P > 0.05$).

There was high statistically significant difference in BMI reduction from baseline visit to the end of the study between group A and group B ($P < 0.01$ and > 0.001).

The mean number of episodes of hypoglycemia was 1.8 (3.7) times (group A), while it was 3.9 (3.8) times (group B). There was no statistically significant difference in number of episodes of hypoglycemia in group A compared to group B ($P > 0.05$).

Conclusion: The reduction of HbA1c levels with continuous running exercise is less than its levels with intermittent postprandial exercise during both exercises in individuals with type 2diabetes, while the reduction of BMI levels with intermittent postprandial exercise is less than its levels with continuous running exercise However, No significant change in incidences of hypoglycemia was found in both groups.

Key Words: Exercise, Type 2 Diabetes, HbA1c, BMI and Hypoglycemia.

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INTRODUCTION

Diabetes is group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action (hepatic and peripheral glucose uptake), or both. Type 2 form of the disease is associated with

obesity.[1] and physical inactivity,[2] and the prevalence of this form is increasing in Westernized countries, owing to the increasing prevalence of obesity and sedentary lifestyles.in Saudi Arabia Diabetes is an endemic hat is going to cause a mass affection on the whole population with studies showing that 45% of the Saudi adult are going to be diabetic by the year 2025.

Physical activity or structured exercise training used alone or in combination with diet, insulin injections, or oral hypoglycemic drugs are the foundations of therapy for type 2 diabetes.[3,4] Evidence for the benefit of physical activity comes from studies showing that individuals who maintain a physically active lifestyle are less likely to develop insulin resistance, impaired glucose tolerance, or type 2 diabetes.[2,5] the effects of exercise training on glucose control and related physiological parameters have also been extensively studied on patients with type 2 diabetes. In 2001, Boule´ ET al.[6] published a meta-analysis showing beneficial effects of exercise training on one aspect of glucose control in diabetic patients, the percentage of HbA1c (A1C) in blood. They also found reductions in two measures of abdominal obesity and little effect on the only other parameter they meta-analyzed which are body mass.

Lifestyle intervention programs that combine regular exercise, dietary modulation and/or oral blood-glucose lowering medication have proven an effective therapeutic strategy in type 2 diabetes.[7,8] Continuous endurance-type exercise training has been shown to lower blood HbA1c, increase insulin sensitivity, improve the risk profile for cardiovascular disease and reduce adipose-tissue mass in patients with type 2 diabetes.[6,9] In addition, exercise training represents the only interventional strategy that has consistently been shown to improve whole body and skeletal muscle oxidative capacity.[10] In accordance, recently published standards of medical care for type 2 diabetes underline the importance of exercise prescription.[11]

However, the clinical guidelines do not include detailed information on the preferred exercise modalities that should be implemented to maximize the clinical benefits of exercise intervention in diabetes patients.[11] Exercise intensity has been suggested to represent one of the most important exercise modalities that determine the clinical outcome of exercise interventions.[7, 9] That has been attributed to the inverse relationship between exercise intensity and glycogen use within the muscle.[12,13] The magnitude of the increase in insulin sensitivity following an acute bout of continuous endurance-type exercise has been associated with the extent of muscle glycogen depletion and the subsequent repletion rate.[14,15] Whether such differences in the acute glucoregulatory effect of a single bout of exercise also translate into improvements in glycemic control following more prolonged endurance type exercise interventions in type 2diabetes patients remains speculative.[16,17]

Exercise can help inducing our metabolic rate.[18,19] it does for that induce more glucose consumption as well as increasing the size of the muscles that will not only help increasing consumption of glucose and fat in the body only, but also will create a new situation inside the body and a new metabolic environment fired up and ready to get easily rid of our daily ingested calories.[20, 21]

The new metabolic environment that gets created by serious exercising make an up regulation not for the metabolic rate but also with up regulation of the sensitivity of insulin receptors,[20] and number exercises helps causing tremendous difference in the level of control of all important risk factors. [9]

Exercise helps people on diet to lose weight,[10] helps with by itself and with the use of statins having better numbers of lipids values.[10, 15]

Exercise also helps having better Blood Pressure and with hypertensive patients who are on medications or not. [22]

Even depression can get alleviated and help preventing it in Diabetes patients and many other chronic diseases that depression can be part of its long term complications.[22, 23]

In spite of all exercises benefits we have to get which is the most appropriated one for our concerned patients

In order for this to happen, we need to test an exercise module to see if certain exercises are more beneficial than others, and if certain ways and programs of exercise are giving more benefits.

We focused only on diabetes control in this study.

METHODOLOGY

In this study we have collected 44 patients all from Jeddah, we have decided to start an open study with 2 groups of diabetic patients who are not having controlled diabetes, all with HbA1c level between 7.5 and 8.2, decided not to add any medicine to their current regiment, and not to increase their doses of their current medications and all the patients in the study were on a kind of statin and no one is on aspirin. Instead, we directed the 2 groups to start a different type of daily exercise program. The exercise in both groups was regular fast running on the fastest speed the patient can do. Group A was asked to run daily for 45 minutes at any time of the day, continuous running without stopping as much as they can, and the group B was asked to run for 15 minutes three times daily each time after a main meal by 60-90 minutes.

All males refused to join group B, and all working women pulled out of group B because it is difficult for them to do three exercise sessions daily.

Patients should have a pre-study (baseline) data of patient's demographics (age, gender and BMI must put full term), patients' Job, PPG and current medications should be recorded at the baseline visit.

It required performing HbA1c and BMI at baseline and after 12 weeks at the end of the study and number of episodes of hypoglycemia at the end of the study.

➢ **Inclusion criteria:**

- Adult males and females of ages not more than 46 years.
- Exercise is part of his/her life style.
- HbA1c is between 7% and 8.2%.
- Patients are not on a diet.
- Patients with normal renal function and normal Creatine Kinase.
- Patients with normal hemoglobin.

➢ **Exclusion criteria:**

- Patient is on more than 2 oral diabetes medicines.
- Patient is on Insulin or a secretagogue.
- Smokers.
- possibility of ischemic heart disease, anemia, thyroid gland disease

STATISTICAL METHODOLOGY

Variables were summarized using contingency tables for qualitative variables (age, BMI, PPG, HbA1c, time of exercise and number of episodes of hypoglycemia). Mean, Standard Deviation, median, range: (mini–max) and for quantitative variables (gender, age, BMI, patients' Job, current medications, dosage and time of exercise).

Continuous variables were summarized using the number of valid observations, mean, Standard Deviation, median, range: (min–max) and categorical variables were summarized using frequency and percentage.

All significant tests were detected at *P*-value 0.05. The following table summarizes the statistical significance and symbols used for *p*-values:

- Student t-test (2-tailed – paired) was used to obtain *P*-value for numeric continuous variables.
- Chi Square test was used to obtain *p*-value for categorical variables.

Table 1: *P*-value, significance and symbols

***P*-value level**	**Significance**	**Symbol**
> 0.05	Not significant	NS
< 0.05 and > 0.1	Significant	*
< 0.01 and > 0.001	Highly Significant	**
< 0.001	Vey Highly Significant	***

RESULTS

Forty four patients were enrolled in the study; 24 patients in Group A and 20 patients in Group B were eligible to be included in the analysis population.

Baseline data included age, gender and BMI is presented in (***Table 2***).

Eighty-three percent of patients in group A were females, and Seventeen percent were males, and all patients in group B were females. The mean age of patients in group A was 42.1±2.8 years,

median was Forty three years with range 36-46 years whereas the mean age of patients in group B it was 43.8 (1.7) years, median was 45 years with range

Forty to Forty-five years for group B. 38% of patients were from 35 to 40 years old, 54% were from 41 to 45 years old, 8% were from 46 to 50 years old in group A and whereas it was 10% of patients were from 35 to 40 years old, 90% were from 41 to 45 years old in group B.

The mean BMI was 26.2±1.2 kg/m^2, median was 26 kg/m^2 with range 24-28 kg/m^2 for group A whereas the mean BMI of patients in group B it was 26.9(1.0)kg/m^2, median was 27 with range 25-28 kg/m^2 for group B. Twelve and half percent of the patients had BMI between 20 and 25 kg/m^2, 78.5% had BMI between 25 and 30 kg/m^2 for group A whereas all patients in group B had BMI between 25 and 30.

Table 2: patient's Demography.

	Group A N (%)	**Group B N (%)**
Age (years)		
Mean (SD)	42.1 (2.8)	43.8 (1.7)
Median (range)	43 (36-46)	45 (40-45)
Age groups		
35-40	9 (38%)	2 (10%)
40-45	13 (54%)	18 (90%)
45-50	2 (8%)	0 (0%)
Gender		
Male	4 (17%)	0 (0%)
Female	20 (83%)	20 (100%)
BMI (kg/m^2)		
Mean (SD)	26.2 (1.2)	26.9 (1.0)
Median (range)	26 (24-28)	27 (25-38)
BMI groups		
20-25	3 (12.5%)	0 (0%)
26-30	21 (87.5%)	20 (100%)

Out of the 24 patients in group A, 12 (50%) of patients were house wives, 4 (17%) of patients were School teachers, 4 (17%) of patients were office worker, 1 (4%) of patient was a SPA owners, 1 (4%) of patient was a Doctor,1 (4%) of patients was a Bank employee and 1 (4%) of patients was a Receptionist. out of the 20 patients in group B, 20 (100%) of patients were house wives. There was statistically significant difference in Patients' Job between group A and group B (*P*-value = 0.0326 < 0.05 and > 0.01– chi-square).

Table 3: Patients' Job.

	Group A N (%)	**Group B N (%)**
House Wife	12 (50%)	20 (100%)
Teacher	4 (17%)	0 (0%)
Office Work	4 (17%)	0 (0%)
SPA owner	1 (4%)	0 (0%)
Doctor	1 (4%)	0 (0%)
Bank employer	1 (4%)	0 (0%)
Receptionist	1 (4%)	0 (0%)
P-value(chi-square)	0.0326	NS

The mean Postprandial Blood Glucose level (PPG) in group A was 150.4 (7.5) mg/dl, median was 149 mg/dl with range 140-166 mg/dl whereas the mean Postprandial Blood Glucose in group B was 144.5 (11.2) mg/dl, median was 141 with range 125-155. There was no statistically significant difference in mean PPG between group A and group B (*P*-value = 0.0678 > 0.05 – t-test) ***(Table 4).***

Table 4: Postprandial Blood Glucose Level (mg/dl).

	Group A N (%)	**Group B (%)**	**N**
Mean(SD)	150.4 (7.5)	144.5 (11.2)	
Median(range)	149 (140-166)	141 (125-166)	
P-value(t-test)	0.0678	NS	

The current medication and the mean Dosage of each medication for group A and group B is presented in ***(Table 5)***.

Out of the 24 patients in group A, 24 (100%) of patients were on Metformin and the mean dose 900 mg, 11 (46%) of patients were on Atorvastatin and the mean dose 18 mg, 5(21%) of patients were on Rosuvastatin, and the mean dose 32 mg, 5 (21%) of patients were on Sitagliptin and the mean dose 100 mg, 7(29%) of

patients were on Simvastatin and the mean dose 20 mg, 2 (8%) of patients were on Acarbose and the mean dose 75 mg. the average number of current medication for each patient in group A was 2.3 medication .

Out of the 20 patients in group B, 20 (100%) of patients were on Metformin and the mean dose 800 mg, 6 (30%) of patients were on Atorvastatin and the mean dose 18.3 mg, 11 (55%) of patients were on Rosuvastatin and the mean dose 10.5 mg, 5 (25%) of patients were on Sitagliptin and the mean dose 100 mg, 3 (15%) of patients were on Simvastatin and the mean dose 13.3 mg, 1 (5%) of patients were on Acarbose and dose 50 mg. the average number of current medication for each patient in group B was 2.3 medication.

There was no statistically significant difference in Current Medication between group A and group B (P-value = 0.3677> 0.05 – chi-square).

There was statistically significant difference in mean dose between group A and group B (P-value = 0.0312 < 0.05 and > 0.01– chi-square).

Table 5: Current Medication and the mean Dosage

	Group A N (%)	**Mean Dose**	**Group N (%)**	**Mean Dose**
Metformin	24 (100%)	900	20 (100%)	800
Atorvastatin	11 (46%)	18.0	6 (30%)	18.3
Rosuvastatin	5 (21%)	32.0	11 (55%)	10.5
Sitagliptin	5 (21%)	100	5 (25%)	100
Simvastatin	7 (29%)	20.0	3 (15%)	13.3
Acarabose	2 (8%)	75	1 (5%)	50
Average no of med/Patient		2.3		2.3
P-value(chi-square) of CM			0.3677	NS
P-value(chi-square) of Dose			0.0312	*

The mean time of exercise in group A was 33.6 (14.1) min/day, median was 43 min/day with range 36-46 min/day whereas the mean time of exercise in group B was 33.5 (8.3) min/day, median was 45 min/day with range 40-45 min/day.

There was no statistically significant difference in time of exercise groups between group A and group B (*P*-value = 0.4422 > 0.05 – chi-square).The exercise time ranges for group A and group B are presented in ***(Table 6)***.

Table 6: Time of Exercise (min/day)

	Group A N (%)	**Group B N (%)**
Time of Exercise (Min/day)		
Mean (SD)	33.6 (14.1)	33.5 (8.3)
Median (range)	43 (36-46)	45 (40-45)
Time of Exercise (Min/day) groups		
15 to 25 min/day	9 (37.5%)	2 (10%)
26 to 35 min/day	2 (8.3%)	12 (60%)
36 to 45 min/day	12 (50%)	6 (30%)
> 46 min/day	1 (4.2%)	0 (0%)
P - value (chi-square)	0.4422	NS

The mean HbA1c in group A at baseline visit was 8 (0.2) %, median was 8% with range 7.5-8.2 %, whereas the mean HbA1c in group A at visit 2 (after 12 weeks) was 7 (0.3) %, median was 7% with range 6.2-7.5%. There was very high statistically significant decrease in mean HbA1c from baseline to end of the study for group A of 1% (*P*-value = 0.0000 < 0.001 – t-test) and percent change was -12.5%.

The mean HbA1c in group B at baseline visit was 7.9 (0.2) %, median was 8% with range 7.5-8.2 %, whereas the mean HbA1c in group B at visit 2 was 6.4 (0.4) %, median was 6% with range 5.9-7.3%. There was a very high statistically significant decrease in mean HbA1c from baseline to end of the study for group B of 1.5 % (*p*-value = 0.0000 < 0.001 – t-test) and percent change was -19.1%.

There also was a very high statistically significant difference in HbA1c reduction from baseline visit to the end of the study between

group A and group B (*p*-value = 0.0000 < 0.001 – t-test).

HbA1c for visits 1 & 2 in both groups A&B is presented in ***(Table 7)***.

Table 7: HbA1c (%) in visits

	Group A		Group B	
Values	**Visit 1**	**Visit 2**	**Visit 1**	**Visit 1**
Mean	8.0	7.0	7.9	6.4
SD	0.2	0.3	0.2	0.4
Median	8	7	8	6
Range	7.5-8.2	6.2-7.5	7.5-8.2	5.9-7.3
Difference	-1.0		-1.5	
% change	-12.5%		-19.1%	
P- value(t-test)for each group	0.0000	***	0.0000	***
P- value(t-test)	0.0001		***	

At the end of the study; 12(50%) of group A were controlled (HbA1c < 7%) while18 (90%) of group B were controlled (HbA1c < 7%). There was high statistically significant difference in controlled patients (HbA1c < 7%) between group A and group B (*P*-value = 0.0046 < 0.01 and > 0.001 – t-test). is presented in ***(Table 8)***.

Table 8: Controlled Patients at the end of the study.

	Group A N (%)	Group B N (%)
HbA1c < 7%	12 (50%)	18 (90%)
HbA1c >= 7%	12 (50%)	2 (10%)
Total	24	20
P - value (chi-square)	0.0046	**

BMI in visits 1 & 2 for both groups A&B is presented in ***(Table 9)***.

The mean BMI in group A at baseline visit was 26.2 (1.2) kg/m², median was 26 kg/m² with range 24-28 kg/m² whereas the mean BMI in group A at visit 2 was 25.7 (1.6) kg/m², median was 26 kg/m² with range 22-28 kg/m². There was statistically significant decrease in mean BMI from baseline to the end of the study for group A of 0.4 kg/m² (*p*-value = 0.0166 < 0.05 and > 0.01 – t-test) and percent change was -1.7%

The mean BMI in group B at baseline visit (visit 1) was 26.9 (1.0) kg/m², median was 27kg/m² with range 25-28 kg/m² whereas the mean BMI in group B at the end of the study (visit 2) was 26.9 (1.0) kg/m², median was 27 kg/m² with range 25-28 kg/m². There was no statistically significant difference in mean BMI from baseline to end of the study for group B (*P*-value = 1.0000 > 0.05 – t-test).

There was high statistically significant deference in BMI reduction from baseline visit to and of the study between group A and group B (p-value = 0.0083 < 0.01 and > 0.001 – t-test).

Table 9: BMI (kg/m²) in visits 1 & 2 for both groups

	Group A		Group B	
Values	**Visit 1**	**Visit 2**	**Visit 1**	**Visit 2**
Mean	26.2	25.7	26.9	26.9
SD	1.2	1.6	1.0	1.0
Median	26	26	27	27
Range	24-28	22-28	25-28	25-28
Difference	-0.4		0.0	
% change	-1.7%		0.0%	
P-value(t-test)for each group	0.0166	*	1.0000	NS
P-value(t-test)	0.0083		**	

The mean number of episodes of hypoglycemia in group A at the end of the study was 1.8 (3.7) episodes, median was 0.0 episodes (no hypoglycemia) with range 0-14 episodes whereas. The mean number of episodes of hypoglycemia in group B at end of the study was 3.9 (3.8) episodes, median was 3.5 episodes with range 0-12 episodes. There was no statistically

significant difference in mean number of episodes of hypoglycemia at end of the study between group A and group B (*P*-value = 0.0891 > 0.05 – t-test).

Number of Episodes of Hypoglycemia in both groups A &B is presented in ***(Table 10)***.

Table 10: Number of Episodes of Hypoglycemia for both groups

	Group A N (%)	**Group B N (%)**
Mean	1.8	3.9
SD	3.7	3.8
Median	0.0	3.5
Range	0-14	0-12
P - value (chi-square)	0.0891	
Significance	NS	

DISCUSSION

We wanted to test an exercise module to see if certain exercises are more beneficial than others, and if certain ways and programs of exercise are giving more benefits.[1,2]

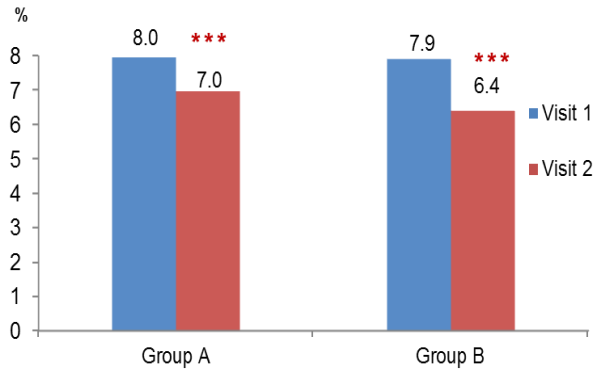
In our study we wanted to compare the response of glycosylated hemoglobin (HbA1c), body mass index (BMI) and incidence of hypoglycemia to continuous running exercise (run daily for 45 minutes at any time of the day, continuous running, without stopping as much as they can "group A") and intermittent postprandial exercise (run for 15 minutes three times daily each time after a main meal "group B").

Although there have been numerous old small studies on the effects of exercising in patients with type 2 diabetes, their findings have varied. There have been no large studies with adequate statistical power to guide practitioners in recommending exercise plans for their patients with diabetes. Exercise interventions reduced glycosylated hemoglobin (HbA1c) in some studies,[24-28] but not in others.[29-35]

However, recent reports indicate that, regular exercise effectively lowers blood HbA1c content in type 2 diabetes patients.[6,7,8,9,36] In accordance, we observed a significant reduction in blood HbA1c level 12 weeks of exercise intervention in the type 2 diabetes patients ***(Table 7)***. It has been well established that the magnitude of the reduction in HbA1c content following prolonged exercise intervention strongly depends on pre-intervention HbA1c levels.[9]

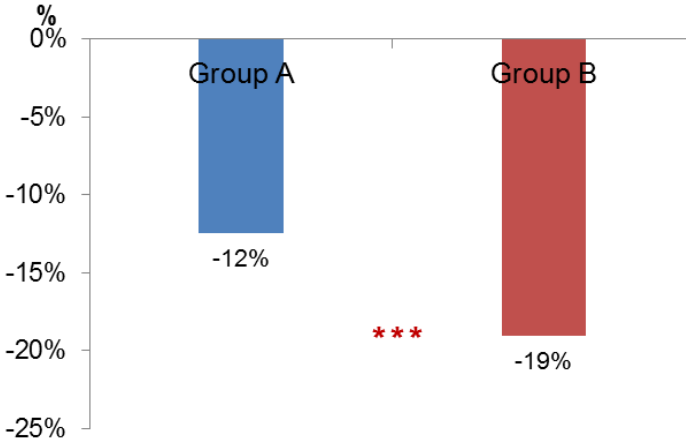
In our study we found that both exercise groups resulted in a decline in mean of HbA1c. However, the mean of HbA1c was dropped from 8 % at baseline visit to 7% at end of the study. There was a very highly statistically significant mean reduction of 1% ($P < 0.001$) for group A and –percent change was 12.5%, whereas the mean of HbA1c was dropped from 7.9% to 6.4% . There was a very high statistically significant mean reduction of 1.5% ($P < 0.001$) for group B and percent change was -19.1%. ***(Figure 1 & 2).***

Figure 1: Average number of HbA1c in both groups at baseline (visit 1) and the end of the study (visit 2).



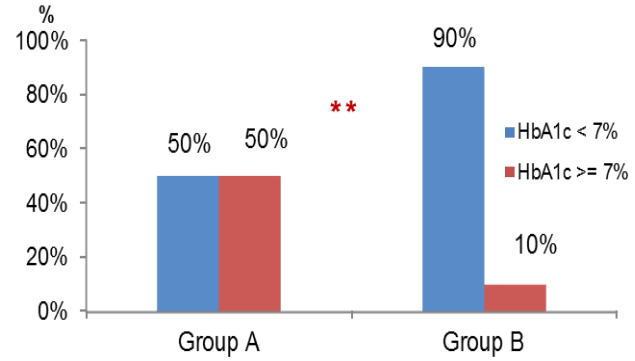
There was a very high statistically significant difference in HbA1c between group A and group B ($P < 0.001$).

Figure 2: % of decrease in HbA1c in both groups.



50% of the patients reached HbA1c level of less than 7% at the end of the study in group A while 90 % for group B. There was a high statistically significant difference in controlled patients (HbA1c < 7%) between group A and group B (*P* < 0.01 and > 0.001) ***(Figure 3).***

Figure 3: % of controlled patients (HbA1c<7%) at the end of the study in both groups.



There have been numerous small studies on the effect of exercise in patients with type 2 diabetes, their findings the BMI comparisons for the exercise groups vs. non exercise control groups.[26-35] no significant post intervention differences were found. The effect of exercise vs. non exercise control was similar.

In our study we found that only group A resulted in a decline in mean of BMI. However, the mean of BMI was dropped from 26.2 kg/m² to 25.7 kg/m² with -0.4% percent decreased. There was statistically significant mean reduction of 1.7% (*P* < 0.05 and > 0.01) for group A whereas the mean BMI at visit 1 and visit 2 was 26.9 kg/m² with no statistically significant difference in mean BMI for group B (*P* < 0.05) ***(Figure 4& 5).*** There was high statistically significant difference in mean BMI between group A and group B (*P* < 0.01 and < 0.001).

Figure 4: Average number of BMI in both groups at baseline visit (visit 1) and at the end of the study (visit 2).

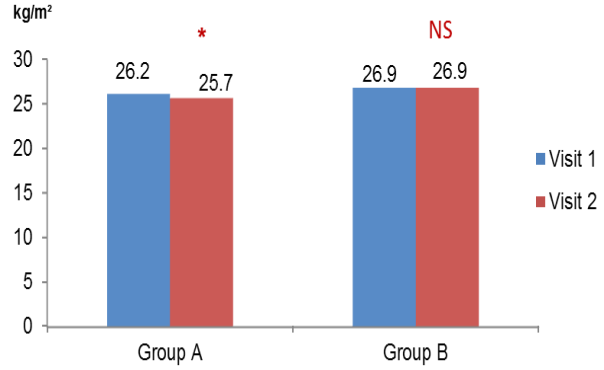
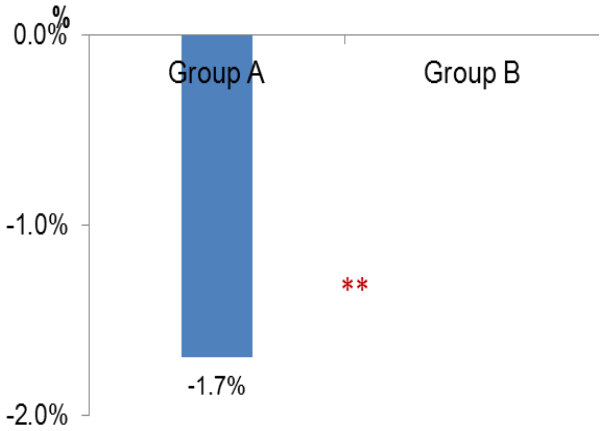


Figure 5: % of decrease in BMI in both groups.



The incidences of hypoglycemia comparison group A vs. group B, not significant post intervention differences were found (*P*> 0.05).

The present findings suggest that prolonged intermittent postprandial exercise (run 60-90 minutes after main meals for 15 minutes three times daily) is more effective when compared with continuous running exercise (run daily for 45 minutes at any time of the day, continuous running without stopping) as a way to lower blood HbA1c level but it is more difficult to adapt as a life style.

CONCLUSION

The reduction in HbA1c levels is less with continuous running exercise compared with intermittent postprandial exercise during exercise and recovery for individuals with type2 diabetes.

The reduction in BMI levels is less with intermittent postprandial exercise compared with continuous running exercise during exercise and recovery for individuals with type2 diabetes.

The effect of hypoglycemia of intermittent postprandial exercise compared with continuous running exercise was similar.

The three times daily postprandial exercising is superior but it is more difficult to adapt as a life style.

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