How to Cite:
Dhumale, A., & Devi, T. P. (2022). Efficacy of aerobic training on blood cholesterol parameters in women with gestational diabetes. *International Journal of Health Sciences*, *6*(S6), 4720–4728. https://doi.org/10.53730/ijhs.v6nS6.11298

Efficacy of aerobic training on blood cholesterol parameters in women with gestational diabetes

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Abstract---Background: To study and find the efficacy of aerobic training on blood cholesterol parameters in women with gestational diabetes. Methods: Ethical clearance was taken from the Institutional Ethical Committee. This study was carried out by analyzing total 34 out of 40 patients with gestational diabetes between the age group of 20 years and above. The participants were divided into experimental and control group by random sampling. The experimental group was given aerobic exercising for 8 weeks 3-4 times a week for 45-50 minutes. Lipid profile was used to check the blood cholesterol parameters before and after the intervention. Result: There was an observed increase in the mean HDL of the exercise group at the end of the 8 weeks. Statically the patients who were given aerobic training showed there was extremely significant difference ($p<0.0001$) whereas in the control group it was not significant (p value0.6593). There was a considerable decrease in the total cholesterol of the exercise group and the control group remained steady. Statistically the exercise group showed there was extremely significant difference ($p<<0.0001$) whereas in the control group it was not significant (p value0.1057). There was a considerable decrease in the mean LDL of the exercise group and the control group remained steady. Statistically the exercise group showed there was extremely significant difference ($p<0.0001$) whereas in the control group it was significant (p value0.0303). Conclusion: This study concludes that regular aerobic exercise 2-3 times a week is beneficial to improve the lipids levels. It also prevents further complications in the gestational period and helps improve the quality of life. It also reduces the risk of cardiovascular diseases.

Keyword---aerobic training, blood, cholesterol, gestational diabetes.

Introduction

Gestational diabetes mellitus

Gestational diabetes mellitus refers to any degree of abnormal glucose tolerance first detected during pregnancy[5]. Gestational diabetes mellitus (GDM) accounts for almost 90% - 95% of all cases of diabetes in pregnancy[10] .Throughout normal pregnancy, insulin sensitivity declines with progressing gestation. The condition is associated with a high frequency of maternal and fetal morbidity[7]. Women with a history of gestational diabetes mellitus are more likely to develop type 2 diabetes and cardiovascular disease after pregnancy compared to other normal women[7] these are due to placental factors, progesterone and estrogen. Usually occurs if pancreatic b-cells are unable to face the increased insulin demand during pregnancy[8] . The prevalance of gestational diabetes was 1-28% in the study conducted in 2015[4] . GDM can lead to increasing complications such as pregnancy hypertension, preeclampsia, hyerhydramnios[6] . It may increase the risk of preterm delivery, macrosomia, hyperinsulinemia, and hypoglycemia for fetuses and newborns[6]. All pregnant women are routinely screened for GDM with a 50g GCT between 24 and 28 weeks of gestation. Women with a serum glucose concentration >140mg/dL (7.8mmol/L) 1hour after GCT are referred to a diagnostic 100g oral glucose tolerance test (OGTT)[4].

Gestational diabetes mellitus and cholesterol

Cholesterol is an important constituent of every cellular membrane to sustain membrane integrity an membrane associated signaling cascades[8] . However less attention has been given to the association between Gestational diabetes mellitus and long term risk of dyslipidemia, a metabolic disorder characterized by elevated levels of low-density (LDL-C), low levels of high density lipoprotein cholesterol(HDL-C) and elevated levels of triglycerides[4] .Numerous reports show that pregnancy is a physiological condition considered by a progressive, weeks of gestation-dependent increase in the maternal blood level of cholesterol. This phenomenon is known as maternal physiological hypercholesteremic in pregnancy, and is considered to be an adaptive response of the mother to satisfy high cholesterol demand by the growing fetus[2] .Oxidative stress is increased by GDM and affects intracellular cholesterol mechanism in fetoplacental endothelium[8] .Dyslipidemia was defined according to the Adult Treatment Panel III,17 which was the relevant guidelines for the time of the study period: LDL-C >160mg/dL (4.14mmol/L) and HDL-C <40mg/dl (1.30mmol/L)[4] .The range mean lipid levesl among women with GDM were 179-505mg/dl for total cholesterol,28-153mg/dl for HDL-C and 77-301mg/dl for LDL-C [11].

Effects of aerobic exercising in cholesterol

Aerobic exercise is defined as any form of physical activity that produces an increased heart rate and respiratory volume to meet the oxygen requirements of the activated muscle[5]. The cardiovascular disease is a leading cause of death worldwide. Low blood levels of high density lipoprotein cholesterol (HDL-C) are an independent risk factor for CVD[3]. Studies on the mechanism by which physical training results in lower VLDL and increased HDL concentrations have shown

that physically trained skeletal muscle has increased lipoprotein lipase activity compared with untrained muscle. This results in greater extraction of circulating VLDL and increased release of HDL resulting from a transfer of VLDL surface proteins to HDL particles[1]. This improvement in the lipid profile with physical training is observed with running a minimum of 10 to 12 miles per week and increases in a dose-response fashion up to distances of approximately 40 miles per week. Less intensive levels of physical activity have little or no effect on lipid profiles[9]. Provide people who are more physically active have higher hdlc levels. Thus the value of regular aerobic exercise in increasing serum hdl-c level and in reducing the risk of CVD[3] .Aerobic exercises like spot walking, half squatting,arm raising and pelvic tilting were specified to the patients[1] .

Materials and Methodology

This was experimental research with a test group and a control group, intended to study the efficacy of aerobic training on the blood cholesterol parameters in women with gestational diabetes in their present pregnancy. The sample was drawn from the women visiting tertiary care hospital for their regular checkup who were at least 24 weeks pregnant. The sample size of the study was 40 drawn from the formula

$$n = \frac{(z\,\alpha/2 + z\,\beta)^2\,(S_1^2 + S_2^2)}{\alpha^2}$$

Random sampling method was opted. The study was carried out for 8 weeks.

Inclusion

Females diagnosed with GDM according to OGTT test were considered. Fasting sugar level ≥ 95mg/dl and 1 hour post prandial level ≥130-140mg/dl was considered. Women who have completed 24 to 31 weeks of gestation were included in the study. Age group of 20 years and above was taken. Patients with increased plasma cholesterol levels were taken. All the women who were ready for voluntary participation were considered**.** Exclusion**:** Women who have had previous history of abortion were excluded from the study. Females with severe obstretic complications were excluded from the study. Previously diagnosed diabetes was not considered**.** Lipid profile was used as the outcome measure.

Procedure

After approval from the institutional protocol and ethical committee, 40 patients with GDM having cholesterol abnormalities were assesed for the eligibility for the study. Simple random sampling was selected for randomization of the samples. Out of 40 pregnant women only 34 completed the study. 3 patients felt uncomfortable to be a part of the study and 3 patients discontinued the study, hence only 34 patients were able to complete the study. The patients were either assigned to experimental (17) or control (17) group. The exercise group participated in the exercise programme which was held on every Monday and Friday for 8 weeks, each session lasting for a maximum of 50 minutes. There was 5 minutes rest intervals after every 20 minutes of exercising. Those in control

group did not take part in any structed programme during the period of study. The serum cholesterol levels of all subjects were assessed through appropriate laboratory procedure at baseline. and 8th week of programme.the exercises were conducted at tertiary care hospital,karad. The exercise classes were held from 11am to 12pm on Mondays and Fridays of each week of the 8 weeks that study lasted. The exercises were carried out in group to make it more interesting and challenging. The subjects were able to gain encouragement from one another. Each exercise session started with 10 minutes warm up exercise. The exercises involved 45mins of walking. Breathing exercises were incorporated intermittently throughout the sessions. Stretches to the exercised muscles were done to cool down.

Statistical analysis

Statistical analysis of the recorded data was done by using the software Instat.Mean and standard deviation for each demographic variable were calculated. Data was calculated.MS Excel was used for drawing various graphs with given frequencies and for master chart. Unpaired t test was used to compare results of pre and posttest.

Demographic variables

The demographic data is shown in table no. 1. Table 1 shows the characteristics of a pregnant women. The average age of the subjects in the exercise group was 25.29 years and that of control group was 28.29 years. The average gravida was 1.64 and 1.82 of the exercise and control group respectively. The average gestational week of the subjects that in exercise group was 26.76 and in the control group was 25.82. Hence all the variables were comparable.

Table 1
Demographic data

	Total number	Exercise group	Control group
variables	N	MEAN±SD	MEAN±SD
Age	34	25.29±1.99	28.29±3.36
Gravida	34	1.64±0.70	1.82±0.72
Gestational week	34	26.76±1.52	25.82±2.12

Table 2
The results of the exercise group

Mean, SD and p-value for exercise group.

Study variables	Mean±SD	t-value	p-value
Pre-intervention TOTAL CHOLESTEROL	188.73±4.98	11.008	<0.0001
Post-intervention TOTAL CHOLESTEROL	168.68±5.61		

Pre-intervention HDL	47.78±3.28	11.552	<0.0001
Post-intervention HDL	61.27±3.52		
Pre-intervention LDL	115.95±6.97	10.081	<0.0001
Post-intervention LDL	94.93±5.01		

Table 3
The results of the control group

Study variables	Mean±SD	t-value	p-value
Pre-intervention TOTAL CHOLESTEROL	187.78±4.45	1.714	0.1057
Post-interventio TOTAL CHOLESTEROL	188.32±3.82		
Pre-intervention HDL	49.55±2.89	0.4492	0.6593
Post-intervention HDL	49.44±2.76		
Pre-intervention LDL	112.81±6.59	2.376	0.0303
Post-intervention LDL	111.49±6.36		

Table 3 mean,SD and p-value for control group

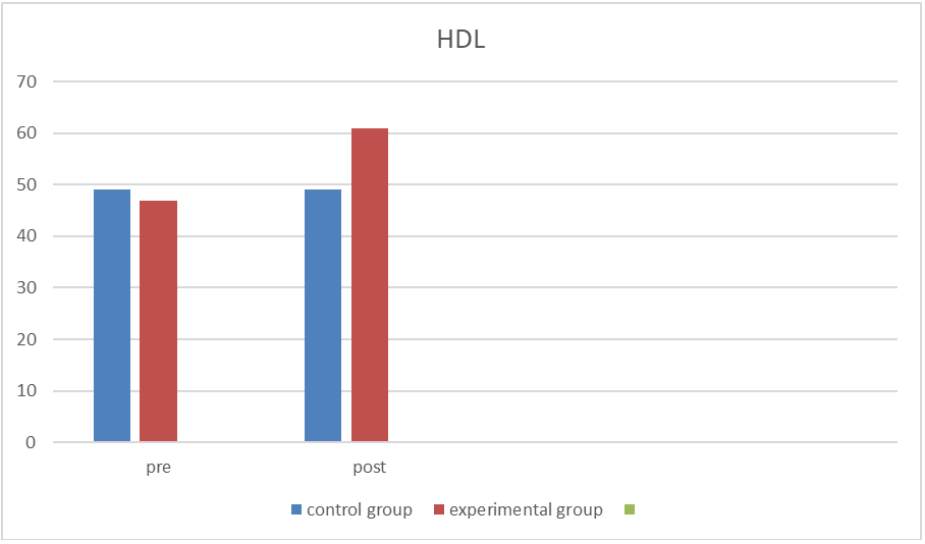

Chart 1. Comparison of HDL of experimental and control group

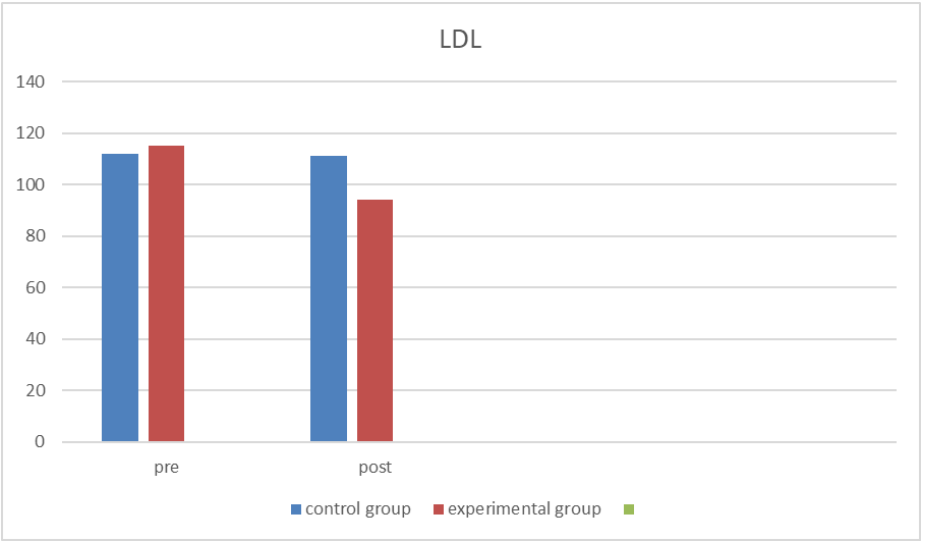

Chart 2. Comparison Of LDL of experimental and control groups

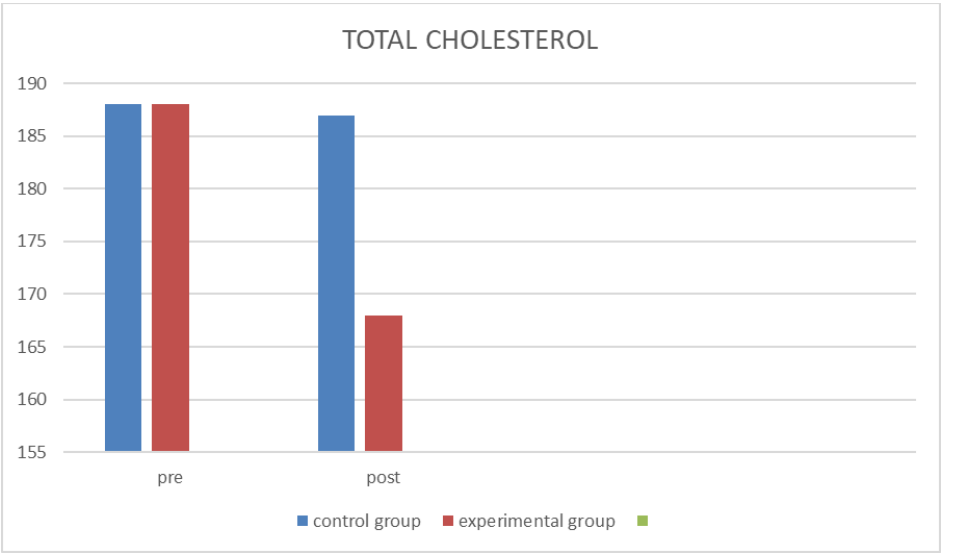

Chart 3. Comparison of Total Cholesterol of experimental and control groups

Interpretation

Table 2 and Table 3 shows the statistical analysis of mean values of lipid profiles of the exercise group and control group respectively at the start of the study and at the end of 8 weeks. There was an observed increase in the mean HDL of the exercise group from 47.78±3.28 at the start of the study to 61.27±3.52 at the end of the 8 weeks. However the mean HDL of the control group remained relativey steady from 49.55±2.89 to 49.44±2.76 at the end of 8 weeks. Statiscally the patients who were given aerobic training showed there was extremely significant difference ($p<0.0001$) whereas in the control group it was not significant (p value0.6593). The mean TOTAL CHOLESTROL of the exercise group was

188.73±4.98 at the beginning and 168.68±5.61 at the termination of the study whereas 187.78±4.45 at the beginning and 188.32±3.82 at the end of the study in the control group. So there was a considerable decrease in the mean TOTAL CHOLESTEROL of the exercise group and the control group remained. Statistically the exercise group showed there was extremely significant difference ($p<<0.0001$) whereas in the control group it was not significant (p value0.1057). The mean LDL of the exericse group was115.95±6.97 at the beginning and 94.93±5.01 at the termination of the study whereas 112.81±6.59 at the beginning and 111.49±6.36 at the end of the study in the control group. So there was a considerable decrease in the mean LDL of the exercise group and the control group remained steady. Statistically the exercise group showed there was extremely significant difference ($p<0.0001$) whereas in the control group it was significant (p value0.0303).

Discussion

This study investigated the efficacy of aerobic training on blood cholesterol parameters in women with gestational diabetes. The 8 weeks of exercise protocol showed some significant changes in the blood cholesterol parameters (HDL,LDL and Total cholesterol).There was an observed increase in the means of HDL in women assigned in exercise group whereas no significant change was observed in the control group. There was an observed decrease in the means of LDL and Total cholesterol in the exercise group whereas control group remained steady. This study confirms that aerobic exercises have a positive impact on the lipid levels in women with gestational diabetes. Studies have shown that exercise guidelines for pregnant women in most countries recommend moderate intensity exercises, therefore in this study moderate intensity exercise were given with supervision of a physiotherapist[6]. Aerobic exercise is any form of physical activity that produces an increased heart rate and respiratory volume to meet the oxygen requirements of the activated muscle. Aerobic exercise has been shown to improve the prognosis of cardiovascular disease[5].

Jovita A Daniel et al. in her study has shown that after 8 weeks of aerobic exercises the Total cholesterol has seen a noticeable decrease. Their study indicated that effect of aerobic exercise resulted in a decrease of around 25mg/dl of net total cholesterol change after the analysis. This study showed a significant decrease in the total cholesterol (p 0.001) at the end of 8th week. The current study has also shown a net change of 20mg/dl of net total cholesterol. The result was extremely significant ($p<0.0001$). In their study it also indicated that the effect of aerobic training resulted in a 11mg/dl elevation of net HDL change. In the current study the HDL increased about 10mg/dl in the exercise group after 8 weeks of exercise. The results were extremely significant ($p<0.0001$).

They also observed a decrease in the LDL by 15mg/dl after 8 weeks of exercise. In the current study also a net change of 20mg/dl in the LDL was seen. Hence significant difference was observed (0.001). The mechanism by which physical training results in lower total cholesterol have shown that physically trained skeletal muscle have increased lipoprotein lipase activity compared with untrained muscle[1].Heavy or Prolonged aerobic exercises could significantly increase the plasma Lpl(lipoprotein lipase) activity thus promoted LPL- mediated

triglyceride hydrolysis. Exercises can affect the activities of lipoprotein lipase in the adipose tissues and muscles which are increased by endurance exercise. Thus increase in the lipoprotein lipase helps to reduce the total cholesterol[1]. Exercise appears to enhance the ability of skeletal muscles to utilize lipids as opposed to glycogen. The mechanisms include increases in lecithin-cholesterol acyltrans (LCAT)—the enzyme responsible for ester transfer to HDL cholesterol, which has been shown to increase following exercise training and increases in lipoprotein lipase activity. It is reported that 1,100 kcal of energy expenditure is required to elicit increases in HDL cholesterol that coincide with significant increases in lipoprotein lipase activity. This increased enzymatic activity increases the ability of muscle fibres to oxidize fatty acids originating from plasma. Thus there is an increase in the HDL after regular exercising.

Exercise helps to stimulate enzymes that help move LDL from the blood and blood vessel walls to the liver. From there the cholesterol is overted to bile or excreted. So the more you exercise the more LDL your body expels it. LDL is classified according to the size and density[6].Exercise increase the average size of the protein particles that carry cholesterol through blood; small particles are more dangerous to the body. Hence exercise helps reduce the LDL. This study concludes that regular aerobic exercise 2-3 times a week is beneficial to improve the lipids levels. It also prevents further complications in the gestational period and helps improve the quality of life

Conclusion

This study concludes that regular aerobic exercise 2-3 times a week is beneficial to improve the lipids levels. It also prevents further complications in the gestational period and helps improve the quality of life. It also reduces the risk of cardiovascular diseases.

References

Chodick G, Tenne Y, Barer Y, Shalev V, Elchalal U. Gestational diabetes and long-term risk for dyslipidemia: a population-based historical cohort study. BMJ Open Diabetes Research and Care. 2020 Jan 1;8(1):e000870.

Daniel JA, Nzeribe E, Udoaku AA. Aerobic training impacts on blood cholesterol of women with gestational diabetes. Open Journal of Obstetrics and Gynecology. 2021 Apr 12;11(4):474-83.

Kodama S, Tanaka S, Saito K, Shu M, Sone Y, Onitake F, Suzuki E, Shimano H, Yamamoto S, Kondo K, Ohashi Y. Effect of aerobic exercise training on serum levels of high-density lipoprotein cholesterol: a meta-analysis. Archives of internal medicine. 2007 May 28;167(10):999-1008.

Leiva A, de Medina CD, Guzmán-Gutierrez E, Pardo F, Sobrevia L. Maternal hypercholesterolemia in gestational diabetes and the association with placental endothelial dysfunction. Gestational Diabetes—Causes, Diagnosis and Treatment. 2013 Apr 24;6:103-34.

Mann S, Beedie C, Jimenez A. Differential effects of aerobic exercise, resistance training and combined exercise modalities on cholesterol and the lipid profile: review, synthesis and recommendations. Sports medicine. 2014 Feb;44(2):211-21.

McDonald SM, Strom C, Remchak MM, Chaves A, Broskey NT, Isler C, Haven K, Newton E, DeVente J, Acosta-Manzano P, Aparicio VA. The effects of aerobic exercise on markers of maternal metabolism during pregnancy. Birth defects research. 2021 Feb 1;113(3):227-37.

Menato G, Bo S, Signorile A, Gallo ML, Cotrino I, Poala CB, Massobrio M. Current management of gestational diabetes mellitus. Expert Review of Obstetrics & Gynecology. 2008 Jan 1;3(1):73-91.

O'Malley EG, Reynolds CM, Killalea A, O'Kelly R, Sheehan SR, Turner MJ. Maternal obesity and dyslipidemia associated with gestational diabetes mellitus (GDM). European Journal of Obstetrics & Gynecology and Reproductive Biology. 2020 Mar 1;246:67-71.

Qiu C, Rudra C, Austin MA, Williams MA. Association of gestational diabetes mellitus and low-density lipoprotein (LDL) particle size. Physiological research. 2007 Oct 1;56(5).

Ryckman KK, Spracklen CN, Smith CJ, Robinson JG, Saftlas AF. Maternal lipid levels during pregnancy and gestational diabetes: a systematic review and meta-analysis. Bjog: an international journal of obstetrics & gynaecology. 2015 Apr;122(5):643-51.

Santi, L. K. S., Sudewi, A. A. R., Duarsa, D. P., & Lesmana, C. B. J. (2021). The effect of pregnancy massage on level of depression, anxiety and stress in pregnant women. International Journal of Health & Medical Sciences, 4(2), 220-225. https://doi.org/10.31295/ijhms.v4n2.1692

Sun Y, Kopp S, Strutz J, Gali CC, Zandl-Lang M, Fanaee-Danesh E, Kirsch A, Cvitic S, Frank S, Saffery R, Björkhem I. Gestational diabetes mellitus modulates cholesterol homeostasis in human fetoplacental endothelium. Biochimica et Biophysica Acta (BBA)-Molecular and Cell Biology of Lipids. 2018 Sep 1;1863(9):968-79.

Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. *International Journal of Health Sciences*, *6*(1), i-v. https://doi.org/10.53730/ijhs.v6n1.5949

Wang Y, Xu D. Effects of aerobic exercise on lipids and lipoproteins. Lipids in health and disease. 2017 Dec;16(1):1-8.

Williams PT, Wood PD, Haskell WL, Vranizan K. The effects of running mileage and duration on plasma lipoprotein levels. Jama. 1982 May 21;247(19):2674-9.

Yaping X, Huifen Z, Meijing Z, Huibin H, Chunhong L, Fengfeng H, Jingjing W. Effects of moderate-intensity aerobic exercise on blood glucose levels and pregnancy outcomes in patients with gestational diabetes mellitus: a randomized controlled trial. Diabetes Therapy. 2021 Sep;12(9):2585-98.