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Effectiveness of Physical Exercise in Early Pregnancy on the Prevention of Gestational Diabetes and Improve Pregnancy Outcome

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Abstract: **Physical activity affects energy expenditure and therefore directly affects glucose utilization. Physical activity enhances glucose uptake, physical exercise both before and during pregnancy, has been associated with a reduced risk of GDM. Purpose: The purpose of the current study was to investigate the effect of physical exercise on prevention of gestational diabetes and improve pregnancy outcomes among women at high risk for gestational diabetes mellitus. Setting: The study was conducted in Maternal and Child Health Centers at Shebin El-Kom city. Design: A quasi-experimental study design was utilized. Sample: A convenient sample included 100 pregnant women were selected after fulfilling the including criteria of the sample. They were divided into two equal groups, study group applied physical exercises during early pregnancy and control group were left for the routine antenatal care. Instruments: There were four Instruments of data collection compromised I: A structured interviewing questionnaire,II: physical activity assessment sheet III: Laboratory Investigations sheet, Semi structured questionnaire for assessing maternal and neonatal outcomes. Results: There was a highly statistically significant difference after physical exercise intervention in early pregnancy on reducing gestational weight gain, gestational diabetes mellitus, and complications of current pregnancy, labor and postpartum. Conclusion: physical exercise during early pregnancy was effective in reduce risk of gestational diabetes mellitus, complications and improve obstetric and neonatal outcomes. Recommendation: Prepare programs about the importance of maintaining healthy body weight through following regular physical exercise and being active all the time to all women before and during early pregnancy.**

Keywords: **physical exercise, prevention of gestational diabetes, maternal and neonatal outcomes.**

1. INTRODUCTION

Regular physical activity, both before and during pregnancy, has been associated with a reduced risk of GDM (Dempsey 2004; Zhang 2014). Physical activity affects energy expenditure and therefore directly affects glucose utilization. Physical activity enhances glucose uptake through translocation of the glucose transporter type 4 (GLUT-4) on skeletal muscle (Kennedy 1999). Insulin sensitivity is increased with physical activity, with effects continuing after exercise is ceased (Perseghin 1996). Increased muscle mass as a result of physical activity is likely to further improve glucose tolerance and increase insulin sensitivity (Yki-Jarvinen 2013).

Obesity and obesity-associated comorbidities are great health problems worldwide including women of childbearing age. The excessive weight gain and retention of weight after birth, both increase the risk of obesity, gestational diabetes, and pregnancy-induced hypertension (Roney BL, et al., 2005). It seems to be the consensus that physical exercise prevents excessive weight gain.

The value of physical activity was illustrated by a meta-analysis including seven prepregnancy and five early pregnancy studies .Women with the highest number of units of prepregnancy physical activity by self-report had approximately one half the risk of developing gestational diabetes as women with the lowest number of units (OR 0.45, 95% CI 0.28-0.75); units of physical activity reflected frequency (hours per week), energy expenditure, and/or level of exertion or intensity. Physical activity in early pregnancy was also protective (OR 0.76, 95%CI 0.70-0.83). Thus, an exercise program of brisk walking, stair climbing, or other vigorous activity before pregnancy and in early pregnancy may reduce the risk of developing gestational diabetes (Tobias et al., 2011).

Physical activity is also important for weight control and maintenance. Women were more likely to be physically inactive than men. Further, adults over 50 years of age were more likely to be inactive than younger adults (Emily, Kahn, Leigh, Ramsey, et al., 2010).

Tobias 2011 summarized in a meta-analysis that greater total physical activity before or during early pregnancy is significantly associated with lower risk of GDM. According to another meta-analysis physical activity and dietary interventions appear to be successful in reducing gestational weight gain (van Dam, et al.,2011). Recently, in a randomized university-hospital based Norwegian study of 855 women, the authors concluded that there was no evidence to prevent GDM or to improve insulin resistance in healthy pregnant women with normal weight offering women a 12-week standard exercise program during the second half of pregnancy (S.N. Stafne, et al.,2012).

Several studies have suggested a link between physical activity and a reduced risk of GDM, but so far the evidence on the feasibility of life-style counseling to increase physical activity in high-risk pregnant women at primary care facility is scarce. In a cluster-randomized trial of 399 Finnish women at high risk for GDM, the intervention was effective in controlling birth weight of the newborns, but failed to have an effect on maternal GDM(Russo LM,2015).

Significance of the study:

Obesity and being overweight are becoming epidemic, and indeed, the proportion of such women of reproductive age has increased in recent times. Being overweight or obese prior to pregnancy is a risk factor for gestational diabetes mellitus, and increases the risk of adverse pregnancy outcome for both mothers and their offspring. Furthermore, the combination of gestational diabetes mellitus with obesity/overweight status may increase the risk of adverse pregnancy outcome attributable to either factor alone. Regular exercise has the potential to reduce the risk of developing gestational diabetes mellitus and can be used during pregnancy; however, its efficacy remains controversial. Based on what is mentioned before, this study is undertaken to investigate the effect of Physical Exercise in Early Pregnancy on the prevention of gestational diabetes and improve pregnancy outcome

Purpose of the Study:

The study purposed to investigate the effect physical exercise in early pregnancy on the prevention of gestational diabetes and improve pregnancy outcome among women at high risk for gestational diabetes.

Research Hypotheses:

1- Physical exercise in early pregnancy of women at high risk for gestational diabetes mellitus will reduce incidence of gestational diabetes.

2- Physical exercise in early pregnancy of women at high risk for gestational diabetes mellitus will reduce gestational weight gain.

3- Physical exercise in early pregnancy of women at high risk for gestational diabetes mellitus will improve pregnancy outcome

2. METHODS

Research design:

A quasi-experimental design (case-control group) was used.

Setting:

The present study was conducted in Maternal and Child Health Centers (MCH) at Shebin El-Kom city (Quibli MCH Center and Bahry MCH Center) These settings were selected because of the highly flow rate . The main function is the

provision of health care to mothers and children up to six years. Services of women provided by MCH include antenatal care for mother's delivery for normal labor, postpartum care, family planning, vaccination of children and follow up of growth and development. This facility usually service normal cases. Abnormal or complicated cases are referred to the General or University Hospital due to technological and specialty services required for diagnosis and treatment. The annual flow rate for pregnant women was 384 in 2017 and 716 in 2018. MCH Bahry annual flow rate for pregnant women was 612 in 2017 and 538 in 2018.

Sampling:

A convenient sample consists of 100 pregnant women were selected from the above mentioned Maternal and child health centers during their booking visit for routine antenatal care on monday and wednesday weekly (40 women was selected from MCH Bahry and 60 women from MCH Quibli). They all fulfilled the inclusion criteria and were enrolled in the current study. The selected women were then randomly assigned into two groups (study and control). Each of the 100 women was asked to pick a piece of paper containing a number (1,2), those who selected number 1 was assigned to study group , those who selected number 2 was assigned to control group. This technique was used to avoid sample contamination and bias.

Sample size: The sample size was calculated by using the following formula

$$N= \frac{2(z_1-\alpha+z_1-\beta)^2\ \sigma^2\ \{1+(m-1)p\}}{md2}$$

The sample size was calculated for each group according to the following equation and the results of the pilot study. The researcher considering a type I error of 0.05, a test power of 0.8, m = n1 =size of sample from population 1, and d = 2 as the least significant difference (Diggle, Heagerty, Liang & Zeger, 2013). Based on the sample size measured, a total of 100 women (50 for each group) participated in the study.

Instruments:

Instrument I: A structured interview questionnaire: It was developed based on the review of currently related literature. It consisted of questions related to the socio-demographic characteristics, family and medical history, present obstetric history, and clinical data: such as self-reported prepregnancy weight, height. Body Mass Index (BMI) was calculated using the following formula: BMI = weight (kg /height (m)2; based on measured height by measuring taps and self-reported prepregnancy weight; blood pressure was measured using a mercury sphygmomanometer, and total weight gain during pregnancy was also, measured.

Instrument II: Physical activity assessment sheet (pre and post):We ask all women about physical activity such as walking to the local shop, cleaning, working, active transport etc. as well as hours of being inactive during days due to sedentary life such as (watching TV, set in front of net, computer or telephone, sedentary office work)

Instrument III: Laboratory Investigations Blood glucose test (gestational diabetes screening test) at initial visit to all high risk cases and at 24-28 weeks gestation, oral glucose tolerance test OGTT (fasting,1-h and 2-h following 75-g glucose load) (American Diabetic Association).

Instrument IV: Semi structured questionnaire for assessing Maternal and neonatal outcomes: for observation and evaluation of Maternal and neonatal outcomes after lifestyle counselling compared to routine antenatal care.

Validity and reliability

For validity purposes, the researchers conducted an extensive literature review and developed the questionnaire from the previously used instruments and reviewing pertinent studies. Instrument 1 was designed by the researchers and validated by three experts (two Professors in Maternal and Newborn Health Nursing and one expert has doctorate degree in Obstetric Medicine) for content accuracy and internal validity, while instruments II, III, and IV were adopted from the previous studies. The interview questionnaire underwent some modifications according to the panel of judgment regarding the clarity of sentences and appropriateness of content. Test-retest reliability was used to estimate reliability.

Administrative Approvals:

An official letter was taken from Dean, Faculty of nursing, Menoufia University and directed to Directors of the study settings. An official permission was obtained to carry out the study from the directors of the above mentioned settings. Also, the approval of the Ethical Committee of the Faculty of Nursing, Monoufia University was obtained.

Ethical Consideration:

An approval of the committee of the research committee in the faculty of nursing, Menoufia University was obtained on 2/6/2015. Approaches to ensuring ethics were considered in the study regarding confidentiality and informed consent. Confidentiality was achieved by the use of closed sheets with the names of the participants replaced by numbers. All participants were informed that the information they provided during the study would be kept confidential and used only for statistical purpose and after finishing the study, the findings would be presented as a group data with no personal participant's information remained.

Pilot study

A pilot study conducted to test the feasibility, applicability and understandability of the tools. It was conducted on 10%of the total sample (6 women) according to the selection criteria. All women participated in the pilot study excluded from the study sample because the researcher made some modifications of the instruments.

Study field work:

The current study was carried out on four phases:

1) Preparatory phase:

An extensive review related to the study area was done including electronic dissertations, available books, articles and periodicals. A review of literature to formulate knowledge base relevant to the study area was also done. A written permission from the institutional authority of the two MCH centers was obtained before conducting the study. The researcher was constructed and prepared of the different data collection tools, in addition to seeking managerial arrangement to carry out the study.

2) Interviewing phase:

The researcher collected the data from the women of the two groups through an interview and assessment.

3) Implementation phase (for study group):

Started immediately after assessment (pre-intervention) each woman in the group was received instructions about exercise and weight gain during pregnancy.

Exercise Instruction: Physical activity PA advice focused on the benefits of exercise in pregnancy, potential safety concerns relating to exercise during pregnancy, tips to increase incidental activity and walking. participants were given health education for 6 sessions about physical activities (walking for 30-60 minutes per day five days a week and being physically active along the day) Regarding physical activity, the aim was to achieve a minimum of 150 min of moderate-intensity physical activity and adherence to physical activities was measured using design sheet given to participants to record days and total number of minutes in which recommended walking exercise achieved. Each participant was scheduled for a minimum of six follow up sessions for three consecutive months (follow up every 2 weeks); follow up were undertaken through participant interview or by telephone calling as available. Each session takes about 20- 30 minutes; number of session was differing according to the participant needs. Participants were receiving verbal instructions supplemented by written material that is supported by pictures as an illustrative guide for more clarification to participants.

4) Evaluation phase:

In this phase, all women recruited in the study were evaluated for the change in physical activity post intervention, maternal outcomes during pregnancy, labor and postpartum ,GWG ,screening for GDM at week 24-28 using 75 g OGTT as well as neonatal outcomes The researcher was received the data throughout pregnancy period ,labor and early

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postpartum by interviewing participants each antenatal visit and telephone contact, mail or through whatsapp for some participants who couldn't attend to assess the effectiveness of the intervention. Regarding labor and post patum I attend only, 60% of cases, and remaining were followed by telephone or net. The Final Visit (post- intervention)

The subjects were taught to monitor body weight at each antenatal visits as recorded in the antenatal follow up card. The accepted gestational weight gain as recommended is 0.5 kg per month for the first 5 months of pregnancy and 0.5 kg per week for remaining pregnancy period. Adherence to The Institute of Medicine IOM guidelines were those subjects who complied with the recommended total gestational weight gain.

Total GWG calculated at end of pregnancy by subtract last gestational weight from pre pregnancy weight then classified to each case according to BMI to average weight gain, excessive gestational weight gain and insufficient weight gain.

Statistical Analysis:

Data analysis

The collected data were scored, tabulated and analyzed using (SPSS) version 22. Descriptive as well as nonparametric statistics were utilized to analyze the data pertinent to the study. The level of significance was set at $p < 0.05$. Chi square test, Independent sample t-test, Fischer exact test (FE), Mean and Mann-Whitney test (nonparametric test) were used to analyze the data.

3. RESULTS

Table (1): Socio-demographic characteristics of the studied Groups (N =100)

Socio-demographic I. Characteristics:	Case (n=50)		Control (n=50)		X^2	P –value
	No	%	No	%		
Age group						
18-24 years	20	40.0%	21	42.0%	2.16$^{(NS)}$	.70
25-29years	17	34.0%	14	28.0%		
30-34years	10	20.0%	8	16.0%		
35-40years	2	4.0%	5	10.0%		
more than 40	1	2.0%	2	4.0%		
Age						
Mean ± SD	26.76 ±*6.11*		26.88 ±*5.12*		0.261$^{(NS)}$	.74
Level of education						
Read and write	2	4.0%	1	2.0%	.63$^{(NS)}$	.89
Basic education	3	6.0%	2	4.0%		
Secondary education	20	40.0%	22	44.0%		
University	25	50.0%	25	50.0%		
Occupation						
Working	20	40.0%	17	34.0%	.39$^{(NS)}$	.53
Housewife	30	60.0%	33	66.0%		
Income						
Enough	37	74.0%	35	70.0%	1.09 $^{(NS)}$	.58
Not enough	13	26.0%	14	28.0%		
Enough and increase	0	0.0%	1	2.0%		
Place of residence						
Urban	46	92.0%	42	84.0%	1.51 $^{(NS)}$	.22
Rural	4	8.0%	8	16.0%		

Table (1) shows the socio-demographic characteristics of the studied groups. The mean age of participants was (26.88 ±5.12). Concerning the education level of the participants in the study samples 50% were university graduates and the majority of participants, about 60% were housewives. As regard to the monthly income of participants 70%, 74% of participants in control and study group respectively were enough; the majority of the sample was urban residence. There was no statistically significant different between two groups regarding socio-demographic characteristics which indicate homogeneity between two groups (p > 0.01).

Table (2): Distribution of Risk factors of gestational diabetes for the studied women in the study and control groups

Characteristics:	Case (n=50)		Control (n=50)		X^2	P -value
	No	%	No	%		
Risk for gestational diabetes						
Body mass index BMI >25 kg/m	9	18.0%	7	14.0%	$2.21^{(NS)}$	.95
Glucose intolerance in any earlier pregnancy	1	2.0%	1	2.0%		
Newborn's macrosomia (>4g) in any earlier pregnancy.	1	2.0%	1	2.0%		
Family history of diabetes(at first and second degree relatives)	9	18.0%	12	24.0%		
(BMI >25 kg/m & Family history of diabetes).	26	52.0%	22	44.0%		
Multiple factors	5	10.0%	8	16.0%		

Table (2) shows that the majority of study participants regarding risk factors of gestational diabetes have (family history of diabetes mellitus and their body mass index BMI was >25 kg/m) 44%, 52% in control and study groups respectively. Family history of diabetes mellitus only 24%, 18% in control and study groups respectively. Multiple factors represents16%, 10% in control and study groups respectively.

Table (3): Distribution of anthropometric measurements for the studied women in the study and control groups.

anthropometric measurements	Case (n=50)		Control (n=50)		X^2	P -value
	No	%	No	%		
Pre-Pregnancy weight kg	74.94 ± 12.74		77.87 ± 16.12		1.008^{ns}	.316
Height cm	160.12 ± 5.36		159.68 ± 4.62		$.44^{ns}$	.661
BMI classification						
Under weight (BMI < 18.5)	1	2.0%	1	2.0%	5.156	.161
Normal Weight (BMI : 18.5 – 24.9)	7	14.0%	10	20.0%		
Over Weight (BMI : 25 – 29.9)	25	50.0%	14	28.0%		
Obese (BMI > 30)	17	34.0%	25	50.0%		
Body mass index BMI *Mean ± SD*	29.19 ± 5.11		30.30 ± 5.74		t-test 1.03^{ns}	.306

Table (3): shows the anthropometric measurements for the studied women, the mean body mass index BMI (pre-pregnancy) was 29.19 ± 5.11, 30.30 ± 5.74 in study and control group respectively.

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Table (4) Physical inactivity of the sample (regarding to No of Hours spend without movement along the day Pre and Post Intervention).

Items	Case		Control		t2test	t3test
	Pre *Mean ± SD*	Post *Mean ± SD*	Pre *Mean ± SD*	P –value2	P –value2	P – value3
Numbers of hours watching TV daily	2.16 ± .82	1.13 ± .47	1.94 ± .88	1.82 ± .80	-1.366$^{(ns)}$ .175	6.25** .000
$t_1$test	14.30**		1.09^{ns}			
P –value	.000		.276			
Numbers of hours sitting in front of net	2.09 ± .69	1.05 ± .41	1.78 ± .61	1.72 ± .68	-2.389-* .019	6.16** .000
$t_1$test	15.08**		1.19^{ns}			
P –value	.000		.266			
Numbers of hours of sedentary work	2.85 ± 1.39	1.55 ± 0.89	2.65 ± 1.11	2.71 ± 1.06	-.505-$^{(ns)}$ .616	3.47* .001
$t_1$test	7.38**		-1.23^{ns}			
P –value	.000		.248			

NB:t1: comparison between pre and post intervention within each group.

t2: comparison between case and control on pre interventions.

t3: comparison between case and control on post interventions.

Table (4) shows that there was no statistically significant difference in numbers of hours for watching TV, numbers of hours spent in working without movement and Hours on computer by mean (2.16, 1.94),(2.09, 1.78),(2.85, 2.65) pre intervention in study and control group respectively but there was highly statistically significant difference post intervention.

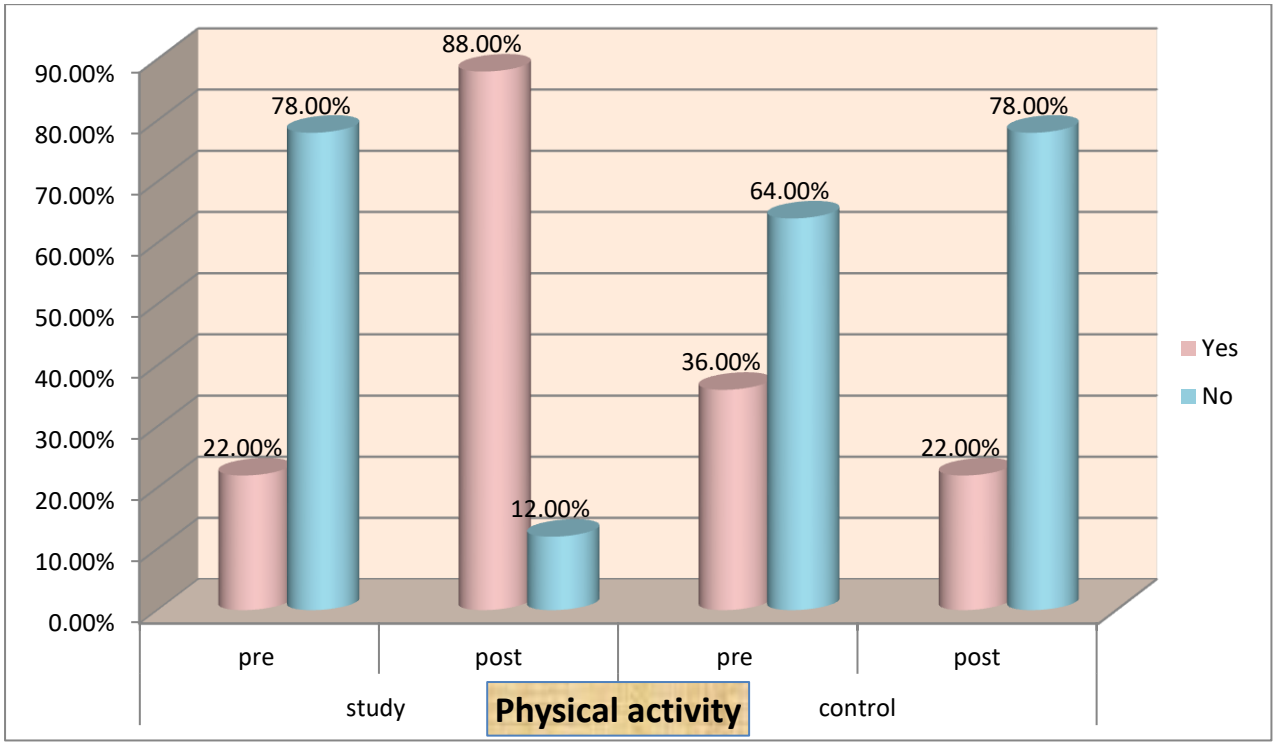

Figure (1): Percentage Distribution of physical activity in studied women in study and control group pre and post intervention.

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Figure (1): shows that there was a difference in physical activity pre and Post Intervention in study group.

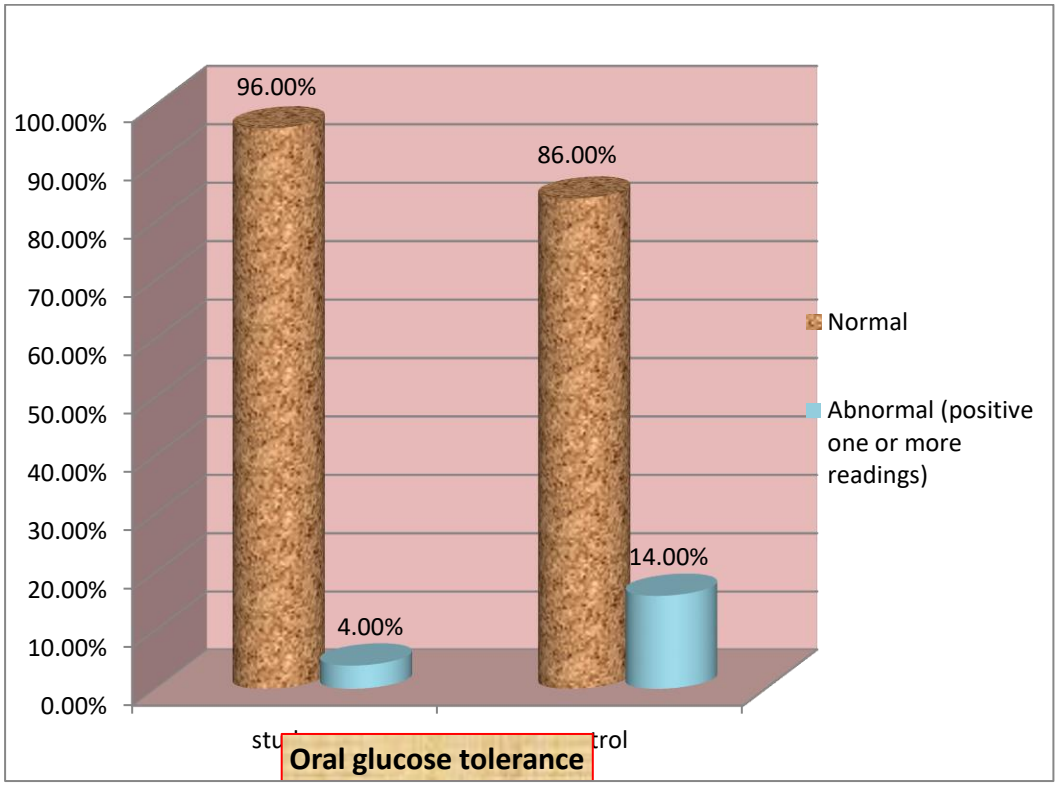

Figure (2): Percentage Distribution of oral glucose tolerance test

Figure (2): shows that there was a statistically significance differences between two groups regarding oral glucose tolerance test (with higher incidence of oral glucose intolerance in control group 14%).

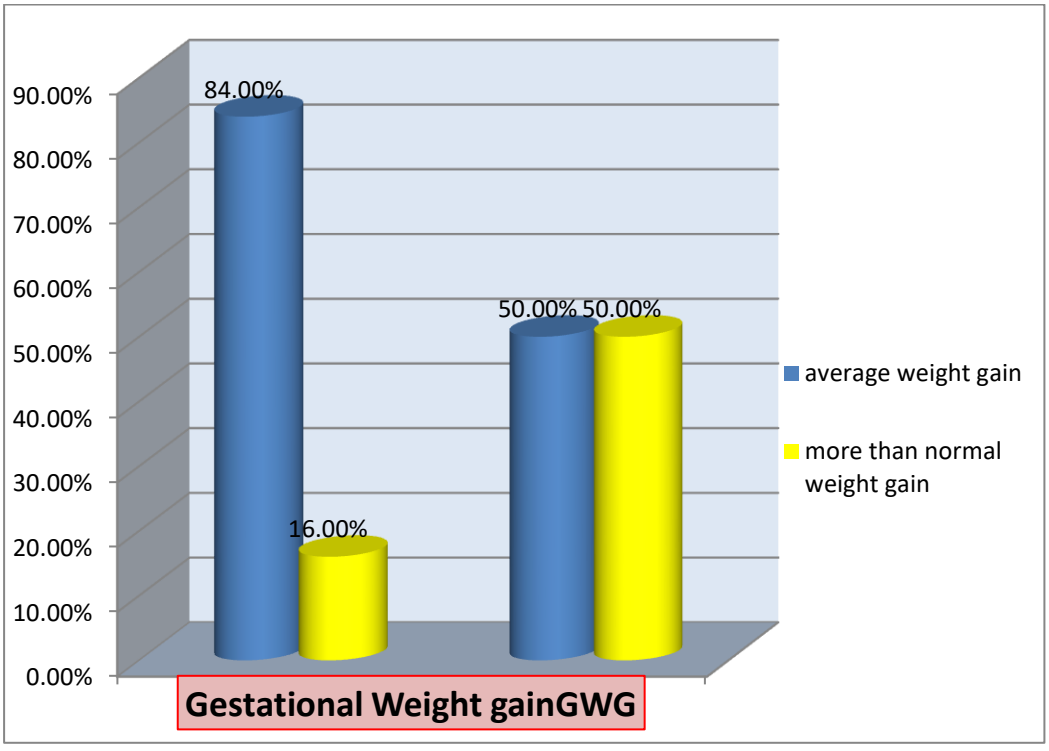

Figure (3): Percentage Distribution of gestational weight gain GWG in studied women in study and control group.

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Figure (3) showed that there was a statistically significant difference in gestational weight gain between two groups, 50% of control group assume excess gestational weight gain but, majority of study group84.0% assume average (normal) gestational weight gain. Study group has significantly lesser total gestational weight gain in intervention as compared to control groups.

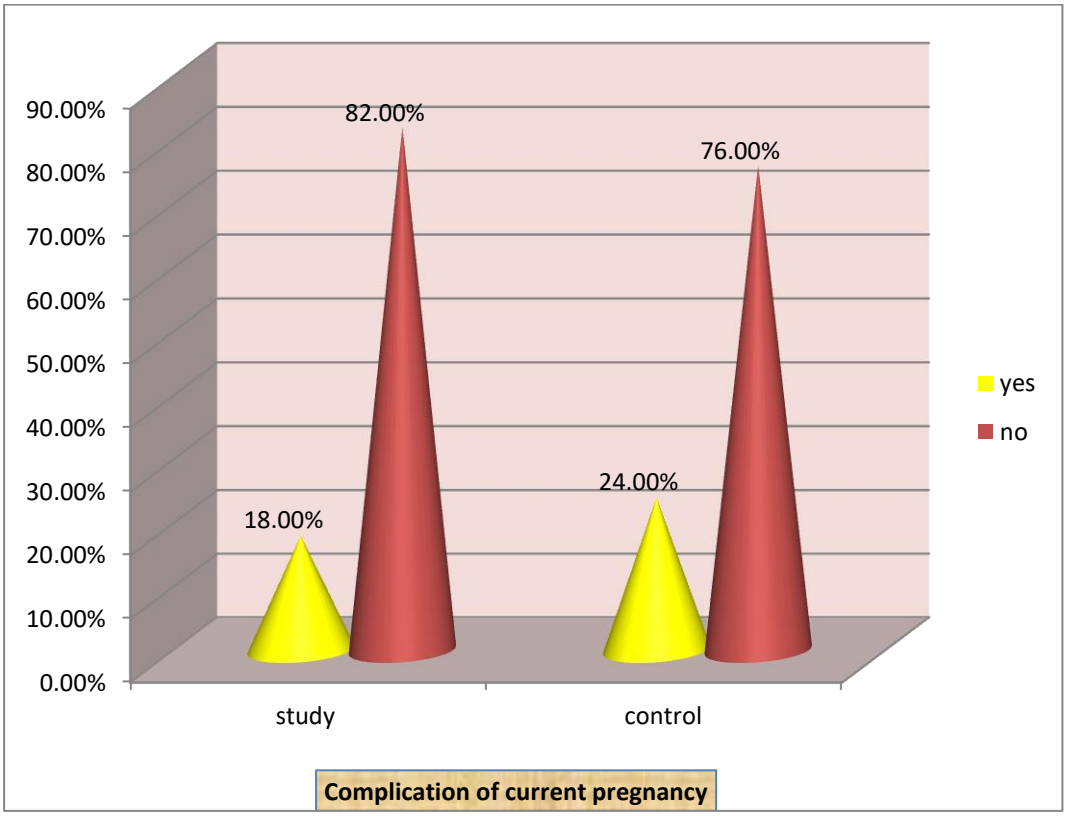

Figure (4): Percentage Distribution of current pregnancy complications.

Figure (4): shows that there was statistically significant difference regarding complications of current pregnancy between two groups with higher incidence in control group24%. The percentage of gestational diabetes was 14% in control group and 4% in study group. Other complications like gestational hypertension and preeclampsia occur in 2% of control group only, preterm labor occur 10% in control group and only 2% in study group.

Table (5): Distribution of fetal and neonatal outcomes in the study and control groups

Items	Case (n=50)		Control (n=50)		X^2	P -value
	No	%	No	%		
Fetal Heart Rate					.543(NS)	.461
Normal	47	94.0%	45	90.0%		
Abnormal	3	6.0%	5	10.0%		
Fetus or neonatal complication						
No					3.05 (NS)	.08
Yes	48	96.0%	43	86.0%		
	2	4.0%	7	14.0%		
Neonate weight					2.307(NS)	.315
< 2500	0	0%	2	4.0%		
2500-4000	49	98.0%	44	88.0%		
>4000	1	2.0%	4	8.0%		
Neonate weight (gm) *Mean ± SD*	3106.0 ± 18.65		3227.0 ± 19.14		t-test 1.28(NS)	.203

Apgar score at 1min						
Normal	40	80.0%	31	62.0%	3.42$^{(NS)}$	.18
Moderate risk	6	12.0%	11	22.0%		
High risk	4	8.0%	8	16.0 %		
Apgar score at 5 min						
Normal	44	88.0%	38	76.0%	1.91$^{(NS)}$	.39
Moderate risk	5	10.0%	9	18.0%		
High risk	1	2.0%	3	6.0%		
Need for resuscitation						
No	49	98.0%	46	93.9%	1.09$^{(NS)}$	.30
Yes	1	2.0%	3	6.1%		
Need for ICU						
No	50	100%	49	98.0%	1.01 $^{(NS)}$	.32
Yes	0	0.0%	1	2.0%		
Congenital defects						
No	50	100%	48	96.0%	2.08 $^{(NS)}$	.156
Yes	0	0.0%	2	4.0%		
If yes, congenital defects						
Hypospadias	0	0.0%	1	50.0%		
Congenital hydrocele	0	0.0%	1	50.0%	3.04 $^{(NS)}$	.196
Stillbirth						
No	50	100%	49	98.0%	1.01 $^{(NS)}$	.32
Yes	0	0.0%	1	2.0%		

Table (5): shows that there was no statistically significance differences regarding fetal and neonatal complications post intervention between two groups, mean neonatal weight was (3106.0 ± 18.65gm), (3227.0 ± 19.14gm) in study and control group respectively. Percentage of neonatal underweight < 2500gm was 4% and macrosomia of newborn >4000gm was 8% in control group. Neonatal complications were 14% in control group. Congenital defects occur 4% in control group (2% hypospadias, and 2% congenital hydrocele).stillbirth was 2% in control group.

Table (6): Correlation between Physical activity and pregnancy outcomes

Items	**Physical activity**			
	Study group		***Control group***	
	R	***P -value***	***r***	***P -value***
gestational weight gain kg	-.030-	.838	-.015-	.920
Complication during labor	-.476**	.001	.167	.247
Complication during postpartum	-.418-**	.003	-.069-	.633
Complication of current pregnancy	-.359*	.010	.066	.647

Table (6) displays the correlations between Physical activity and pregnancy outcomes. The results showed strong negative correlation between Physical activity and poor pregnancy outcomes .As the physical activity increase ,the gestational weight gain, complications during pregnancy, labor and postpartum decrease(r=-.030-,-.359, -.476, -.418) respectively.

4. DISCUSSION

The findings of the current study revealed that the research hypothesis was supported. Regarding physical activity there was highly statistically significant difference in numbers of hours for watching TV, numbers of hours spent in working without movement and Hours on computer in study group. Thus mother decrease sedentary life and become physically active, there was also, highly statistically significant difference in performing physical activity (walking) in study group pre and post intervention.

Our study findings supports importance of regular physical activity during pregnancy this also concurred with the RCT published by Price et al (2012), 20 inactive women were randomized at 12 to 14 weeks' gestation to a group that remained sedentary or to a group that performed aerobic exercise (45- to 60-minute duration, performed 4 times per week, at moderate intensity). Gestational diabetes mellitus was slightly less common among the active group 9.6% vs 12.9% in controls.

Gestational weight gain as outcome improved by physical exercise ,this is our study assumption, which comes in congruent with a study by **LesserKB et al., (2014)** that examine whether Diet or exercise, or both, for reduced the risk of excessive GWG on average by 20% overall. Interventions involving low glycaemic load diets, supervised or unsupervised exercise only, or diet and exercise combined all led to similar reductions in the number of women gaining excessive weight in pregnancy.

A study done by the Harvard School of Public Health Diabetes **(Health Canada, 2011)** showed that, following regular exercise and an improved diet that's low in fat and high in fiber significantly helped with type II Diabetes Mellitus prevention, and gestational diabetes mellitus reduction.

Also, similar to study in Madrid, Spain by **Barakat et al,(2012)** The influence of an exercise programme performed by healthy pregnant women on maternal glucose tolerance found that Significant differences were found between study groups . A moderate physical activity PA programme performed during pregnancy improves levels of maternal glucose tolerance.

This finding is harmonious with study by **BaS et al., (2014)** Sao Paulo, Brazil who informed that an adequate glycaemic control of pregnant women with GDM by means of a resistance exercise programme. They reported that a significant reduction in the number of patients who required insulin was observed in the study group compared with the control group. The finding is also supported by **Dempsey et al., (2010)** in Swedish Medical Center, Seattle, WA, USA. a study of 155 GDM cases and 386 normotensive, non-diabetic pregnant controls found that recreational PA performed before and/or during pregnancy is associated with a reduced risk of GDM. Had reduction in risk of 55 and 48%, respectively.

In addition, these findings were supported by A meta-analysis of 9 RCTs that included 2059 women with an uncomplicated, singleton pregnancy with normal body mass index showed that women who were assigned randomly to aerobic exercise had similar incidence of preterm birth PTB, 49% lower incidences of GDM, 79% lower incidence of gestational hypertension GHTN disorders, 18% lower incidence of cesarean delivery, and a 9% higher rate of vaginal delivery. **(Rosenberg L,,et al., 2016).**

Moreover, A recent metaanalysis that focused, as in **(Tommaso M,,et al., and Wang et al, 2017)** on overweight or obese women included 9 RCTs and 1502 women and showed benefits of exercise in terms of a 38% lower rate of PTB and 39% lower rate of GDM.

Physical activity affects energy expenditure and therefore directly affects glucose utilization. Physical activity enhances glucose uptake through translocation of the glucose transporter type 4 (GLUT-4) on skeletal muscle **Kennedy (1999)**. Insulin sensitivity is increased with physical activity, with effects continuing after exercise is ceased **(Perseghin 1996)**. Increased muscle mass as a result of physical activity is likely to further improve glucose tolerance and increase insulin sensitivity **(Yki-Jarvinen 2013)**.

In a prospective cohort study of approximately 1000 women, also conducted in the state of Washington, investigators observed similar reductions in GDM risk associated with physical activity before and during pregnancy. Compared with inactive women, experienced a 76% decrease in GDM risk **(Sorensen, T.K. eta al., 2014).** Furthermore, those who expended 21.1 MET-hours per week or more (the equivalent of 5.3 h·wk_1 of moderate-intensity exercise such as brisk walking) experienced a 74% reduction, compared with inactive women. Thus it appears that approximately30 min·d_1 of moderate-intensity physical activity performed during pregnancy may be sufficient to decrease the risk of GDM

In contrast with our findings **Oostdam N1, et al., (2012) and Ong et al. (2009)** investigated the effect of a supervised 10-week, home-based, exercise programme, beginning at week 18 of gestation, on glucose tolerance and aerobic fitness in 12 previously sedentary obese women. There were no statistically significant differences in blood glucose levels at 1 h and 2 h of the post-intervention oral glucose tolerance test in the control arm as compared with the exercise arm. **Callaway et al. (2010**) randomized 50 obese women to an individualized exercise programme with an energy expenditure goal of 900 kcal per week (n = 25) or to routine care (n = 25). While insulin resistance did not differ between the groups, 73% of women in the lifestyle intervention group achieved > 900 kcal/week of exercise-based physical activity at 28 weeks compared with 42% of women in the control arm. Finally **Oostdam et al. (2012)** randomized 121 overweight women to an exercise intervention (n = 62) or to a control arm (n = 59). They found that the exercise programme did not reduce maternal fasting blood glucose levels, insulin sensitivity or birth weight .This may be explained that intervention in these

study had started too late at week 18 gestation which was not enough to produce positive outcomes but only change physical activity.

In the present study, there was a statistically significant difference in gestational weight gain between two groups, 50% of control group assume excessive gestational weight gain but, majority of study group 84.0% assume average (normal) gestational weight gain. Study group has significantly lesser total gestational weight gain in intervention as compared to control groups.

It comes in congruent with a study by **Lawrie TA et al., (2015)** that examine whether Diet or exercise, or both, for preventing excessive weight gain in pregnancy. Cochrane Database of Systematic Reviews It was found that Women receiving diet or exercise, or both interventions were more likely to experience low GWG than those in control groups .

In addition, Metaanalyses of RCTs of exercise to prevent or treat GDM have reported mixed results **Hans S, et al., (2012)** and **Sanabria-Martínez G et al., (2015)**; in the current RCT, an important feature appears to be the early institution of regular exercise at the beginning of the second trimester. The exercising group gained significantly less weight than the control group during the second trimester (4.1 vs 5.9 kg). **(Wang C, et al., 2015)** the third trimester weight gain in the 2 groups was so similar (4.6 kg in each group) that this explanation may not be adequate to explain the phenomenon. The finding that reductions in weight gain compared with control group were limited to the second trimester supports the role of early institution of the intervention.

In contrast to our findings, a study by **Katriina Oet al., (2013)** in Finland showed no significant differences between the groups in total gestational weight gain, macrosomia, was discovered. This finding may also be due to the fact that power calculations were based on the main outcome incidence of GDM.

The present study found that the mean duration of current pregnancy(gestational age at birth) was 39.22± .95, 38.98 ± 1.22 in study and control group respectively , mean neonatal weight was (3106.0 ± 18.65gm), (3227.0 ± 19.14gm) in study and control group respectively. Percentage of neonatal underweight < 2500gm was 4% and macrosomia of newborn >4000gm was 8% in control group. Neonatal complications were 14% in control group. Congenital defects occur 4% in control group (2% hypospadias, and 2% congenital hydrocele).stillbirth was 2% in control group.

The findings of the present study were similar to study by **Lamberg S. et al. , (2011)** in USA among the newborns, gestational age at delivery was similar in both groups (39.461.9 wk versus 39.661.3 wk). The average newborns' birthweight was lower in the intervention group than in the usual care group (3,532 g versus 3,659 g) .There was no statistically significant differences between the groups in the proportion of macrosomic infants. Since there were only four infants with low birthweight (< 2.500 g).

The correlations between Physical activity and pregnancy outcomes. The results showed strong negative correlation between Physical activity and poor pregnancy outcomes .As the physical activity increase ,the gestational weight gain, complications during pregnancy, labor and postpartum decrease(r=-.030-,-.359, -.476, -.418) respectively.

This comes in agreement with **Clapp JF et al., (2009), Adamu B, et al (2016)** who reported that exercise during pregnancy is considered beneficial, improving maternal wellbeing and cardiovascular performance. More specifically, exercise in pregnancy has been associated with a reduction in the risk of gestational diabetes **(Dempsey JC et al., 2014, Oken E, et al. 2012)**, pre-eclampsia **(Sorensen TK,et al., 2010)** and operative birth **(Metzger BE, et al., 2010)**, and with improvements in fetal growth **(Kim H, et al., 2011).**

It is similar to what reported by the American College of Obstetricians and Gynecologists (ACOG) has advocated that all pregnant women, without contraindications to exercising, should be active and participate in mild-to-moderate exercise for at least 30 minutes on most days of the week American College of Obstetricians and Gynecologists **ACOG (2016)**. ACOG recommend that pregnant women who are overweight or obese should be encouraged to follow an exercise programme in order to optimize health outcomes for both the woman and her infant.

This is in agreement with a study results which reported that physical activity and exercise during early pregnancy were associated with a reduced risk of GDM. Women who regularly exercise throughout pregnancy present better glycemic control, with improved maternal and fetal outcomes of GDM **(Jovanovic-Peterson L 2015, Clapp JF. 2015).**

In addition**, Liu. X et al., (2011)** who study impact of diet and physical activity on plasma glucose metabolism, insulin sensitivity and pancreatic β-cell function in Hispanic women revealed that exercise showed statistically significant positive influences on glucose metabolism, insulin sensitivity and β-cell function. Such observation is of great public health advisory importance.

5. CONCLUSION

According to the findings of the present study, it can be concluded that there was a highly statistically significant difference after physical exercise intervention in early pregnancy on reducing gestational weight gain, gestational diabetes mellitus, complications of current pregnancy, labor and postpartum this supported the study hypotheses. Based on the present findings; the study hypotheses were accepted.

6. RECOMMENDATIONS

In light of the study findings, the following recommendations are proposed:

Prepare programs about the importance of maintaining healthy body weight through following regular physical exercise and being active all the time to all women before and during early pregnancy to assume healthy pregnancy and fetus and make these programs free and available for public.

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