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Effect of Lifestyle counselling on Pregnancy Outcomes among Women at High risk for Gestational Diabetes Mellitus

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Abstract: **Gestational diabetes mellitus GDM represents a growing health concern, it is linked to short term and long term adverse health outcomes in women and their offspring. Purpose: The purpose of the current study was to investigate the effect of lifestyle counseling on 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 received lifestyle counselling during 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: Life style assessment sheet III: Laboratory Investigations sheet, Semi structured questionnaire for assessing maternal and neonatal outcomes. Results: There was statistically significant reduction in complications of current pregnancy, labor and postpartum in study group than in control group. Conclusion: life style counselling during pregnancy for women at high risk for gestational diabetes was effective in reduce risk of gestational diabetes mellitus, complications, improve obstetric and neonatal outcomes. Recommendation: Using programs about the lifestyle modification intervention among high risk women as a routine antenatal care for all high risk cases.**

Keywords: **lifestyle counselling, women at high risk for gestational diabetes, maternal and neonatal outcomes.**

Operational Definitions: lifestyle counselling is the provision of professional assistance and guidance to women at high risk for gestational diabetes mellitus regarding lifestyle modification including regular physical activity, healthy diet, and healthy weight gain during pregnancy.

1. INTRODUCTION

Gestational diabetes mellitus(GDM) is one of the most common medical disorders found in pregnancy. It affects between 2-14% of pregnancy worldwide. The prevalence of GDM ultimately reflects the background rate of type 2 diabetes. There has also been an increase in the rate of GDM over the last generation, possibly related to community lifestyle factors as well as better case ascertainment (Kirke,et al.2014).

It is associated with short and long term morbidity in both mother and child. Adverse infant outcomes include macrosomia, hypocalcemia, erythemia, hypoglycemia, jaundice, and birth trauma (American Diabetes Association 2016).

Major risk factors for GDM include older age in pregnancy, a family history of diabetes, pre-pregnancy overweight, previous GDM and race or ethnicity. Modifiable factors include excess adiposity, physical activity, and diet . Dietary components associated with GDM risk include macro-nutrients, micronutrients, and individual foods, such as refined carbohydrates, saturated and transfats, heme iron, and processed meats (Zhang et al., 2011).

Evidences have suggested that both diet and physical activity altered the increase in insulin resistance especially during mid and late pregnancy (Clapp, J.F. 2016). Therefore, behavioral interventions were important to promote pregnant women practicing healthy diet in order to prevent subsequent obesity and GDM (Siega-Riz, A.M.,et al 2014). Saldana et al. found that there is significant asssociation between high saturated fat diet intake and glucose intolerance in pregnant women (Saldana, T.M., et al 2013). While taking high fiber diet will have protective effect in preventing GDM incidence (Davenport, M.H., et al 2008).

Significance of the study:

Based on review of the available research and clinical practice, GDM represents a growing health concern; multiple population based studies have shown increases in the occurrence of gestational diabetes in the past decade. Gestational diabetes affects 2-14% of pregnancies (Schneider, Clara, and LDN. 2014) It is linked to short and long term adverse health outcomes in women (like gestational hypertension, increase rate of cesarean section and pre-eclampsia during pregnancy and an exceptionally high risk for type 2 diabetes after pregnancy) and their offspring born macrosomic and have birth defects (Yin Y., et al. 2014).

Prevention of gestational diabetes could be an important strategy in curbing the diabetes epidemic in this generations and future one. Therefore, it is a pivotal to identify potentially risk factors. Several potentially modifiable factors have been related to a lower risk of gestational diabetes mellitus include maintaining a healthy body weight, adapting a healthy diet, and regular physical activity (Hillier, T.et al. 2008). Early detection of risk factors and provide appropriate program to decrease this risk through diet and exercise modification will help people at high risk to reduce their risk of getting gestational diabetes. Thus the researcher find it is important to evaluate potential benefits of providing lifestyle counselling for women at high risk for gestational diabetes mellitus on pregnancy outcomes.

Purpose of the Study:

The study purposed to investigate the effect of lifestyle counselling on pregnancy outcomes among women at high risk for gestational diabetes mellitus.

Research Hypotheses:

1- Lifestyle counselling of women at high risk for gestational diabetes mellitus will maintain normal glucose tolerance test and normal gestational weight gain than control group.

2- Lifestyle counselling of women at high risk for gestational diabetes mellitus will reduce risks of maternal, fetal and neonatal complications than control group.

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.

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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: Life style assessment sheet (pre and post)

Part I Nutritional assessment. Data about patient's dietary intake and habits collected using the 24 Hours Dietary Recall for three days including Friday. It used to analyze the nutritional values of consumed food to know the amount of total calories per day (National Nutrient Database for Standard Reference, 2000). Women were asked to record all foods and drink for a 24 hour period for 3 days including Friday. The number of total calories eaten was identified by nutritional specialist at nutritional database. A coefficient alpha reliability of 0.92 in the sample, measured of peoples 24 hours dietary recall was reported (Kruger, 2010).

Part II Physical activity assessment :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, Menoufia University was obtained.

Ethical Consideration:

An approval of the committee of the research committee in the faculty of nursing, Menoufia University was obtained on 9/12/2014. 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 (10women) 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 lifestyle counseling about diet, exercise and weight gain during pregnancy.

Dietary Education: Participants were given health education about important of healthy diet for mother and her fetus. The diet should be (good balanced diet)that included calories (30-35 Cal/kg/BW/day) It divided as 3 meals and two snakes .The aim that the mother doesn't exceed 2500 kcals per day. Carbohydrates should represent 60% from total calories (375 gm), Protein 20% from total calories (125 gm) and Fat 30% from total calories (83 gm). Participants were encouraged to move toward the following Dietary Recommendations during Pregnancy to gain the recommended weight for body mass index (BMI) by: (Barger, 2010; Source: Food and Nutrition Board, IOM, 2011).

-Three meals a day and two snacks to avoid prolonged periods of fasting

-Intake fruits and vegetables (two to five times per day) and monounsaturated fats with adequate protein.

-Intake fiber-rich carbohydrates and limit carbohydrates with a high glycemic index (i.e. fruit juices and sodas) encourage whole grains, whole-wheat breads and cereals, legumes.

-At least two servings of omega-3 rich fish a week or consume omega 3 supplements.

Ensure adequate intake of the following vitamins and minerals:

-Vitamin A (530-550 µg/d) as beta-carotene and limit food sources of preformed vitamin A, such as liver or cod liver oil.

-Vitamin D from sunshine exposure; if not feasible, supplement with vitamin D3 (1000-4000 IU/d depending on BMI and skin type).

-Women who are vegan need vitamin B12 supplements (2.2 µg/d).

-Iodine (160 µg/d) through diet or a multivitamin.

-Iron (27 mg/d) through diet, multivitamin, or additional low-dose supplement if anemic.

-Calcium (1000 mg/d) through diet with higher levels suggested for women at risk for preeclampsia.

Avoid foodborne illnesses that can cause maternal or fetal disease by eating:

-Well-cooked meat, poultry (including eggs) and fish.

-Only pasteurized dairy and fruit juices.

-Avoid soft cheeses, processed meats, and raw sprouts.

Avoid unhealthy diet by

- Take low-fat meat and low-fat dairy and to reduce the intake of sugar-rich foods

-Avoid fast food, soda and reduce caffeine..

Consider motivators and barriers to healthy eating

Themes of Motivators & Barriers to Healthy Eating (Reyes et al., 2013):

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.

Healthy weight gain (GWG)

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.

4) Evaluation phase:

In this phase, all women recruited in the study were evaluated for the change in dietary habits, and 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 postpartum by interviewing participants each antenatal visit and telephone contact, mail or through whatsapp for

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some participants who couldn't attend to assess the effectiveness of the intervention. Regarding labor and postpatum I attend only, 60% of cases, and remaining were followed by telephone or net. The Final Visit (post- intervention)

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).

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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 duration of pregnancy and its complications for the studied women in the study and control groups

Items	Case (n=50)		Control (n=50)		X^2	P -value
	No	%	No	%		
Duration of current pregnancy per week					4.819 ns	.438
36.00	0	0.0%	3	6.0%		
37.00	1	2.0%	2	4.0%		
38.00	10	20.0%	10	20.0%		
39.00	21	42.0%	16	32.0%		
40.00	13	26.0%	16	32.0%		
41.00	5	10.0%	3	6.0%		
Mean ± SD	39.22± .95		38.98 ± 1.22		t-test 1.09 ns	.276
Complication of current pregnancy					.542 ns	.461
Yes	9	18.0%	12	24.0%		
No	41	82.0%	38	76.0%		
If yes complications					12.606 s	.022
gestational diabetes	0	0.0%	5	41.7%		
gestational hypertension	0	0.0%	1	8.3%		
Preeclamsia	0	0.0%	1	8.3%		
gestational diabetes and gestational hypertension	0	0.0%	1	8.3%		
edema and proteinuria	0	0.0%	1	8.3%		
gestational diabetes and preeclamsia	1	11.1%	1	8.3%		
Proteinuria	7	77.8%	2	16.7%		
gestational diabetes and proteinuria	1	11.1%	0	0.0%		

Table (3): shows that the mean duration of current pregnancy was 39.22± .95, 38.98 ± 1.22 in study and control group respectively. 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.

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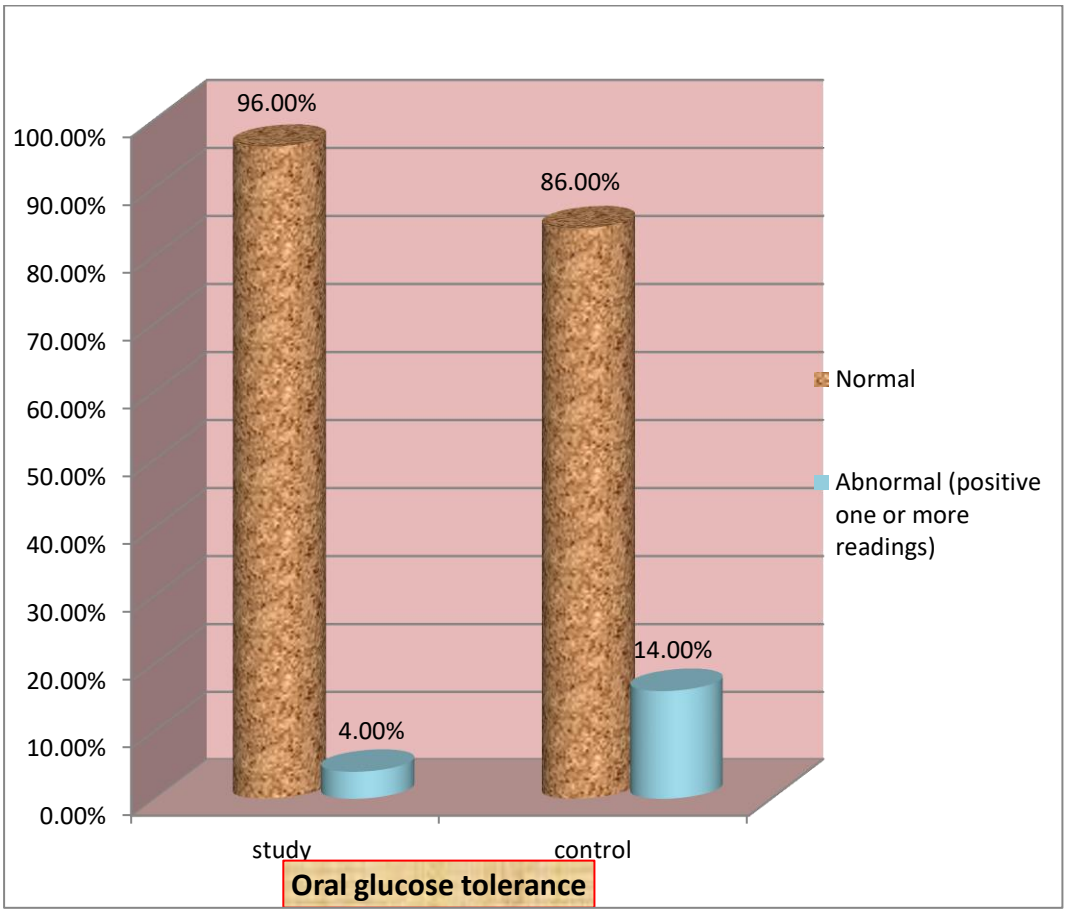

Figure (1): Percentage Distribution of oral glucose tolerance test

Figure (1): 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%).

Table (4): Distribution of labor and postpartum complications outcomes for the studied women in the study and control groups

Items	Case (n=50)		Control (n=50)		X^2	P -value
	No	%	No	%		
Complication during labor						
No	49	98.0%	40	80.0%	8.27 (S)	.004
Yes	1	2.0%	10	20.0%		
If yes labor complication						
Excessive blood loss	0	0.0%	2	20.0%	4.92 (S)	.029
Use of forceps or ventose	0	0.0%	1	10.0%		
Preterm labor	1	100.0%	5	50.0%		
Failure to progress normal labor	0	0.0%	2	20.0%		
Mode of delivery					5.11(S)	.018
spontaneous vaginal delivery	14	28.0%	7	14.0%		
Forceps	0	0.0%	2	4.0%		
elective cesarean section	33	66.0%	32	64.0%		
Emergency cesarean section	2	4.0%	6	12.0%		
elective CS after previous 2 normal	0	0.0%	2	4.0%		
Emergency CS after previous normal delivery	1	2.0%	1	2.0%		

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Complication during postpartum						
No					9.76 (S)	.002
Yes	47	94.0%	35	70.0%		
	3	6.0%	15	30.0%		
If yes						
wound infection and delayed wound healing	2	66.7%	3	20.0%	7.36 (S)	.004
delayed wound healing						
low breast feeding initiation and	1	33.3%	5	33.3%		
maintenance rate	0	0.0%	6	40.0%		
postpartum hemorrhage and low breast feeding						
	0	0.0%	1	6.7%		
Perineal outcomes						
a- Perineal tear	0	0.0%	1	11.1%	.80 (NS)	.67
b- Episiotomy	3	100.0%	7	77.8%		
c- No episiotomy	0	0.0%	1	11.1%		

Table (4): shows that there was statistically significant difference regarding complications during labor and postpartum between two groups with higher incidence in control group 30%. The incidence of cesarean section was higher in control group 82%, than study group72%. Forceps delivery occur 4% in control group.

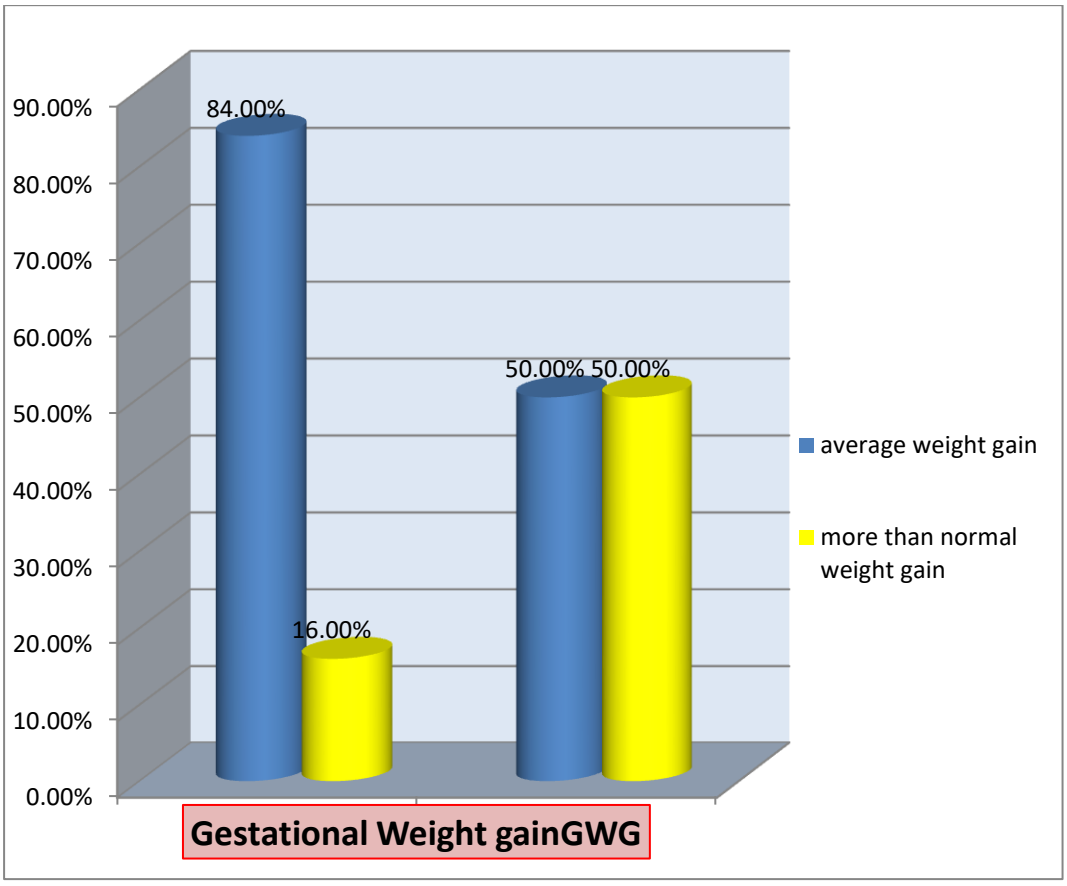

Figure (2): Percentage Distribution of gestational weight gain GWG in studied women in study and control group.

Figure (2) 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.

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Table (5): Correlation between Body mass index and outcomes

Items	Body mass index			
	Study group		*Control group*	
	R	***P -value***	***r***	***P -value***
Systolic blood pressure after 20 week	.405**	.004	.582**	.000
Diastolic blood pressure after 20 week	.237	.097	.447**	.001
gestational weight gain kg	.191	.183	.412**	.003
Complication during labor	.401**	.004	.255	.074
Complication during postpartum	.173	.228	.562**	.000
Complication of current pregnancy	.307*	.030	.125	.389

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table (5) displays the correlations between Body mass index and pregnancy outcomes. The results showed strong positive correlation between total Body mass index and poor pregnancy outcomes .As the Body mass index increase, the systolic blood pressure, diastolic blood pressure, total gestational weight gain, complications during pregnancy, labor and postpartum increase.

4. DISCUSSION

The findings of the current study revealed that the research hypotheses were supported. The present study found that the mean age of participants was (26.88 ±5.12), (26.76 ±6.11Y) in the control and study group respectively. All were mothers volunteered to participate The researcher selected this age group in reference to **Eeva Korpi-et al., (2012)** who study the effect of intensive counselling on physical activity in pregnant women at high risk for gestational diabetes mellitus in South Ostrobothnia Hospital District in Seinäjoki, Finland. This comes in agreement with a study performed by **Valkama A., et al., (2016)** in Kuopio, regarding the effect of dietary counselling on food intakes in pregnant women at risk for gestational diabetes who studied the same age group. Baseline characteristics were similar in the intervention and control groups this mean homogeneity in two groups and effective randomization.

As regard to body mass index the mean body mass index BMI (pre-pregnancy) was 29.19 ± 5.11 kg/m², 30.30 ± 5.74 kg/m² in study and control group respectively. With 84%,78% being overweight or obese (BMI ≥25 kg/m2) in study and control group. This current finding was confirmed by studies conducted by **Andersson S et al., (2016)** in Helsinki and **Saila B et al., (2016)** in South Karelia, which found 84% of participant being overweight or obese. This explain the increasing prevalence of overweight and obesity worldwide and thus increase risk of gestational diabetes mellitus and type 2 diabetes mellitus.

The present study showed that there was statistically significant difference regarding complications of current pregnancy between two groups with higher incidence in control group 24%.. The mean duration of current pregnancy was 39.22± .95, 38.98 ± 1.22 in studied and control group respectively. Also, there was statistically significant difference regarding complications during labor and postpartum between two groups with higher incidence in control group 20%, 30% respectively. The incidence of cesarean section was higher in control group 82%, than in study group72%. Forceps delivery occur 4% in control group.

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.

All literature emphasizes the importance of lifestyle counselling on both exercise and diet for pregnant women to avoid any complications during pregnancy, labor and posrpartum period, This current study finding was confirmed by **Tobias et al. (2010)** who reported in a systematic review and meta-analysis in USA that higher levels of physical activity either before or during pregnancy were associated with a significantly lower risk of developing Gestational Diabetes. It is also, supported by a recent systematic review and meta-analysis of randomized trials by **Russo et al., (2015)** that included physical activity interventions has demonstrated a modest protective effect of exercise in pregnancy in the development of

GDM. A 28% risk reduction was observed in those that participated in regular physical activity compared to the control group, all exercise interventions consisted of an aerobic component **(Callaway LK, et al., 2010**) and**(Ko CW et al., 2014)** with some combining anaerobic training in the form of strength and resistance training**(Price BB et al., 2012)** and **Barakat R, et al., (2013)**. Walking was the most common aerobic exercise used by. **Hopkins SA, et al., (2010)** and **Nobles C, et al., (2015)** these support use of walking in our study as the most common aerobic exercise.

Regarding benefits of dietary counseling our findings also, in harmony with data from a study by **Jenkins DJ, et al., (2011)**, in a euglycemic cohort, demonstrated that dietary counselling intervention in pregnancy in Toronto, Ontario, Canada reduced glucose intolerance and gestational weight gain. Similarly, multiple dietary consultations in an obese pregnancy resulted in less glucose intolerance in a small-randomized trial (n = 50). A randomized trial from Australia by **Quinlivan JA,., et al., (2011)** reported that a multidisciplinary approach incorporating a 'continuity care, regular recording of weight and diet education reinforced over multiple antenatal sessions resulted in significantly lower GDM rates in an obese population. Advice was given on inexpensive healthy food choices that could be found locally and the importance of reading food labels. Recipes for a healthy pregnancy diet.

It was also, supported by The RADIEL study from Finland by **Koivusalo SB, et al., (2015)** which was a RCT of 293 women and assessed the effect of a combined lifestyle intervention on an at risk group. They reported a GDM incidence of 13.9% in the intervention group and 21.6% in the control group.

These findings are in disagreement with a RCT of 61 women with a BMI of ≥_25 kg/m2 where Gestational Diabetes was reported as part of their secondary outcomes by **Petrella et al. (2014)** which revealed that a GDM rate of 23.3% in the control group and 57.1% in the intervention group P = 0.009. Also, these findings were not in congruence with the Dali lifestyle project by **Simmons et al. (2015)** recently published data from its pilot RCT. This study reported that women in the healthy eating group alone significantly reduced their fasting glucose. When some of these randomized trials were included in a systematic review and meta-analysis, no clear difference in GDM rates could be identified between intervention and control groups **(Bain E, et al., 2015).**

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. **(Di Mascio D,,et al., 2016).**

Moreover, A recent meta analysis 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.

We found in our study that during early pregnancy, individualized dietary, exercise and weight gain counseling has resulted in a reduced GDM rate, which is in keeping with findings from previous study by **Thornton, Smarkola, Kopacz, & Ishoof, (2010). Thornton et al.(2010)** assessed the effectiveness of active nutritional and behavioral intervention in obese pregnant women. The intervention group was placed on a balanced nutritional regimen. Participants were also encouraged to engage in 30 minutes of walking per day. The results showed that women who did not adhere to the nutritional regimen compared to those women who did adhere were more likely to have GDM. However, differences in GDM rate had not been found in trial of **Luoto et al. (2011),** which was in contrast to our finding. The trial was to examine whether individual intensified counseling on physical activity, diet and weight gain integrated into routine maternity care visits could prevent the development of GDM, but result concerning GDM was inconclusive. A possible reason for negative result concerning GDM prevention may be the risk group status of the women recruited to the trial. The study included women with at least one GDM risk factor, most women had quite low risk for developing GDM. However, overweight /obese women were chosen as study population in their study, which had a higher risk for developing GDM, helping to highlight the effect of the intervention. Another reason for negative result concerning GDM prevention might be the period from initiating the dietary counseling (16–18 wk gestation onwards) to the measurement of GDM at 26–28 wk gestation had been too short to produce changes in dietary habits and furthermore to have an effect on development of GDM. In our study, both the exercise counseling and dietary counseling were implemented at 8- 12 wk gestation, leaving a much longer time for women to change their dietary and exercise habits.

On the other hand a study by **Sagedal LR et al.,(2015)** in Norway to examine whether a lifestyle intervention in pregnancy limits gestational weight gain (GWG) and provides measurable health benefits for mother and newborn. There was no significant difference between groups in the frequency of pregnancy complications or operative deliveries. The intervention demonstrated no effect on the mean birth weight of term infants, or on the proportion of large newborns. despite a modest but significant decrease in GWG. This may be rationalized by different ethnicities group, and degree of risk factor.

Unfortunately, a study Lifestyle patterns in early pregnancy linked to gestational diabetes mellitus diagnoses by **Ruiz-Gracia T., et al., (2016)** in Spain found that, regular physical activity in early pregnancy was not associated with a decrease in GDM risk. This discrepancy could possibly be explained by the fact that this population was mainly sedentary as their researcher describe, and therefore sample size inadequate for detecting differences between the exercise and non-exercise groups.

Gestational weight gain as outcome improved by counselling ,this is our study assumption, which comes in congruent with a study by **Lumbiganon P, TA et al., (2015)** 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 Center, 2010)** 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.

This comes in agreement with what reported by **Public Health Agency of Canada (2011)** that healthy eating and physical activity have a great impact on prevention of type II Diabetes Mellitus and GDM. **Penn, White, Lindström, den Boer et al., (2013)** reported that intensive lifestyle intervention can prevent type II Diabetes Mellitus and recurrent gestational diabetes.

In contrast to our findings also, there are two therapeutic studies by **Avery MD, et al., (2012)** in University of Minnesota, School of Nursing, Minneapolis, USA and **Lesser KB et al., (2014)** in Rhode Island, USA have reported no differences in glycaemic control following exercise. In addition, **Dye et al., (2012)** in New York, USA. and **Bartollotto et al., (2010)** in two different studies did not observe any overall benefit of exercise during pregnancy on glucose tolerance ,also, **Callaway et al., (2010)** examined the feasibility of an individualized exercise programme to prevent GDM in obese pregnant women in Brisbane, Australia. They informed that the intervention was feasible and prompted a modest increase in PA. However, they are not confident that this intervention would be sufficient to prevent GDM. In the same line to our findings **Retnakaran (2012)** examined 851 Hispanic participants in Proyecto Buena Salud. who underwent a glucose challenge test and a 3-h oral glucose tolerance test in late pregnancy and gravid PA. They reported that gravid moderate/sports activity is associated with a reduced risk of glucose intolerance in pregnancy.

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.

This finding has been supported by several literature reviews, for example a study conducted in California State, San Luis USA. **Phelan S, et al., (2011)** revealed that low-intensity behavioral intervention during pregnancy reduced excessive gestational weight gains and prevented postpartum weight retention. In harmony with this study, **Ludwig S, et al., (2012)** conducted in Winnipeg, Manitoba, Canada found that lifestyle intervention during pregnancy increased physical activity, improved dietary habits and reduced EGWG in urban-living pregnant women.

On the other hand a study in Madrid, Spain by **Barakat et al, (2012)** who study the influence of an exercise programme performed by pregnant women found that no differences in maternal weight gain. A possible explanation of the study findings may be due to Interventions focus on exercise modification only and this not sufficient for decrease the incidence of Gestational Diabetes Mellitus and for decreasing the risk it must be a combination of diet and exercise modification.

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.

It is similar to a study by **Katriina Oet al., (2013)** in Finland showed no significant differences between the groups in neonatal ponderal index, macrosomia, or head circumference was discovered. This finding may also be due to the fact that power calculations were based on the main outcome incidence of GDM.

It have been previously reported that 18% relative risk reduction in infant birth weight above 4 kg following the provision of an antenatal intervention for pregnant women who are overweight or obese **Dodd JM, et al., (2014)** in Adelaide, South Australia. This observed effect on infant birth weight appears to have been mediated by changes in maternal diet quality and physical activity, despite the fact that maternal gestational weight gain.

The correlations between gestational weight gain and pregnancy outcomes. The results shows strong positive correlation between gestational weight gain and poor pregnancy outcomes .As the gestational weight gain increase, the neonatal weight, complications during pregnancy, labor and postpartum increase (r=.340, .152,.378**,.311*) respectively.

Pregnancy weight gain and outcomes for mothers and infants, it is well known from large studies in a number of countries that excessive weight gain during pregnancy is associated with multiple maternal and neonatal complications. Retrospective cohort studies have examined the relationship between gestational weight gain and adverse neonatal outcomes among infants born at term. Gestational weight gain above the upper limit of the IOM guideline has been associated with a low five-minute Apgar score, seizure, hypoglycaemia, polycythaemia, meconium aspiration syndrome and large-for-gestational age compared with women within weight gain guidelines by **Hedderson (2016) and Stotland (2017)**. For obese women, low-gestational weight gain has been shown to decrease the risk of several undesirable outcomes including pre-eclampsia, caesarean section, instrumental delivery, and large-for-gestational-age births; whereas, excessive weight gain increased the risk for caesarean delivery in all maternal BMI classes **(Cedergren 2016).**

Findings from a national study in the UK revealed that compared with pregnant women in general, obese pregnant women were at increased risk of having a co-morbidity diagnosed before or during pregnancy (in particular pregnancy-induced hypertension and gestational diabetes), were at increased risk of having induction of labour and a caesarean birth, were more likely to have postpartum haemorrhage, and their babies were at increased risk of stillbirth, neonatal death, of being large-for-gestational age and more likely to be admitted for special care **(Cmace 2010).**

A number of studies have concluded that excessive gestational weight gain increases postpartum weight retention by **Gunderson (2010); Keppel (2010); Polley (2013); Rooney (2012); Rossner (2009); Scholl (2015)** and is related to a two to three fold increase in the risk of becoming overweight after delivery by **Gunderson (2013)**. Moreover, mothers who gained more weight during pregnancy have been shown to have children at higher risk of being overweight in early childhood by **Oken (2009).**

Maternal obesity and excessive gestational weight gain (GWG) are significant contributors to the global obesity epidemic with approximately 50% of women entering pregnancy overweight or obese and 50% of women gaining excess pregnancy weight **(Hure et al., 2012; Kowal et al., 2012; Rasmussen and Yaktine, 2013 and McPhie et al., 2015)**. Indeed, obesity before pregnancy predisposes women to infertility, hypertension, and gestational diabetes, along with offspring neurological, metabolic, and respiratory conditions **(Callaway et al., 2006; Pantasri and Norman, 2014).** Excess GWG is associated with adverse outcomes such as caesarean delivery, hypertensive disorders of pregnancy, gestational diabetes, and infant macrosomia **Rasmussen and Yaktine, (2014); Haugen et al., (2014).** It is also linked with increased risk of short- and long-term obesity in both the mother and offspring **(Siega-Riz et al., 2009 ; Manna et al., 2013; Cohen et al., 2014).**

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 **(Melzer K, 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.

The correlations between total calories intake and pregnancy outcomes. The results showed strong positive correlation between total calories intake and poor pregnancy outcomes .As the total calories intake increase, the gestational weight gain, complications during pregnancy, labor and postpartum increase (r=.044, .346**, .366**, .253) respectively.

The present findings were supported by studies conducted in UK and Brazil both found a positive association between dietary pattern and birth weight, a 'health conscious' pattern in UK and a snack dietary pattern in Brazil by **Northstone K., et al.,(2011), Coelho N.D.L.P., et al.,(2015)**. Moreover, another study from the Netherlands suggested that high adherence to an energy-rich dietary pattern was associated with improve perinatal outcomes done by **Bouwland-Both M.I., et al., (2013).**

In contrast, two studies found that no dietary pattern was significantly associated with any of the birth outcomes **(Colon-Ramos U., et al., 2015, Saunders L., et al., 2014)**. An adherence to Mediterranean diet was not significantly associated with the risk of delivering an infant with fetal growth restriction **(Saunders L., et al., 2014)**. No dietary pattern was significantly associated with any of the birth outcomes, the mixed dietary patterns may provide antagonistic relationships between foods and nutrients that result in null associations with birth outcomes **(Colon-Ramos U., et al., (2015)**.

In Denmark, a Mediterranean diet during pregnancy was associated with reduced risk of preterm birth **(Mikkelsen T.B., et al., 2008)**. Results from a large prospective cohort study in Norway, showed that a "traditional" dietary pattern or a "prudent" dietary pattern during pregnancy was associated with a reduced risk of preterm birth, 9% and 12% respectively (**Englund-Ogge L., et al., 2015**).In another large, prospective cohort of close to 60,000 Danish women followed during pregnancy, researchers found that a high intake of Western-type diet led to an increased risk of preterm birth, while a seafood diet had a modestly protective effect by **Rasmussen M.A., et al.,(2014).**

In contrast to the above studies, in a Brazilian cohort, investigators did not observe associations between dietary patterns and prospective changes in blood pressure during pregnancy and the early postpartum period. The difference may be explained on the basis that this study only included healthy pregnant women and excluded those who developed hypertension or preeclampsia. The investigators hypothesized that the powerful mechanisms involved in maternal hemodynamic adaptations, such as the integrity of endothelium, were not disrupted in normotensive pregnant women, and maintained blood pressure despite the different dietary intakes (**Eshriqui I., et al., 2016**).

The present study found that there was a strong positive correlation between total Body mass index and poor pregnancy outcomes .As the Body mass index increase, the systolic blood pressure, diastolic blood pressure, total gestational weight gain, complications during pregnancy, labor and postpartum increase.

It is similar to a study by **Vanessa L. et al., (2018)** in rural India and Pakistan which investigated the relationship between early pregnancy body mass index (BMI) and maternal, perinatal, and neonatal outcomes, and revealed that the proportion of women with an adverse maternal outcome increased with increasing maternal BMI. Less than one third of non-overweight/non-obese women, 47.2% of overweight women and 56.0% of obese women experienced an adverse maternal outcome, risks of hypertensive disease/severe preeclampsia/eclampsia, cesarean/assisted delivery were higher among women with higher BMIs. Overweight women also had significantly higher risk of perinatal and early neonatal mortality compared to underweight/normal BMI women. Overweight women had a significantly higher perinatal mortality rate.

Based on the current findings, all hypotheses of this study were accepted.

5. CONCLUSION

According to the findings of the present study, it can be concluded that there was a statistically significant difference after life style counselling on diet, exercise and GWG on reducing gestational weight gain, oral glucose tolerance test, complications of current pregnancy, labor and postpartum between study and control group. 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:

It is recommended that pre pregnancy care facilities and clinics to do proper screening in identifying risk of pre pregnancy BMI and continue proper antenatal monitoring for good gestational weight gain in order to prevent GDM.

Prepare training programs for nurses about the importance of lifestyle modification intervention in reducing maternal and perinatal complications among high risk women as a routine antenatal care.

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