Physical Inactivity Associated with Impaired Glucose Tolerance among Pregnant Women

R Kurup, C Boston, A Khan, E Rogers, S Lewis-Isles, R Roberts-Martin

ABSTRACT

Objective: To assess the effects of exercise on pregnant women in controlling glucose levels and body mass index (BMI).

Methods: A total of ninety (90) pregnant women were enrolled from 3 health centers- Kitty Health Centre, Herstelling Health Centre and Versailles Health Centre in Guyana. The study population was randomly assigned to an Intervention group (IG) and Control group (CG). Body Mass Index (BMI) and Random Blood Sugar (RBS) levels were compared before and after intervention. Multivariate correlation analysis and t tests were performed to find the differences between pre and post interventions.

Results: IG had 73.7% obese in IG and 26.3% obese in CG during the initial phase. Final phase showed a 50% decrease in BMI of IG were a BMI increase of 50% in CG. The adjusted RBS in the IG decreased from 30% - 5% in 280-459 glucose level range were as in CG RBS increased from 50% - 75% in the 280-339 range. A correlation of 0.94 (95% CI 0.89-0.97, $p<0.0001$) and a correlation of 0.97 (95% CI 0.94-0.98) were shown among IG and CG respectively for RBS. BMI among IG showed a significant correlation of 0.97 (95% CI 0.95-0.98, $p<0.0001$) pre and final BMI were as CG showed a correlation of 0.96 (95% CI 0.94-0.98, $p<0.0001$).

Conclusion: This study concludes that physically active pregnant women showed a less weight gain during pregnancy and also were at a less risk of suffering from impaired glucose tolerance.

Keywords: Blood sugar, physical activity, pregnant women

Faculty of Health Sciences, University of Guyana, Georgetown, Guyana.

Correspondence: Dr R Kurup,Faculty of Health Sciences, University of Guyana, Georgetown Guyana

INTRODUCTION

It is very well known fact physical activity during pregnancy improves health of mother and her unborn child as well as reduce the risk of gestational diabetes, reduce duration of labor, back pain, insomnia and anxiety in pregnant women (1-5). The American College of Obstetricians and Gynecologists (ACOG) recommends that all women who are free from medical or obstetric complications engage in 30 minutes or more of moderate intensity physical activity on most days of the week (6).

Pregnant women who develop GDM are at increased risk of developing pre-eclampsia and increased need for induction of labor and caesarean section (7, 8) along with complications of having a large-for-gestational age (LGA) or macrosomic infant, they are at higher risk of cephalopelvic disproportion, uterine rupture and perineal lacerations (9). It is also evident that women with GDM have seven to eight times the risk of developing type 2 diabetes (T2DM) when compared with those who have had a normoglycaemic pregnancy (10, 11). Physical activities were successful in decreasing BMI and RBS levels over the course of pregnancy (12-15). Observational studies have found physical activity during normal pregnancy decreased insulin resistance and therefore, might help to decrease the risk of GDM (16-18). Obesity is also known to develop hypertensive disorders during pregnancy and is a major cause of maternal deaths worldwide. In Caribbean and Latin America, hypertensive disorders are responsible for 26% of maternal deaths and physical exercise during pregnancy could offer benefits (19, 20). This study therefore evaluates the impact of physical activity (exercise) with regard to BMI and RBS in pregnant women.

METHOD

Description of the study

A total of 90 randomly selected pregnant women who attended the pre-natal health center were identified for the study. The health centers selected were Kitty, Herstelling and Versailles health centers in Guyana. The women were invited to participate in the study by their medical practitioner once they were identified as healthy and have uncomplicated pregnancy. The study was divided into three phases:

Phase one entailed the assessment of participants, interviews and performing glucose testing during their first visits to the clinic. Phase two was follow up and feedback process. Phase three encompassed re-testing for Gestational Diabetes and making direct observations.

Study design:

The study was a randomized controlled clinical trial (RCT). A study attrition diagram is shown in the flow chart. All the women who were healthy and have uncomplicated and singleton pregnancies were included in the study. Those with severe illnesses were excluded from study such as: polycystic ovarian disease, kidney disease, liver disease, asthma, Rheumatic heart illness, serious hypertension.

Women who had Gestational diabetes mellitus were assigned to an intervention group (exercise group) and the women who did not have Gestational diabetes mellitus were assigned to a control group (will not participate in exercise).

A structured questionnaire was given to each participant to obtain general information, maternal characteristics, socioeconomic status, background information, and knowledge of diabetes, and family history of diabetes.

Ethical consideration:

All participants were informed about the aim and study protocol, confidentiality was ensured by giving each participant a special ID number and a written informed consent were signed by the

Analysis:

All 90 participating pregnant women were weighed and their BMI was calculated by dividing weight (kg) by the square of height (m^2), or use the BMI calculator after measuring and weighing. BMI percentile charts for pregnant women under 18 years were used. Weight, BMI and height were recorded for each participant.

All the participants, who had a BMI of 30 or more, were explained about the risk, both to their health and the health of the unborn child. Women with a greater BMI in the study were referred to a trained health professional for assessment and personalized advice, advice on healthy diets, and advice on physical activities. They were advised/encouraged to lose weight after pregnancy.

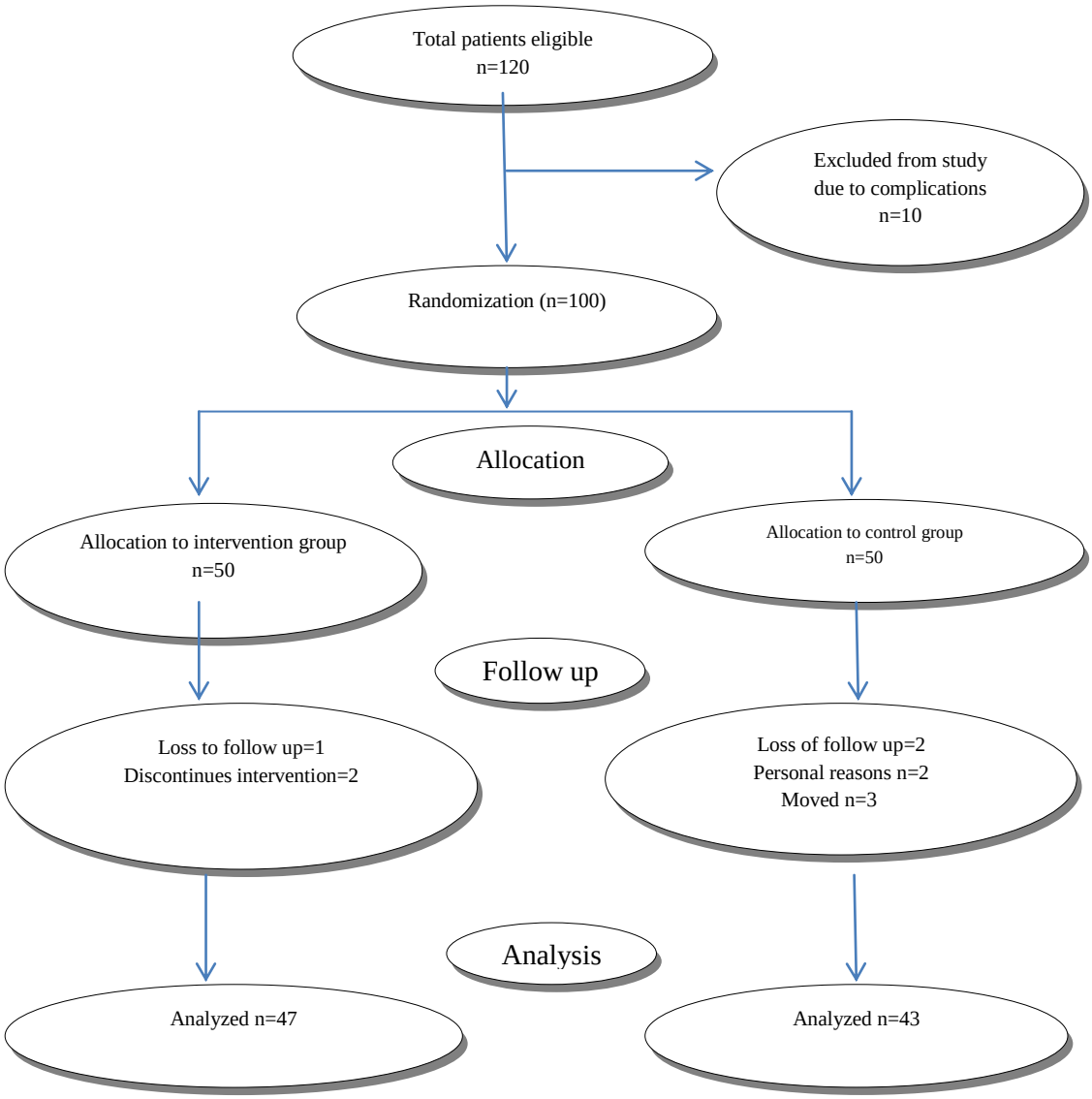
In the study population, women from both exercise and control groups were screened for gestational diabetes with a non-fasting oral glucose challenge test using One Touch Dial Glucose testing kit. A random 1 hour PPSs (postprandial glucose) was taken to determine the glucose levels of participants after a 50g oral glucose load is given. The participants were asked to fast for 1 hour before a finger prick test. Once the 1 hour glucose test result was at least 140 mg/dl, the participants were referred for a 100gm fasting glucose 3-h tolerance test.

Normal results were blood glucose below 95 mg/dl at baseline, below 180 mg/dl at 1 h, below 155 mg/dl at 2 h and below 140 mg/dl at 3 h, all with accordance to WHO criteria.

After the initial phase, women in the control group were asked to carry out their normal day to day routine and the women in the exercise group were asked to carry out an exercise session of mild to moderate exercises (such as 10-12 minutes walking, 5 minutes light, static stretching (avoiding muscle pain) of most muscle groups (upper and lower limbs, neck and trunk muscles). These physical activities were advised for 15mins to gradually 30mins for three days of each week for four weeks until their next monthly visit. Participants were made aware of adequate intake of calories and nutrients. Women in the exercise group were followed to remind them to perform these exercises, ensure they are taking the adequate calories before carrying out exercise activities, and to get feedback on any kind of stress during the exercises.

One month later after follow up, participants were retested for Gestational diabetes mellitus using the same glucose testing method mentioned above and all results were recorded and later analyzed. A report was created based on the analysis of the study and given to the Health Centers as well as the Ministry of Health.

Flow chart showing selection of participants



Results

Table 1 shows the background of the participants involved in the study group. A total of 120 pregnant women were eligible for the study during the period, of which 20 were excluded after developing complications. A total of 100 pregnant women, 50 in control and 50 in intervention

group (IG) were allocated. Only 47 (52.2%, 95% CI 42.0-62.3) in the control group (CG) and 43 (47.7%. 95% CI 37.7-57.9) in intervention group completed the study.

Mean±SD RBS and mean±SD weight before and after intervention are demonstrated in Table 2. Mean of Pre RBS in IG was 174.1±78.9 and CG was 138.5±66.3. Post RBS mean value was 153.5±59.6 in IG and 152.3±63.0 in CG. Mean pre BMI in IG was 25.8±5.5 and CG was 22.9±5.0 were as post BMI in IG and CG were 24.9±4.9 and 24.9±4.9 respectively.

Figure 1 demonstrates the correlation among pre and post RBS and pre and post BMI in entire study group. A strong correlation was seen between Pre BMI and final BMI with r=0.95 (95% CI 0.93-0.97, p<0.0001), pre RBS and final RBS with r=0.92 (95% CI 0.88-0.95, p<0.0001). Pre RBS with pre BMI showed a correlation of 0.76 (95% CI 0.65-0.83, p<0.0001), final RBS with final BMI showed a correlation of 0.69 (95% CI 0.56-0.78, p<0.0001).

Multivariate correlation between Pre and final RBS among IG and CG is shown in Figure 2. A correlation of 0.94 (95% CI 0.89-0.97, p<0.0001) and a correlation of 0.97 (95% CI 0.94-0.98) were shown among IG and CG respectively.

There was also a decrease in BMI with >30 by 23.7% within the IG however CG showed an increase by 23.7% within BMI range of >30. Also recorded were a complete extinction of the high RBS levels (400-459mg/dl) in the IG with pre RBS of 50.0% to 14.3% final RBS. On the other hand CG showed a decrease of RBS levels in the normal range from 61.1% to 57.1%.

DISCUSSION

The current study evaluated the accuracy of physical activity among pregnant women in reducing BMI and RBS level. The study revealed that physical activity during pregnancy is associated with a reduced risk of GDM. This study found that increase moderate activity was associated with a significantly reduced risk of any degree of glucose intolerance in pregnancy. It was very evident that obese and overweight pregnant women, with a BMI of ≥30kg/cm² had a high RBS result as compared with those who have a BMI of ≤25kg/cm². Women who were physically active and carried out moderate exercises (at least 3 times per week for at least half hour each day) had reduced glucose levels and decrease weight gain. The magnitude of this association was greatest for overweight and obese women.

Taken together, these converging lines of evidence suggest that current efforts to encourage frequent physical activity can benefit pregnant women and result in substantial reductions in the incidence of Gestational diabetes mellitus and increase glucose tolerance. Among pregnant Latinas, where it was proven that excessive gestational weight gain is, in turn, associated with maternal complications such as cesarean delivery, hypertension, preeclampsia, impaired glucose tolerance, and gestational diabetes mellitus (21). In another study it was proven that changes in lifestyle risk factors (e.g., regular exercise, healthy diet) among overweight and obese pregnant women may reduce the risk of obesity and impaired glucose tolerance and subsequent type2 diabetes and cardiovascular disease for both mother and offspring. Indeed, recent recommendations by the National Heart, Lung, and Blood Institute highlight the need for physical interventions before and during pregnancy, particularly among vulnerable populations including ethnically diverse groups (22). A meta-analysis indicated 24% lower risk of GDM for women in the highest activity group during pregnancy compared with those in the lowest activity

group (pooled OR = 0.76; 95% CI = 0.70-0.83; $P < .0001$) (23). In light of the fact that walking is the most popular form of exercise in pregnancy (24), several of these observational studies evaluated the impact of walking independently. Studies were consistent in finding that moderate exercise such as walking was significantly and inversely associated with GDM risk. Taken together, these data support the idea that an improvement in insulin sensitivity with moderate activity may be contributing to the reduced risk of GDM.

According to Diabetes Australia, the management and treatment of gestational diabetes is a team effort, involving the woman with gestational diabetes, family, doctor and specialists, dietitian and credentialed Diabetes Educator. There are three basic components in effectively managing gestational diabetes by: (i) monitoring blood glucose levels, (ii) adopting a healthy eating pattern, (iii) physical activity during pregnancy through increasing walking and developing a more active lifestyle (25).

CONCLUSION

This study indicates that greater total physical activity during pregnancy was significantly associated with a lower risk of GDM and obesity. The study also revealed that adoption of such a lifestyle-based intervention by pregnant by custom fitting the physical activity into a daily routine appropriate to individual lifestyles facilitates these women with a lower weight gain especially those who had a BMI of ≥30kg/cm² and reduced their risk of GDM by lowering those glucose levels closer to normal.

ACKNOWLEDGEMENTS

The authors would like to extend a sincere thank you to all of the women who participated in this study as well as all staffs of the health centers during the study.

Competing interests

The authors declare that they have no competing interests.

REFERENCES

1. Smith KM, Foster RC and Campbell CG. Accuracy of physical activity assessment during pregnancy: an observational study. BMC Pregnancy Childbirth 2011; 11:86.
2. American College of Obstetrics and Gynecology: Committee opinion number 267: Exercise during pregnancy and the postpartum period. Ob Gynecol 2002; 99: 171-173.
3. American College of Sports Medicine: Impact of physical activity during pregnancy and postpartum on chronic disease risk: Roundtable consensus statement. Med Sci Sports Exerc 2006; 38: 989-1006.
4. Dempsey JC, Butler CL, Sorenson TK, Lee I, Thompson ML, Miller RS, Frederick IO, Williams MA: A case-control study of maternal recreational physical activity and risk of gestational diabetes mellitus. Diabetes Res Clin Pract 2004; 66:203-215.
5. Dempsey JC, Sorenson TK, Williams MA, Lee I, Miller RS, Dashow EE, Luthy DA: Prospective study of gestational diabetes mellitus risk in relation to maternal recreational physical activity before and during pregnancy. Am J Epidemiol 2004; 159:663-670.
6. ACOG Committee on Obstetric Practice. ACOG Committee opinion, number 267, January 2002: exercise during pregnancy and the postpartum period. Obstet Gynecol. 2002; **99**(1):171–173.
7. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS, Australian Carbohydrate Intolerance Study in Pregnant Women (ACHOIS) Trial Group. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. N Engl J Med 2005; 352(24): 2477–86.

8. Landon MB, Spong CY, Thom E, Carpenter MW, Ramin SM, Casey B, et al. A multicenter, randomized trial of treatment for mild gestational diabetes. N Engl J Med 2009; 361(14):1339–48

9. Jastrow N, Roberge S, Gauthier RJ, Laroche L, Duperron L, Brassard N, et al. Effect of birth weight on adverse obstetric outcomes in vaginal birth after cesarean delivery. Obstet Gynecol 2010; 115: 338–43.

10. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet 2009; 373(9677):1773–9.

11. Chodick G, Elchalal U, Sella T, Heymann AD, Porath A, Kokia E, et al. The risk of overt diabetes mellitus among women with gestational diabetes: a population-based study. Diabetic Med 2010; 27(7):779–85.

12. Hui A, Back L, Ludwig S, Gardiner P, Sevenhuysen G, Dean H et al. Lifestyle intervention on diet and exercise reduced excessive gestational weight gain in pregnant women under a randomised controlled trial. BJOG 2012; **119(1)**:70–77.

13. Aittasalo M, Raitanen J, Kinnunen TI, Ojala K, Kolu P, Luoto R. Is intensive counseling in maternity care feasible and effective in promoting physical activity among women at risk for gestational diabetes? Secondary analysis of a cluster randomized NELLI study in Finland. Int J Behav Nutr Phys Act. 2012; **9(1)**:104.

14. Callaway LK, Colditz PB, Byrne NM, Lingwood BE, Rowlands IJ, Foxcroft K et al. Prevention of gestational diabetes: feasibility issues for an exercise intervention in obese pregnant women. Diabetes care 2010; **33(7)**:1457–1459.

15. Hawkins M, Chasan-Taber L, Marcus B, Stanek E, Braun B, Ciccolo J et al. Impact of an Exercise Intervention on Physical Activity During Pregnancy: The Behaviors Affecting Baby and You Study. Am J Public Health. 2014; 104(10):e74-e81.

16. Morisset AS, St-Yves A, Veillette J, Weisnagel SJ, Tchernof A, Robitaille J. Prevention of gestational diabetes mellitus: a review of studies on weight management. Diabetes Metab Res Rev 2010; 26(1):17–25.

17. Redden SL, Lamonte MJ, Freudenheim JL, Rudra CB. The association between gestational diabetes mellitus and recreational physical activity. Matern Child Health J 2011; 14(4): 515-9.

18. Reece EA, Leguizamón G, Wiznitzer A. Gestational diabetes: the need for a common ground. Lancet 2009; 373 (9677):1789–97

19. Khan KS, Wojdyla D, Say L, Gülmezoglu AM and Look PFV. WHO analysis of causes of maternal death: a systematic review. The Lancet 2006; 367(9516): 1066–1074.

20. Kasawara KT, Burgos CS, do Nascimento SL, Ferreira NO, Surita FG, Pinto e Silva JL. Maternal and perinatal outcomes of exercise in pregnant women with chronic hypertension and/or previous preeclampsia: A randomized controlled trial," ISRN Obstet Gynecol 2013; 2013:857047.

21. Barakat R, Cordero Y, Coteron J, Luaces M, Montejo R: Exercise during pregnancy improves maternal glucose screen at 24–28 weeks: a randomized controlled trial: Br J Sports Med 2012;46:656–661.

22. Chasan-Taber L. Physical Activity and Dietary Behaviors Associated with Weight Gain and Impaired Glucose Tolerance Among Pregnant Latinas. Adv Nutr 2012; 3: 108-118.

23. Chasan-Taber L, Schmidt MD, Pekow P, Sternfeld B, Manson JE, Solomon CG, Braun B, Markenson G. Physical Activity and Gestational Diabetes Mellitus among Hispanic Women. J Womens Health 2008; 17(6): 999-1008.

24. Tobias DK, Zhang C, van Dam RM, Bowers K, Hu FB. Physical activity before and during pregnancy and risk of gestational diabetes mellitus: a meta-analysis. Diabetes Care 2011; 34(1):223-229.

25. Australia Diabetes 2015. https://www.diabetesaustralia.com.au/managing-gestational-diabetes.

Table 1: Background information of the study group

	Total	95% CI	Intervention Group	95% CI	Control Group	95% CI
Health Centers						
Kitty	40 (44.4)	34.6-54.7	25 (58.1)	43.3-71.6	15 (31.9)	20.4-46.2
Herstelling	20 (22.2)	14.8-31.8	0		20 (42.5)	29.5-56.6
Versailles	30 (33.3)	24.4-43.5	18 (41.8)	28.3-56.7	12 (25.5)	15.3-39.5
Age						
Mean±SD	24.4±5.5	23.3-25.6	25±5.9	23.2-26.8	23.8±4.9	22.4-25.3
SE	0.57		0.91		0.72	
Min -Max	16-40		16-40		16-36	
Median	23		25		23	
Gestational Period						
Mean±SD	26±5.9	24.8-27.2	25.3±6.5	23.3-27.3	26.6±5.4	25.1-28.2
SE	0.62		0.98		0.78	
Min -Max	12-38		12-38		16-36	
Median	27		26		28	
Race						
Afro-Guyanese	49 (54.4)	44.2-64.3	26 (60.5)	45.6-73.6	23 (48.9)	35.3-62.7
Indo-Guyanese	28 (31.1)	22.5-41.3	10 (23.3)	13.2-37.7	18 (38.3)	25.8-52.6
Mixed	8 (8.8)	4.6-16.6	5 (11.6)	5.1-24.5	3 (6.4)	2.1-17.2
Portugese	2 (2.2)	0.06-7.7	2 (4.6)	1.2-15.4	0	
Chinese	3 (3.3)	1.1-9.3	0		3 (0.64)	2.2-17.2
Family History						
Yes	46 (51.1)	40.9-61.2	23 (53.5)	38.9-67.5	23 (48.9)	35.3-62.7
No	44 (45.8)	38.8-59.0	20 (46.5)	32.5-61.1	24 (51.1)	37.2-64.7
History of Diabetes						
Yes	31 (34.4)	25.4-44.7	13 (30.2)	18.6-45.1	18 (38.3)	25.8-52.6
No	59 (65.6)	55.3-74.6	30 (69.7)	54.8-81.4	29 (61.7)	47.2-74.2

Table 2: Mean RBS AND bmi before and after intervention

	Total	95% CI	Intervention Group	95% CI	Control Group	95% CI
PreRBS						
Mean±SD	155.5±74.4	139.9-171.1	174.1±78.9	149.7-198.4	138.5±66.3	119.1-158.0
SE	7.84		12		9.67	
Min -Max	48-405		50-405		48-315	
Median	128		180		115	
Post RBS						
Mean±SD	152.8±61.1	23.3-25.4	153.5±59.6	135.2-171.8	152.3±63.0	133.7-170.7
SE	6.44		9.1		9.2	
Min -Max	16-37		78-328		84-301	
Median	24		142		140	
PreBMI						
Mean±SD	24.3±5.5	23.2-25.4	25.8±5.5	24.1-27.5	22.9±5.0	21.4-24.3
SE	0.57		0.84		0.73	
Min -Max	15-36		15-35		15-36	
Median	23		26		23	
Post BMI						
Mean±SD	24.4±4.9	23.3-25.4	24.9±4.9	23.4-26.5	24.8±4.9	22.4-25.3
SE	0.52		0.75		0.71	
Min -Max	16-37		16-35		16-37	
Median	24		25		24	

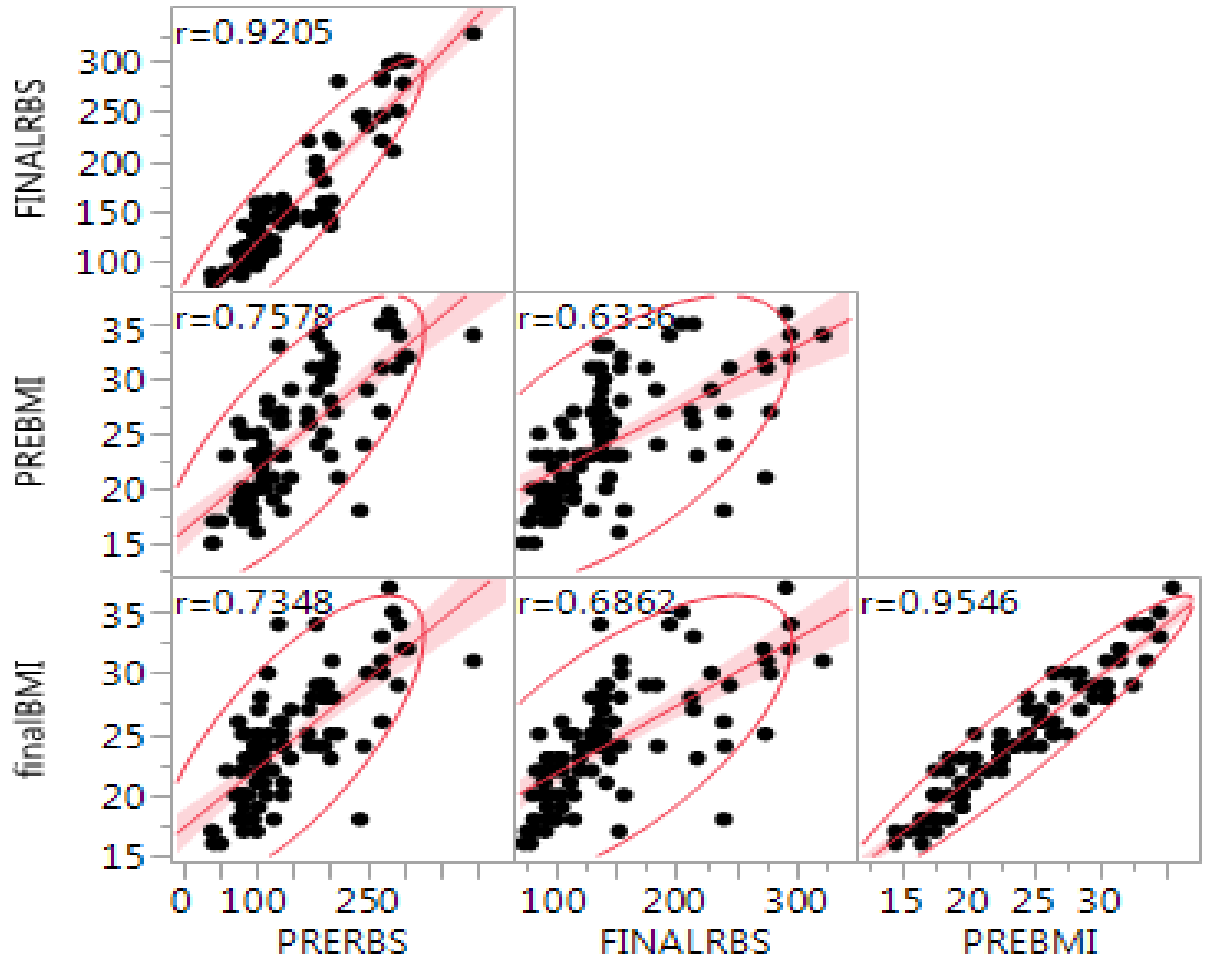


Fig. 1 Correlation of RBS and BMI among entire study population.

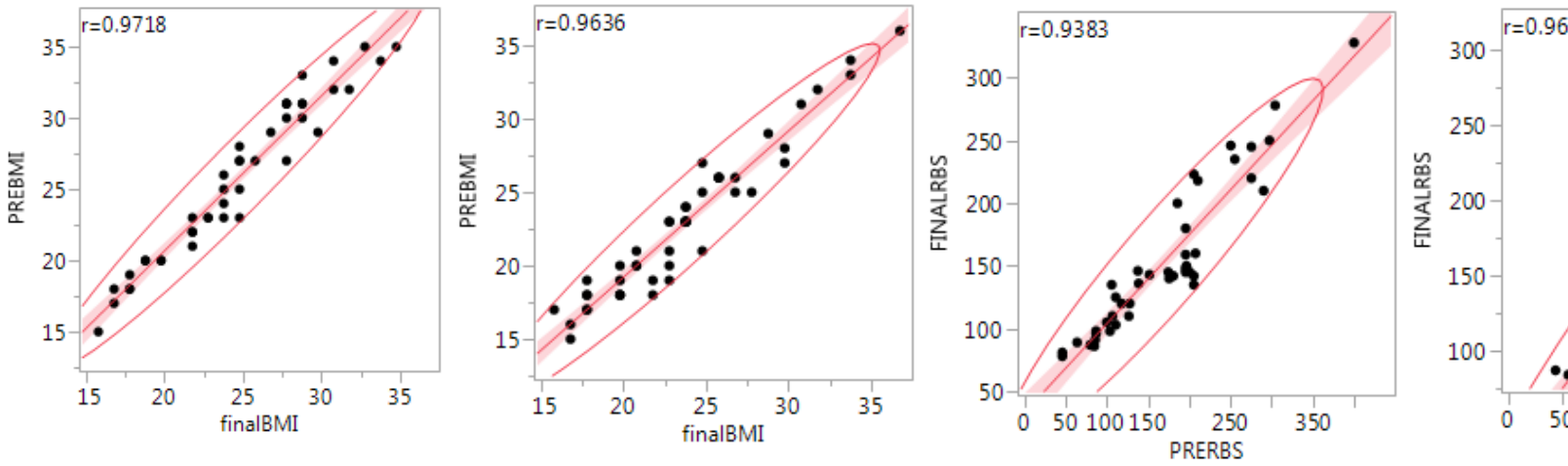


Fig 2: Correlation of BMI and RBS between control group and intervention group.