Original Article

Physical activity in pregnancy and its effect on weight-related parameters: A pilot randomized controlled trial

Atividade física na gravidez e seu efeito sobre os parâmetros relacionados ao peso: Um estudo piloto randomizado e controlado

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ABSTRACT | INTRODUCTION: The decline in the level of physical activity during pregnancy is related to various pregnancy related complications. Therefore, regular physical activity during pregnancy plays an important role in maintaining good reproductive health and healthy lifestyle. **OBJECTIVES**: was to assess the effect of supervised exercises, text messages, and pedometer-based physical activity interventions during pregnancy on physical activity levels and weight-related parameters. **MATERIALS AND METHODS:** Controlled, randomized, parallel-group pilot study. Sixty pregnant women were randomized into five groups (N= 12 in each group): Group A: Supervised exercise; Group B: Pedometer; Group C: Pedometer plus text message; Group D: Text message and Group E: Control. Pregnant women aged 20-30 years with a singleton pregnancy and gestational age of less than 16 weeks at inclusion, a BMI ≥ 18.5 kg /m2, an availability of mobile phone and ability to speak and read Hindi and English languages were selected for participation in the study. Women with twin or multiple pregnancies, BMI >30kg/m2, high-risk pregnancy as decided by the gynecologist, any pregnancy related complications such as pre-gestational hypertension, pre-gestational diabetes, and other major health conditions restricting their physical activity at the time of recruitment and illiterate pregnant women were excluded from the study. Group A received supervised light to moderate intensity exercise of 45-60 minutes once weekly from the 15th week till delivery. Groups B and C were encouraged to improve physical activity level, focusing at a steps count of at least 5000-7500 steps per day assessed by pedometer on seven consecutive days per month. Group C in addition to pedometer and group D received standard SMS related to pregnancy care (physical activity, diet, motivational, and educational specific. One-way ANOVA was used to estimate the between-group differences and Paired t-test was used to estimate the within-group difference in the outcome variables (p=0.05). **RESULTS:** The result of the study showed statistically significant between groups differences in the weight at 9th month (p=0.029) and weight retention at 2months post-partum (p=0.005). The supervised exercise group retained less weight during post-partum period as compared to control group (Supervised exercise vs Control, MD = 2.79kg, p=0.002). However, there was no statistical significant improvement in gestational weight gain, BMI, waist circumference, hip circumference and waist to hip ratio as compared to groups. **CONCLUSIONS:** It can be concluded that supervised exercises are effective in increasing physical activity, reducing weight-related parameters, and help in adopting a healthy lifestyle during pregnancy.

KEYWORDS: Pedometer. Text messages. Exercise. Gestational weight gain.

RESUMO | INTRODUÇÃO: O declínio no nível de atividade física durante a gravidez está relacionado a várias complicações relacionadas à gravidez. Portanto, a atividade física regular durante a gravidez tem um papel importante na manutenção da boa saúde reprodutiva e de um estilo de vida saudável. **OBJETIVOS:** Avaliar o efeito de exercícios supervisionados, mensagens de texto e intervenções de atividade física baseadas em pedômetros durante a gravidez sobre os níveis de atividade física e parâmetros relacionados ao peso. **MATERIAIS E MÉTODOS:** Estudo piloto de grupo paralelo controlado e aleatório. Sessenta mulheres grávidas foram aleatorizadas em cinco grupos (N= 12 em cada grupo): Grupo A: Exercício supervisionado; Grupo B: Pedômetro; Grupo C: Pedômetro mais mensagem de texto; Grupo D: Mensagem de texto e Grupo E: Controle. Mulheres grávidas de 20 a 30 anos de idade com uma gravidez de um botão e idade gestacional inferior a 16 semanas na inclusão, um IMC ≥ 18,5 kg /m2, uma disponibilidade de telefone celular e capacidade de falar e ler hindi e inglês foram selecionadas para participação no estudo. Mulheres com gestações gêmeas ou múltiplas, IMC >30kg/m2, gravidez de alto risco conforme decisão do ginecologista, quaisquer complicações relacionadas à gravidez, tais como hipertensão pré-gestacional, diabetes pré-gestacional e outras condições de saúde importantes que restringem sua atividade física no momento do recrutamento e mulheres grávidas analfabetas foram excluídas do estudo. O Grupo A recebeu um exercício supervisionado de luz a moderada intensidade de 45-60 minutos uma vez por semana a partir da 15ª semana até o parto. Os grupos B e C foram encorajados a melhorar o nível de atividade física, concentrando-se em uma contagem de passos de pelo menos 5000-7500 passos por dia avaliados por pedômetro em sete dias consecutivos por mês. O grupo C, além do pedômetro e o grupo D receberam SMS padrão relacionados aos cuidados da gravidez (atividade física, dieta, motivacional e educacional específica). Foi utilizada a ANOVA de uma via para estimar as diferenças entre os grupos e foi utilizado o teste t pareado para estimar a diferença dentro do grupo nas variáveis de resultado (p=0,05). **RESULTADOS:** O resultado do estudo mostrou estatisticamente significativo entre as diferenças de peso dos grupos no 9º mês (p=0,029) e a retenção de peso nos 2 meses pós-parto (p=0,005). O grupo de exercício supervisionado reteve menos peso durante o período pós-parto em comparação com o grupo de controle (Exercício supervisionado vs Controle, MD = 2,79kg, p=0,002). Entretanto, não houve melhora estatística significativa no ganho de peso gestacional, IMC, circunferência da cintura, circunferência do quadril e relação cintura/quadril em comparação com os grupos. **CONCLUSÃO:** Pode-se concluir que os exercícios supervisionados são eficazes para aumentar a atividade física, reduzir os parâmetros relacionados ao peso e ajudar na adoção de um estilo de vida saudável durante a gravidez.

PALAVRAS-CHAVE: Pedômetro. Mensagens de texto. Exercício. Aumento de peso Gestacional.

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Introduction

Pregnancy is a period in which pregnant women face lots of difficulties regarding the regulation of their body weight.[1] Due to cultural beliefs, pregnant women decrease their physical activity levels or exertion during pregnancy. Additionally, many studies have found that women tend to decline their level of physical activity during pregnancy.[2-4] But now, new researches have shown that exercises have positive effects on maternal or neonatal outcomes during pregnancy.[5,6] During pregnancy, many women are anxious about the health of their child, so, pregnancy period has been recognized as a "teachable moment" for developing healthy nutritional habits and physical activity behaviors to improve their health.[7]

During pregnancy, women are at higher risk of developing sedentary behaviors due to specific environmental demands such as antenatal care responsibilities, physical demands such as nausea and weight gain, and psychological demands such as mood swings.[8] Studies have suggested that most pregnant women do not involve in the recommended level of physical activity as there are many barriers to physical activity such as lack of energy and motivation, pain and other health issues, exercise safety concerns, and lack of support from their spouse and family.[9-11] According to American College of Obstetrics and Gynaecology guidelines, healthy pregnant women are encouraged to perform at least 30 minutes of moderate-intensity physical activity or exercise every day on most days of the week.[12] Whereas, pregnant women in developed countries have been known to follow physical activity recommendations but in India, only about 10% of the females follows the guidelines for physical activity during pregnancy.[13] The steps are a basic unit of human motion and thus are a preferred measure to estimate physical activity. The pedometer is a common and popular tool to measure daily step counts. Studies have also found that pedometer-based physical activity intervention is associated with decreased weight gain, increased physical activity during pregnancy, and retention of less pregnancy weight after delivery.[14-16] Along with this, due to the boom in telecommunication technology, the usage of mobile phones can also be used to motivate pregnant females by sending messages related to healthy behavioural interventions. So, mobile phones can also be used as a health behaviour strategy in pregnant women by delivering text messages and short message services to them.[17] Various studies have also advocated the use of supervised exercises as an important aspect for controlling excessive gestational weight gain and post-partum weight retention.[18,19]

Previous studies have also used supervised exercises[18], text messaging intervention[17] and pedometer assisted physical activity[14] interventions in pregnant women as separate interventions. To date, no study has used the pedometer, text message and supervised exercises as interventions simultaneously to promote a healthy lifestyle and to induce behaviour that encourages physical activity in pregnant females. Therefore, the present study aims to assess the effect of supervised exercises, text messages, and pedometer-based physical activity interventions during pregnancy on physical activity levels and weight-related parameters.

Materials and methods

Study design

The present study was a randomized controlled, parallel-group pilot trial. The study was conducted at a leading maternity hospital OPD listed on the Guru Jambheshwar University Science and Technology panel Hisar, Haryana, India. The study was approved by Institutional Ethical Committee vide letter no. PTY/2018/710 dated 31st October 2018 and was done following the declaration of Helsinki, 2013. The present study was prospectively registered in Clinical Trial Registry India CTRI/2019/01/016888. The study was conducted from March 2019 to August 2020. Prior to participation in the study, written informed consent was collected from all the pregnant females.

Participants

Women aged 20-30 years with a singleton pregnancy confirmed by ultrasound scan in 11-14 weeks and gestational age of less than 16 weeks at inclusion, having a BMI ≥ 18.5 kg /m2, having an availability of mobile phone and ability to speak and read Hindi and English languages were selected for participation in the study. Women with twin or multiple pregnancies, age over 30 years BMI >30kg/m2, high-risk pregnancy

as decided by the gynecologist, any pregnancy related complications such as pre-gestational hypertension, pre-gestational diabetes, and other major health conditions restricting their physical activity at the time of recruitment and illiterate pregnant women were excluded from the study.

Randomization

According to eligibility criteria the participants were selected and then randomly assigned into five groups by computer generated random number table; group A: Supervised exercise; group B: Pedometer; group C: Pedometer plus text message; group D: Text message and Group E: Control. Due to the nature of the intervention, principal investigator and participants were not blinded to group allocation. The statistician was blinded to the participants allotment (defined as group A to group E).

Procedure

All the selected pregnant females were told about the significance of physical activity and a healthier lifestyle during pregnancy in addition to a standard hospital care regime. Pregnant women were encouraged to do physical activity (i.e. walking and exercises) at moderate intensity on the Borg scale of perceived exertion (12-14 on Borg scale of perceived exertion) in accordance with exercise guidelines by the American College of Obstetrics and Gynaecology.[12] After randomization, they were instructed individually according to the assigned group.

Group A (Supervised exercise): The participants in this group received antenatal exercise sessions once weekly by a certified antenatal and postnatal care physiotherapist. Participants in this group received supervised light to moderate intensity exercise of 45-60 minutes once weekly from the 15th week till delivery (4th month-9th month). A total of 24 training sessions were planned for each woman. Exercise sessions included group or individual exercises starting from light warm-up that included basic stretching exercises of all muscles groups (upper limb, neck, trunk, and lower limb muscles) breathing exercises, abdominal and back care exercises, pelvic floor strengthening exercises in standing and sitting; and resistance exercises.

Group B (Pedometer): Pregnant females allocated to this group were advised individually and encouraged by the physiotherapist to improve the level of physical activity, focusing at a step count of at least 5000-7500 steps per day (i.e. low-active category of physical activity) as a reference point for measuring the physical activity level in our study.[20] Physical activity was measured by daily steps count by a pedometer. Omron HJ-320 Tri-Axis Pedometer was used to measure the steps count. The pedometer has a seven-day memory with an automatic reset at the end of the day. The pedometer was worn at the waist level. Pregnant women were educated about the use of a pedometer and were asked to wear the pedometer in the morning after getting up from bed till night except during bathing. Daily step counts were assessed by pedometer and was noted on a chart and returned to the investigator on the next visit. Daily steps count recorded on seven consecutive days per month were collected and analyzed.[21]

Group C (Pedometer plus text message): The participants in this group in addition to pedometer also received text messages twice weekly throughout the pregnancy. The basic messages on pregnancy and pregnancy-related care such as evidence-based messages for physical activity, educational messages for general health and well-being, messages for healthy nutrition and motivating for positive health behavior, information specific to women's gestational age, and messages focused on pregnancy-related myths in India were delivered. The nutrition-specific messages were also delivered to the participants focusing on encouraging the healthy food behaviors such as seasonal fruits and vegetables, dry fruits, fresh juice, homemade food and avoid junk, oily and packed food from the market.

Group D (Text message): The participants in this group received similar text messages twice-weekly during the entire pregnancy as delivered in group C on pregnancy and pregnancy-related care.

Group E (Control): Pregnant females in this group received usual antenatal care from the gynecologist. At the baseline visit, they were advised to follow a healthy nutritious diet and were told about the significance of physical activity in pregnancy.

The outcome variables were assessed three times i.e. at the baseline visit (14th -16th week), at full term (36-38 weeks) and 2 months postpartum. Height, weight, Body mass index, and pre-pregnancy weight were measured at the baseline visit.

Outcome Variables

The primary outcome variables were gestational weight gain, post-partum weight retention, body mass index, the amount of time spent in each physical activity in 6th month, 9th month of pregnancy and 2 months post-partum, waist circumference, hip circumference and step counts. Secondary outcome variables were obstetric and neonatal complications. Pregnancy Physical Activity Questionnaire (PPAQ) was used at each visit to measure the type of physical activity performed by pregnant women in the previous month.[22] The amount of time spent at each activity was multiplied by the intensity and was added to calculate weekly energy expenditure in METs h/wk.[23]

Average steps count of seven consecutive days were assessed by pedometer for each month i.e. from 4th month to 9th month during pregnancy in pedometer and pedometer plus text message group only. Pre-pregnancy weight was self-reported by pregnant females, while a digital weighing machine was used to measured weight at delivery and two months post-partum. At the baseline visit, height was measured bare foot by using a stadiometer. A non-stretchable measuring tape was used to measure waist and hip circumference. Gestational weight gain was obtained by subtracting the pre-pregnancy weight from the weight at the full term. Post-partum weight retention was obtained by subtracting the pre-pregnancy weight from the weight measured at two months post-delivery. BMI was calculated by a standard formula. Data related to the type of delivery, Gestational age, neonatal complications, gender, and weight of the baby were collected from the hospital records.

Sample size

Total 60 pregnant women were taken, 12 participants in each group as a thumb rule for minimum sample size in pilot study.[24]

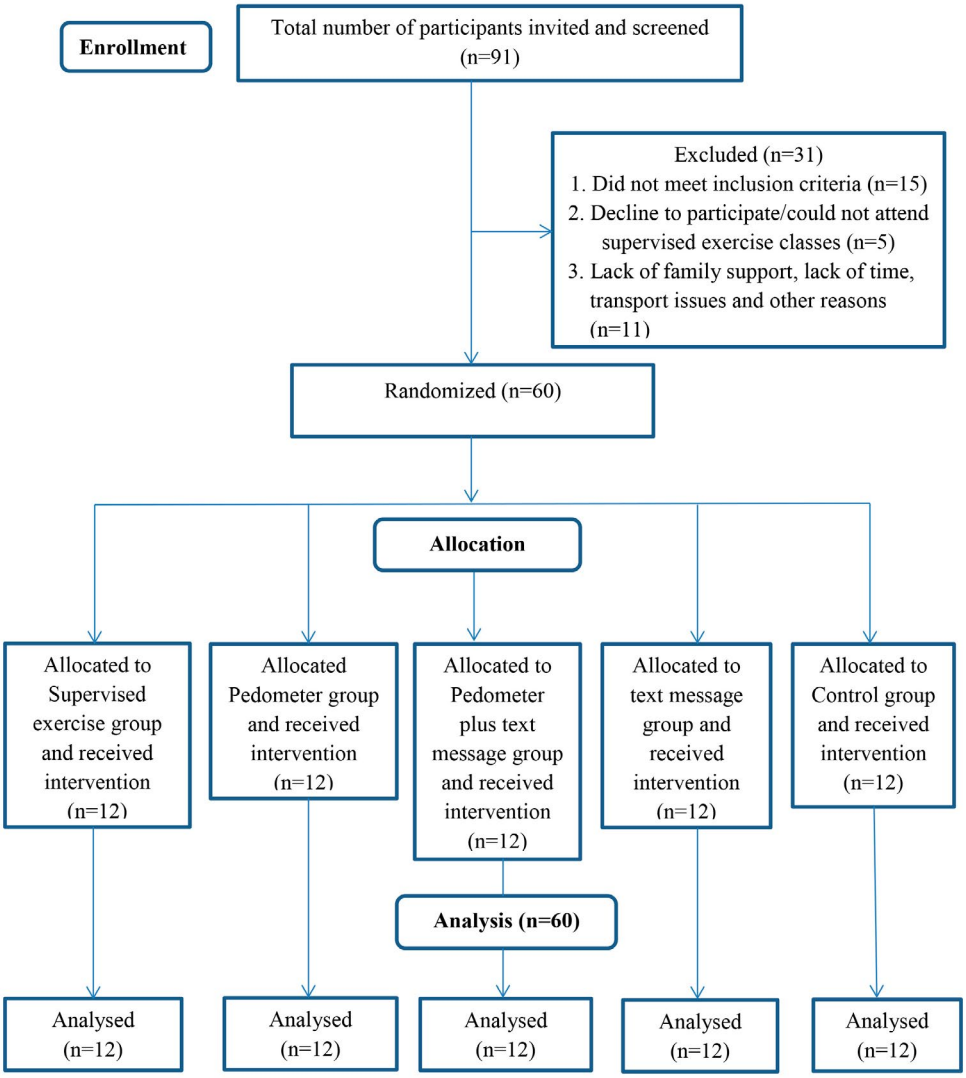
Statistical analysis

Data were analyzed using statistical software (SPSS 21.0). Normality of data was assessed by Kolmogorov-Smirnov test. The data was found to be normally distributed. Baseline characteristics were described using mean and SD, frequency, and percentage. Categorical data were presented as numbers and percentages and Chi-square test was used for categorical data. Continuous data were presented as mean ±SD. One-way ANOVA was used to estimate the between-group differences in the outcome variables. If the variables were found significant, post hoc analysis was done using LSD multiple comparisons. Paired t-test was used to estimate the within-group difference in the outcome variables. The significance level was set at p=0.05.

Results

Among 91pregnant women, 60 pregnant women were eligible and randomized into one of the five groups, 12 per group, Figure 1.

Figure 1. Flowchart detailing participant selection, inclusion/exclusion criteria



The mean age and baseline weight of included pregnant women were 25.77±3.03 years and 58.92±9.24 kg respectively.76.7% of females were primigravida. All the included participants were well educated and belong to similar socio-economic status. None of the participants reported any major harms and undesired effects during the intervention. At the baseline no significant difference was found in the outcome variables in all five groups, Table 1.

Table 1. Describes the baseline characteristics and p-value of all included participants of the study

Characteristics		Supervised Exercise group (n=12)	Pedometer group (n=12)	Pedometer plus text message group (n=12)	Text Message group (n=12)	Control group (n=12)	Total (n=60)	p
Age		26.75±2.30	25.00±2.17	26.50±3.53	25.50±3.87	25.08±2.97	25.77±3.03	.498[1]
Height (m)		1.63±0.04	1.63±0.07	1.59±0.06	1.65±0.06	1.63±0.05	1.62±0.06	.145[1]
Baseline Wt. (Kg)		56.38±6.15	61.24±6.10	58.83±9.24	61.09±10.24	56.67±7.58	58.82±9.24	0.063[1]
Baseline BMI (Kgm^2)		21.98±3.09	23.76±2.56	23.53±3.68	24.08±3.81	20.67±1.96	22.80±3.26	0.046[1]
Baseline WC (cm)		79.58±5.93	86.00±7.20	85.96±9.36	87.17±9.26	82.08±9.51	84.16±8.89	0.152[1]
Baseline HC (cm)		91.08±6.91	94.92±7.09	96.21±9.32	98.75±11.69	94.75±11.27	95.14±9.48	0.399[1]
Primiparous (N %)		12/12(100)	7/12(58.3)	9/12(75)	8/12(66.7)	10/12(83.3)	46/60(76.7)	0.142[2]
Blood pressure	SBP	118.33±14.03	114.17±9.00	116.25±8.29	120.50±8.40	117.50±7.54	118.35±10.17	0.067[1]
	DBP	72.50±8.66	73.83±5.22	75.83±9.96	75.25±10.40	74.58±7.22	73.40±8.60	0.265[1]
Blood Sugar		97.44±5.37	99.58±11.68	98.10±11.80	102.28±6.14	97.65±6.60	99.01±8.67	0.645[1]
Job(Yes/NO) (N %)		3/9	1/11	4/8	1/11	4/8	13/47	0.341[2]
Urban/Rural (N %)		7/5	6/6	8/4	3/9	5/7	29/31	0.294[2]
Education N (%)	10^{th}	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(8.3)	1(1.7)	0.501[2]
	12^{th}	0(0.0)	1(8.3)	2(16.7)	3(25.0)	1(8.3)	7(11.7)	
	UG	3(25.0)	6(50.0)	4(33.3)	3(25.0)	6(50.0)	22(36.6)	
	PG	9(75.0)	5(41.7)	6(50.0)	6(50.0)	4(33.3)	30(50.0)	

Mean ±SD values for all included participants. BMI=Body mass index, WC=Waist circumference, HC=Hip circumference, SBP=systolic blood pressure, DBP=Diastolic blood pressure. [1]Anova; [2]chi-square test

The result of the between group comparison using one way ANOVA showed that the mean gestational weight gain was 12.42±2.68 kg at delivery while two months post-partum weight retention was 6.74±2.51 kg. The result of one-way ANOVA also showed statistically significant between groups differences in the weight at 9th month (p=0.029) and weight retention at 2months post-partum (p=0.005). Post-hoc multiple comparisons showed that supervised exercise group retained less weight during post-partum period as compared to other groups (Supervised exercise vs Control, MD = 2.79kg, p=0.002; Pedometer vs Control, MD = 2.15kg, p=0.018 and Pedometer plus text message vs Control, MD = 2.39kg, p=0.006). Post-hoc analysis for weight at 9th month also showed that supervised exercise group significantly gained less weight as compared to other groups (Exercise vs Control, MD= 4.08kg, p=0.0001). Table 2 shows comparison of weight related parameters at pregnancy and post-partum two months using one way ANOVA between all 5 groups.

Table 2. Between group comparisons of weight related parameters at pregnancy and post-partum 2 months using one way ANOVA of all 5 groups

Time interval	Variables	Supervised Exercise group (n=12)	Pedometer group (n=12)	Pedometer plustext message group (n=12)	Text Message group (n=12)	Control group (n=12)	p-value
Pregnancy	GWG (kg)	11.71±1.97	12.14±3.15	11.96±2.72	12.99±2.77	13.25±2.80	0.932
Post-partum 2	Post weight (Kg)	61.92±6.30	67.92±6.73	64.17±9.82	68.50±10.89	65.00±10.09	0.029
months	Post BMI (Kg/m^2)	23.70±2.40	26.83±2.53	25.53±2.84	27.03±3.67	25.21±3.55	0.064
	Post WC (cm)	84.75±7.14	92.67±8.86	90.75±7.42	94.50±8.86	89.92±9.45	0.074
	Post HC (cm)	95.08±7.05	100.92±6.57	99.33±7.60	105.75±9.77	103.33±10.61	0.066
	PPWR (Kg)	5.54±2.17	6.18±1.42	5.94±2.42	7.41±1.94	8.33±3.34	0.005

Mean ± SD values for all variables; BMI=Body mass index; WC=Waist circumference; HC= Hip circumference; GWG = Gestational weight gain and PPWR = Post-partum weight retention.

The result of physical activity assessments using PPAQ showed that the group A, B and C reported more time in doing total activities, sports and exercise activities and moderate-intensity activities at 6th, 9th month of pregnancy and at 2 month post-partum as compared to the control group. The intensities of activities and other domains of the PPAQ between the groups at all-time points of assessment are described in Table 3.

Table 3. Physical activity levels throughout the study using PPAQ

Variables	Months	Supervised - Exercise group(N=12)	Pedometer group (N=12)	Pedometer plustext message group (N=12)	Text Message group (N=12)	Control group (N=12)	F-value	p-value
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD		
Total Activity	6Month	100.79±29.56	83.33±37.89	91.43±22.53	74.08±17.94	78.77±32.05	1.643	0.176
	9Month	104.07±10.29	97.46±53.95	103.79±23.89	84.61±17.12	85.77±25.72	1.347	0.264
	2MonthPP	82.93±27.05	80.28±13.71	81.46±17.21	69.48±10.77	66.26±21.16	2.799	.035
Sedentary activity	6Month	6.01±4.4	4.27±0.8	5.89±6	7.77±2.06	7.78±5.07	3.09	.023
	9Month	4.88±4.37	6.27±4.7	5.5±4.94	8.17±1.59	11.63±8.29	2.673	.041
	2MonthPP	12.64±1.8	12.94±1.88	14.05±2.61	16.17±1.85	13.05±2	1.204	0.32
Light-intensity activity	6 Month	60.89±26.13	51.17±39.41	56.48±18.63	45.3±16.76	49.74±21.7	1.403	0.245
	9 Month	62.65±23.58	60.24±31.06	64.55±14.71	52.20±14.95	48.44±21.57	1.438	0.234
	2MonthPP	49.89±6.82	46.21±8.1	41.41±8.7	34.58±9.06	35.82±8.44	0.688	0.603
Moderate-intensity activity	6 Month	33.89±9.98	27.89±16.86	29.06±8.38	21.01±7.59	21.57±10.04	2.41	0.06
	9 Month	36.54±12.76	30.95±16.38	33.74±5.8	24.24±4.73	25.7±8.29	3.304	.017
	2MonthPP	20.40±9.37	21.13±15.17	26±9.51	18.73±17.98	17.39±16.07	4.185	.005
Household/ care giving activity	6 Month	61.07±18.1	69.79±34.08	50.91±13.59	58.37±14.25	58.56±19.97	1.214	0.316
	9 Month	45.33±16.44	48.01±17.63	47.31±10.6	44.29±8.19	33.92±11.13	2.21	0.08
	2MonthPP	84.18±11.58	81.89±14.22	84.64±12.16	78.64±22.57	80.79±21.22	2.522	0.051
Occupational activity	6 Month	13.63±21.31	10.43±19.65	5.1±14.19	14.1±14.19	12.35±19.26	0.769	0.55
	9 Month	12.66±19.88	8.33±17.44	4.1±14.19	10.1±14.19	13.32±21.29	0.765	0.553
	2MonthPP	0±0	0±0	0±0	0±0	0±0		
Sports/exercise activity	6 Month	10.38±3.19	8.77±3.43	7.26±4.36	7.31±1.45	5.49±1.84	4.349	.004
	9 Month	19.16±3.57	14.13±2.58	17.78±3.17	11.29±1.84	7.86±2.86	29.506	.0001
	2MonthPP	4.22±1.47	4.45±1.9	3.67±0.43	0.77±0.9	1.42±0.99	22.283	.0001
Transportation	6 Month	3.18±5.57	8.93±7.6	1.93±1.51	1.9±6.57	4.96±7.93	2.62	.045
	9 Month	17.56±8.76	9.42±9.04	11.67±5.13	9.98±4.03	10.49±5.07	2.903	.030
	2MonthPP	0±0	0±0	0±0	0±0	0±0		
Inactivity	6 Month	5.12±4.26	5.55±1.88	6.67±5.75	9.9±2.36	8.41±5.32	2.715	.039
	9 Month	8.08±4.46	11.45±10.6	9.76±5.12	14.8±1.89	12.19±8.4	2.252	0.075
	2MonthPP	2.67±1.8	2.94±1.88	3.12±2.61	4.07±1.85	4.05±2	1.204	0.32

ANOVA Test.

The estimated daily step counts in the pedometer group were similar in the pedometer plus text message group from 4th month to 7th month: in the 4th month mean step count was 3902±1079 and 3937±1428 steps/day; in the 5th month, 4866±1312 and 4451±1687 steps/day; in 6th month, 5175±983 and 4607±1645 steps/day, and 5608±1183 and 4696±1415 steps/day at 7th month. The result of the study showed a statistically significant increase in the number of steps from 8th to 9th month in the pedometer plus text message group as compared to the pedometer group. In the 8th month, the pedometer plus text messages group and pedometer group reported 6197±1394 and 4814±1214 steps/day (P=0.017), and in the 9th month, 6475±1091 and 5199±1534 steps/day (p=0.028) respectively.

The mean gestational age was 38.32±1.03 weeks and the mean infant birth weight was 2.86±0.26 kg. Among the five groups, no notable differences were found for gestational age at delivery and birth weight. In all five groups, the mode of delivery was normal, 66.67% in the group A, B and D, 75% in group C and 58.33% in group E and by cesarean section, 16.67% in group A and C, 25% in group B and D and 33.33% in group E. Table 4 describes all the secondary outcomes of all the five groups.

Table 4. Between group comparisons of pregnancy outcomes in all 5 groups

Variables		Exercise group (n=12)	Pedometer group (n=12)	Pedometer plus text message Group (n=12)	Text Message Group (n=12)	Control group (n=12)	F-value[1]/ Chi-square[2]	p-value
Gestational Age		38.42±1.24	38.08±1.08	38.67±0.65	38.17±0.94	38.25±1.22	0.584[1]	0.675[1]
Infant Birth Weight (Kg)		2.83±0.28	2.96±0.23	2.94±0.33	2.83±0.25	2.78±0.20	1.075[2]	0.378[1]
Type of delivery	Induction of Labor (N %)	1 (8.33)	3(25)	2 (16.67)	5 (41.67)	5 (41.67)	12.769[2]	0.887[2]
	Normal delivery (N %)	8 (66.67)	8 (66.67)	9 (75)	8 (66.67)	7 (58.33)		
	Cesarean section (N %)	2 (16.67)	3 (25)	2 (16.67)	3 (25)	4 (33.33)		
	Vacuum delivery (N %)	2 (16.67)	1 (8.33)	1 (8.33)	1 (8.33)	1 (8.33)		

Results are given as Mean±SD; N(%); [1] ANOVA Test; [2]Chi-Square Test.

Discussion

The present study is the first study using supervised exercises, pedometer, and text messages simultaneously to estimate the effectiveness of these interventions on physical activity and weight-related parameters. The aim was to investigate the effectiveness of different behavioral interventions (supervised exercises, text messages, and pedometer-based physical activity interventions) on physical activity level, weight- related parameters and pregnancy outcomes during pregnancy.

The result of our study reported statistically significant reduction in post-partum weight retention at 2 months post-partum. The mean weight retention was lower in supervised exercise group followed by pedometer plus text message group and pedometer group as compared to control group. Previous studies based on exercise and lifestyle intervention also reported similar trend for lower mean in post-partum weight retention.[24,25] The possible reason for the lesser post-partum weight retention in addition to the loss of placenta, amniotic fluid, non-adipose tissue and maternal blood volume[26], there can be the improved tonicity of the musculature and lesser fat retention because of the supervised exercise sessions during pregnancy.

This study also showed that there was statistically insignificant between group difference in the gestational weight gain. Although the mean gestational weight gain was found to be lower in the supervised exercise group followed by pedometer plus text message and pedometer groups. Consistent with the finding of our study, previous studies focusing on exercises and pedometer assessed physical activity were also effective in reducing gestational weight gain[14,27] The association between gestational weight gain and post-partum weight retention is well established in the literature. In the current study, post-partum weight retention and gestational weight gain were lower in pregnant women attending the supervised exercise throughout the intervention period. This finding was consistent with the study of Haakstad et al..[18]

Interventions such as supervised exercises, pedometer plus text message and pedometer have shown to improve the physical activity level from 4th month to 9th month of pregnancy as compared to control group. This increase in level of physical activity was helpful in maintaining the gestational weight gain in accordance with the ICMR guidelines. During pregnancy, increasing physical activity levels to achieve recommended physical activity is important, as it can assist females in attaining appropriate weight gain by increased energy expenditure. The salient finding of the present study was significant increase in daily steps count from the 4th month to the 9th month as reported by pedometer in the group B and C. In 8th and 9th months of pregnancy, increase in the number of steps were found to be statistically significant (p=0.017 and p=0.028) in group C as compared to group B. In our study, the application of pedometer in the pedometer plus text message and the pedometer group was found to be an effective approach to improve the physical activity level as they were able to reverse the decline trends of physical activity, as most of the pregnant females remained more physically active and have increased their physical activity level in the third trimester. Another study also showed similar trend for physical activity level in pregnant women with gestational diabetes mellitus by using WINGS-MOC intervention.[13] A review has also suggested that physical activity in pregnancy is beneficial for well-being of maternal and infant health.[28]

In the third trimester, pregnant women in supervised exercises, pedometer plus text message and pedometer groups remained more active and spent more time in sports and exercise activities as compared to text message and control group as demonstrated by pregnancy physical activity questionnaire. Text message alone intervention was not found as effective as other interventions to manage gestational weight gain and increase physical activity in pregnancy. Although previous research using text messages as intervention to manage gestational weight gain and increase physical activity showed mixed results.[29,30]

Our results revealed that increased in physical activity during pregnancy leads to have a greater number of normal deliveries as compared to cesarean delivery in intervention groups as compared to the control group. This finding was found to be consistent with the study of Barakat et al.[31] The improved tone of pelvic floor musculature, abdominal and physical fitness may be important factors for such pregnancy outcomes. Increased sedentary behavior in pregnant females has been found to be linked with unfavorable pregnancy outcome.[32]

Early implementation of interventions, personal counselling, supervised exercises or physical activity, regular weight monitoring and pre-set maximal GWG goal are the several factors that may add to the control of GWG during pregnancy.[33] Walking is self-paced and the most preferred physical activity for an individual to sustain their physical activity level; so it can be easily incorporated in pregnant females to increase their physical activity level during pregnancy.Walking can be easily adopted during pregnancy but still there is requirement of pregnancy-focused community walking initiatives.[34] A pedometer is a small and inexpensive device and can be easily used in pregnant women to address physical activity patterns or step counts during walking or any household activity. Regarding the generalization, applicability and external validity of our clinical trial, the study showed high adherence rate (≥90%) for all BMI females that strongly supports our results to the healthy pregnant population.

The present study has some limitations such as: the assessment of physical activity was self-reported, only one-way text messages were used, in addition, the participants and the investigator were not blinded.

Although the study is still ongoing, the findings to date suggest that pregnant women should be regularly educated about the positive impact of exercise and physical activity by skilled health professionals. Supervised exercise and the use of a pedometer are recommended to increase physical activity and decrease sedentary behavior throughout pregnancy. These behaviors play an important role in maintaining a long-term healthy lifestyle for both mother and child.

Conclusions

It can be concluded that supervised exercise sessions of light to moderate intensity can limit excessive gestational weight gain, reduce post-partum weight retention, increase physical activity and help in adopting a healthy lifestyle during pregnancy.

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Author contributions

Rani V and Joshi S participated in the creation, design and analysis of data for data collection, interpretation of results and elaboration of scientific writing.

Conflicts of interest

No financial, legal or political conflicts involving third parties (government, corporations and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to grants and funding, advisory board participation, study design, preparation of manuscript, statistical analysis, etc.).

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