Original Article

The Relationship between Physical Activity during Pregnancy, Post-Cesarean-Section Pain, and Analgesia Requirement

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Abstract

Background & Objective: The cesarean section increases worldwide and has many side effects, including acute pain. This study investigated the relationship between physical activity during pregnancy, analgesic consumption, and maximal postoperative pain in women with low segment cesarean section.
Materials & Methods: 340 Cesarean section women were interviewed by demographic and global physical activity questionnaires during the pre-operative visits. The participants were categorized into high, moderate, and low physical activity groups (high PA, moderate PA, low PA, respectively) according to the global physical activity questionnaire guidelines. The maximal postoperative pain (MPP), the type, and doses of analgesia used/2 days were recorded. Pearson correlation, Chi-square, and one-way ANOVA were used to analyze the data.
Results: MPP was reduced in the high PA group (5.48 ±1.72) compared to the moderate (6.46±1.30) and low PA groups (6.97±1.92; p<0.0005, p<0.0005, respectively). There was a difference between the moderate and low PA groups (p=0.04). Paracetamol was the common analgesic without significant difference among groups (p=0.37). The numbers of paracetamol doses significantly reduced in the high PA group (3.31±1.65) compared to the low PA group (4.03±2.01, p=0.01). MPP had a significant and low negative correlation with total physical activity (r=-0.25, p=0.0005). There was a negative significant correlation between occupation (r=-0.491, p=0.0005), recreational (r=-0.262, p=0.0005), and travel activities (r=--0.150, p=0.006) with MPP. There was a low positive correlation between sedentary activity and MPP (r=0.23, p=0.0005).

Conclusions: Maternal physical activity can be a non-pharmacological and cost-effective method of pain management.

Keywords: Acute Pain, Physical Activity, Pregnant Women

Introduction

Cesarean section (Cs) is one of the major surgeries for women worldwide. The international healthcare community presented the ideal rate for Cs 5 - 15% of all live births (1). Over 1.3 million Cesarean sections have been performed annually in the United States (2). The rate of Cs in India has doubled between 2005-2015 (3), and this was 48% in 2014 in Iran (4). Iran has one of the highest rates of Cs globally (5). Increased Cs are multidimensional and caused by various factors such as fear of labor pains (6-8), urinary incontinence, and emotional aspects (8). Some possible complications of cesarean deliveries are postpartum hemorrhage, hysterectomy, adhesions, cesarean section scar, abdominal wall endometriosis,

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and postoperative pain (9). According to the International Association for the Study of Pain (IASP), pain is "An unpleasant sensory and emotional experience associated with or resembling that associated with actual or potential tissue damage"(10). Therefore, the post-cesarean section pain can be caused by surgical wounds, bloating, uterine contractions, tension, and psychological stress (11). Women with severe post-cesarean acute pain are 2.5 and 3 times more likely to reveal chronic pain and develop postpartum depression than women with moderate post-cesarean pain, respectively (12). The post-cesarean section pain is associated with breastfeeding and newborn care problems (2,13), chronic pain (2), prolonged hospitalization (14), decreased return of intestinal activity, increased risk of deep vein thrombosis, intestinal effects, delay in recovery (15), and low sleep quality (16, 17).

Researchers reported that the analgesic regimen is inadequate and needs to improve for pain intensity management (17, 18).

Some studies have shown that a period of the physiotherapy program and massage therapy in the early stage of the post-cesarean section has a positive effect on pain reduction and analgesic consumption (19-21). A recent study also reported a relationship between physical activity and pain-related disability reduction in women with normal delivery (22). While pain management through an analgesic regimen has some challenges and physical activity has many health benefits, this study aimed to investigate the relationship between physical activity during pregnancy, analgesic consumption, and maximal postoperative pain (MPP) in women with low segment cesarean section.

Materials & Methods

This cross-sectional study was performed at the postpartum unit at Valiasr hospital, a public hospital in the southwest of Iran, affiliated with the ministry of health, Fars province. It is the largest government hospital that serves medical services to Fasa and suburbs. All women gave written informed consent after the purpose of the study had been fully explained. The local ethics committee approved the study protocol in 2019-06-17 (Approval ID: IR.FUMS.REC.1398.043).

Subject Selection

From 1147 elective cesarean sections referred to Valiasr hospital in 2019 and 2020, 340 healthy women (18-35 years) undergoing elective cesarean section with spinal anesthesia participated in this study. Based on the Cochran formula with a confidence level of 95% confidence interval of 5%, the minimal sample size was 288. We increased the sample size as large as possible (to 340 participants). All participants had a normal and single pregnancy in their first or second gravid and a balanced diet (based on weight gain during pregnancy).

Our exclusion criteria were suffering from heart disease, diabetes mellitus, pre-eclampsia or eclampsia, circulation surgery, history of preterm premature rupture of membranes or cervical incompetence, preterm labor, frequent bleeding in the second trimester, placenta Previa, intrauterine growth restriction, hypertension in pregnancy, pulmonary disease, epilepsy, twin and multiple pregnancies, insufficient weight gain during pregnancy, and complication during the operation, and history of opioid use.

Protocol

Patients filled demographic and global physical activity questionnaires based on their physical activity during pregnancy in the pre-operative visits. Pain scores were measured every 4 hours after surgery, and the highest score was considered maximal pain intensity (23). Painkillers (paracetamol/ paracetamol + pethidine) were prescribed based on the pain complaints by patients. We inserted the total doses of painkillers over 48 hours postoperative.

Measurements

In this study, three questionnaires were used for data collection.

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Basic data questioner

It contains three parts, including participant's characteristics, the number of antenatal visits, and analgesia used.

Visual analog pain scale (VAS) to assess pain intensity

A numerical scale ranging from 0 to 10 tries to measure the pain intensity. 0 and 10 points indicate no pain and unbearable pain, respectively (24). An assessor who was unaware about the patient's groups recorded the maximum pain intensity 24 hours after surgery based on the VAS score.

Global Physical Activity Questionnaire (GPAQ)

World health organization developed GPAQ to assess physical activity in 2002. It was recommended to monitor physical activity (PA) in developing countries (25). It consists of 16 questions to estimate the physical activity levels in 3 areas (occupation, travel, and recreational activities) and sedentary behavior. The participants were categorized into low, moderate, and high-intensity PA groups according to the GPAQ guidelines.

Statistical Analysis

The normality of the data distribution was assessed by visual assessment based on the histogram. The results were presented in mean (SD), median (range), or number (percentage). One-way ANOVA, chi-square, and spearman correlation performed at a significant level of $P \leq 0.05$. Effect size calculated by Eta squared and assessed based on Cohen's benchmarks (26). All statistical analyses were performed using SPSS software (version 26.0, Chicago, IL, USA).

Results

Table 1 presents the participants' characteristics. The means (SD) ages for low, moderate, and high groups were 25.60(3.87), 25.26(3.73), and 24.50(4.02), respectively. 61.8% of low, 59.57% of moderate, and 65.16% of high groups had high school and diploma. Furthermore, 79.09%, 85.10%, 80.89% in low, moderate, and high groups, respectively, were housewives. 60%, 65.24 %, and 68.53% of low, moderate, and high groups, respectively, were urban area residence. The mean (SD) numbers of antenatal visits were 4.30(1.43), 4.64(1.63), and 4.34(1.46) in low, moderate, and high groups, respectively. There were no significant differences among groups concerning their characteristics and number of antenatal visits.

Table 1. Number and percent distribution of the study subjects according to their socio-demographic characteristics and the number of antenatal visits

Variables (N)	Low PA (n=110)	Moderate PA (n=141)	High PA (n=89)	Total (n=340)	One-way ANOVA (P) or X^2(P)
Age (years) Mean ±SD	25.60±3.87	25.26±3.73	24.50±4.02	25.17±3.86	(0.13)[a]
Level of education No (%)					
Educational level up to middle school	33 (30)	45 (31.91)	25 (28.08)	103 (30.29)	0.77(0.94)[b]
High school and diploma	68 (61.8)	84 (59.57)	58 (65.16)	210 (61.76)	
University Degree and above	9 (8.2)	12 (8.51)	6 (6.74)	27 (7.94)	

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Occupation No (%)					
- Housewife	87 (79.09)	120 (85.10)	72 (80.89)	279 (82.05)	1.62 (0.44) [b]
- Working	23 (20.91)	21 (14.89)	17 (19.11)	61 (17.95)	
Residence No (%)					
- Urban	66 (60)	92 (65.24)	61 (68.53)	219 (64.41)	1.63 (0.44) [b]
- Rural	44 (40)	49 (34.75)	28 (31.46)	121 (35.58)	
Number of ante-natal Mean ±SD	4.30±1.43	4.64±1.63	4.34±1.46	4.45±1.52	(0.15) [a]

[a] indicates the result of one way ANOVA (p); [b] indicates the result of X2 (p): Chi-Square Test & P

Physical activity parameters (MET/day) and VAS scores are reported in Tables 2 and 3, respectively. The high PA group had the highest score in occupation 85.71 (205.71) (MET/day) and travel 480 (378) (MET/day). The highest score in sedentary behavior belonged to the moderate PA group 480 (180) (MET/day). The median (IR) of recreation (MET/day) was equal to 0 in all groups (Table 2).

Table 2. Median (IR) of the physical activity parameters (MET/day) in all participants and three subgroups

Physical activity parameters (MET/day)	Occupation	Travel	Recreation	Sedentary behavior	Total Physical activity
All participants (N= 340)	0(0)	2400 (2880)	0 (0)	480 (300)	102.857 (85.72)
Low PA (N=110)	0 (0)	0 (141.42)	0 (0)	465 (315)	0 (217.142)
Moderate PA (N=141)	0 (0)	411.42 (257.14)	0 (0)	480 (180)	411.42 (171.42)
High PA (N=89)	85.71 (205.71)	480 (378)	0 (0)	300 (195)	480 (517.28)

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Table 3. Maximum Postoperative Pain intensity (visual analog scale) in participants and three subgroups

Pain score (VAS)	No pain (%)	Mild pain (%)			Moderate pain (%)			Severe pain (%)			Worst unbearable pain	Mean (SD)	One-way ANOVA (p)
	0	1	2	3	4	5	6	7	8	9	10		
Participants (%)	0	0	0	0.9	11.8	26.2	16.8	18.2	13.5	6.2	6.5	6.37 (1.73)	-
Total	0	0.9			54.8			39.7			6.5		
Low PA(%) (N=110)	0	0	0	0.9	10	18.2	12.7	13.6	21.8	10	12.7	6.97 (1.92	
Total (%)	0	0.9			49.9			45.4			12.7		
Moderate PA(%) (N=141)	0	0	0	0	1.4	27.7	22.0	30.5	10.6	5.7	2.1	6.46 (1.30)	* (p<0.0005)
Total (%)	0	0			51.1			46.8			2.1		
High PA(%) (N=89)	0	0	0	2.2	30.3	33.7	13.5	4.5	7.9	2.2	5.6	5.48 (1.72)	
Total (%)	0	2.2			77.5			14.6			5.6		

* indicates significant difference at p <0.05

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The highest mean (SD) VAS score (MPP) was in low PA (6.97±1.92), moderate PA (6.46±1.30), and high PA (5.48 ±1.72), respectively (Table 3). One-way ANOVA test indicated a significant difference among groups F (2, 338) =20.74, p=0.0005). Eta squared (η2) (d=0.11) showeda moderate effect size. According to the Tukey post hoc test, there was a significant difference in the high PA group compared to the moderate PA and low PA groups (p<0.0005, p<0.0005, respectively). There was also a remarkable difference between the moderate PA and low PA groups (p=0.042, Chart 1).

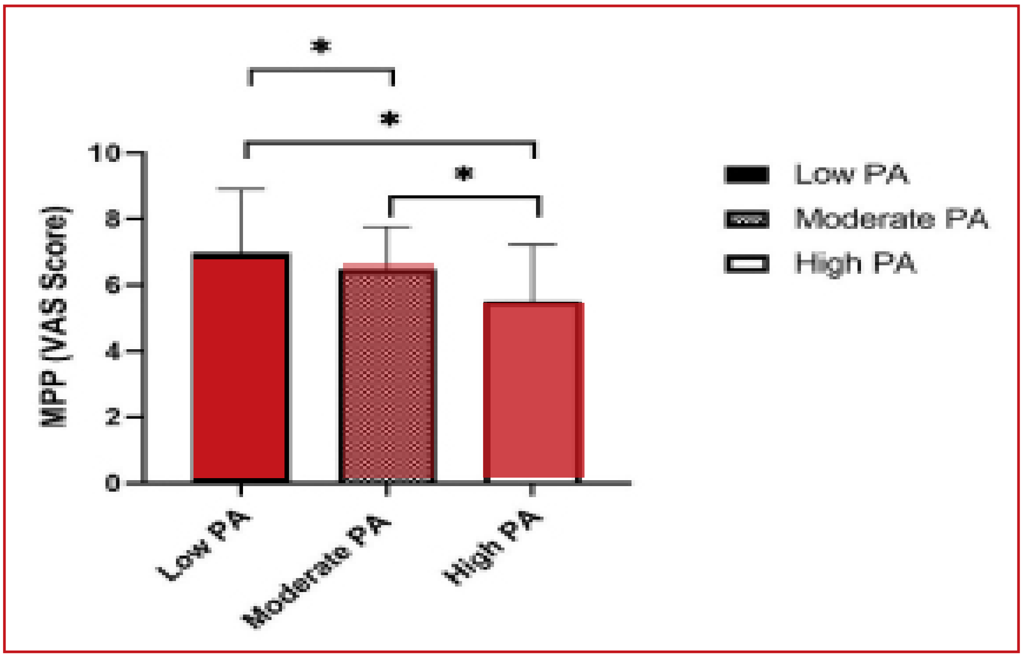

Chart 1. The mean (SD) VAS score of maximum postoperative pain (MPP) in low physical activity (PA), moderate PA, and high PA groups. * indicates statistically significant at p<0.05

Paracetamol was the common analgesic used among low (80.91%), moderate (85.81%), and high PA (87.64%) groups; however, the differences were not significant (p=0.377; Table 4).

Table 4. The mean (SD) and percent distribution of the study subjects according to analgesia used during the post-cesarean period

Type of analgesic used:	Low PA (N=110)		Moderate PA (N=141)		High PA (N=89)		Total (N=340)		X²(P)
- Paracetamol injection	89	80.91%	121	85.81%	78	87.64%	288	84.71%	$X^2(2)$ = 1.95 (p=0.37)
- Paracetamol and Pethidine injection	21	19.09%	20	14.18%	11	12.35%	52	15.29%	

There was no significant difference among groups p>0.05.

Indeed, there was a significant difference F (2, 337) =3.86, p=0.02) in mean numbers of paracetamol doses used/ 2 days in low PA (4.03±2.01), moderate PA (3.64±1.79), and high PA (3.31±1.65) groups. Eta squared (η2) (d=0.02) showed a small effect size. ITukey's post hoc test revealed a significant difference between the high and low PA groups (p=0.01, Figure 2).

However, there was no remarkable difference in the moderate PA group compared to the high and low PA groups (p=0.37, p=0.21; respectively, Chart 2).

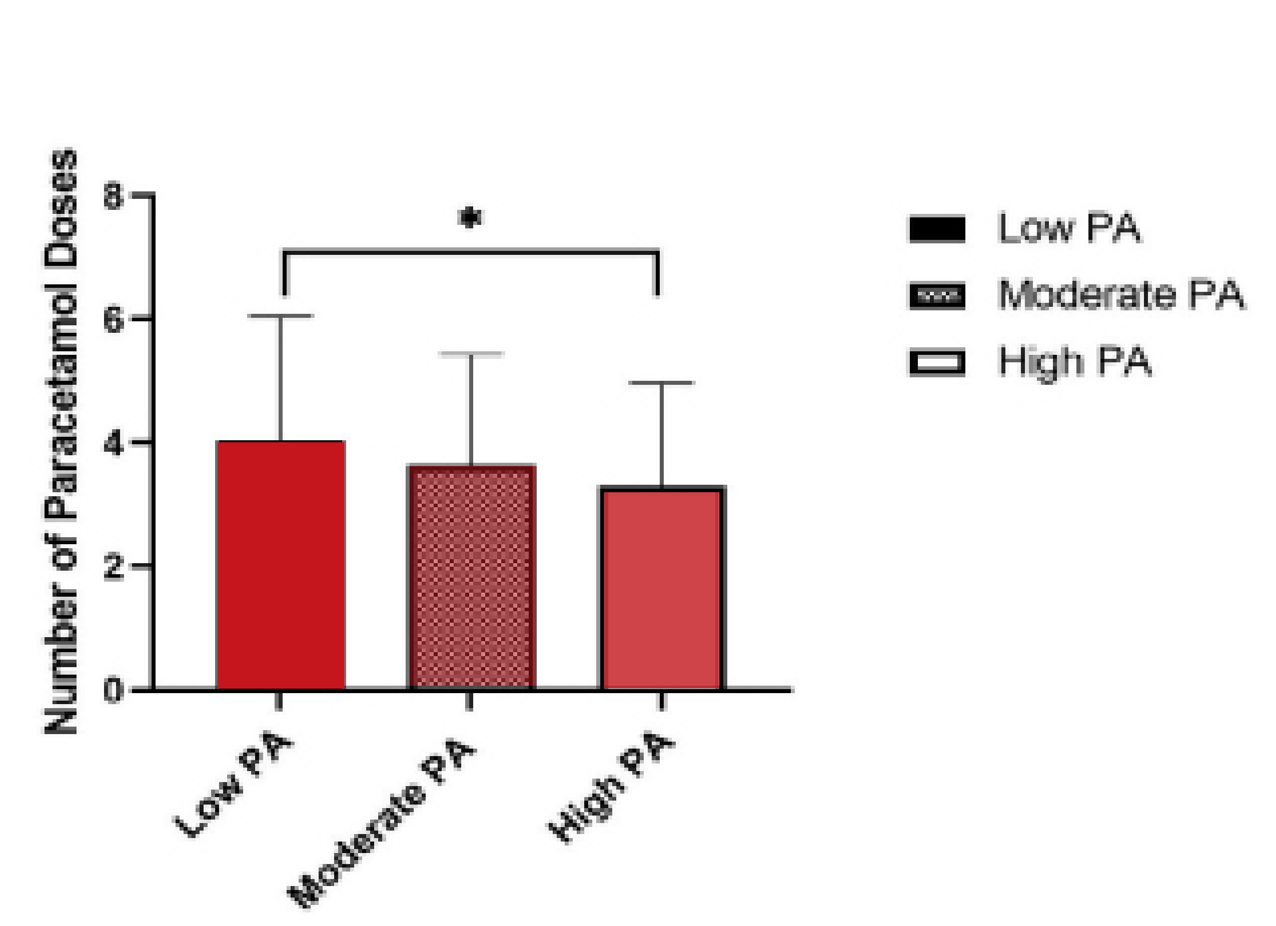

Chart 2. The mean (SD) of paracetamol doses used/2 days in Low physical activity (PA), moderate PA, and high PA groups. * indicates significant difference at p<0.05

MPP (VAS score) had a significant but low negative correlation with total physical activity (TPA; MET/day; r=-0.25, p=0.0005; Figure 1.A). There was a negative significant correlation in MPP and physical activity domains including occupation (MET/day; r= -0.491, p=0.0005; Figure 1.B), recreation (MET/day; r= -0.262, p=0.0005; Figure 1.C), and travel activities (MET/day; r= -0.150. p=0.006; Figure 1.D). There was a negative significant correlation between MPP and total physical activity duration (TPAD; minutes/day; r =-0.24, p=0.0005; Figure 1.E). Also, there was a significant but low positive correlation between MPP and sedentary activity (SA) and in studying women (r= 0.23, p=0.0005; Figure 1.F).

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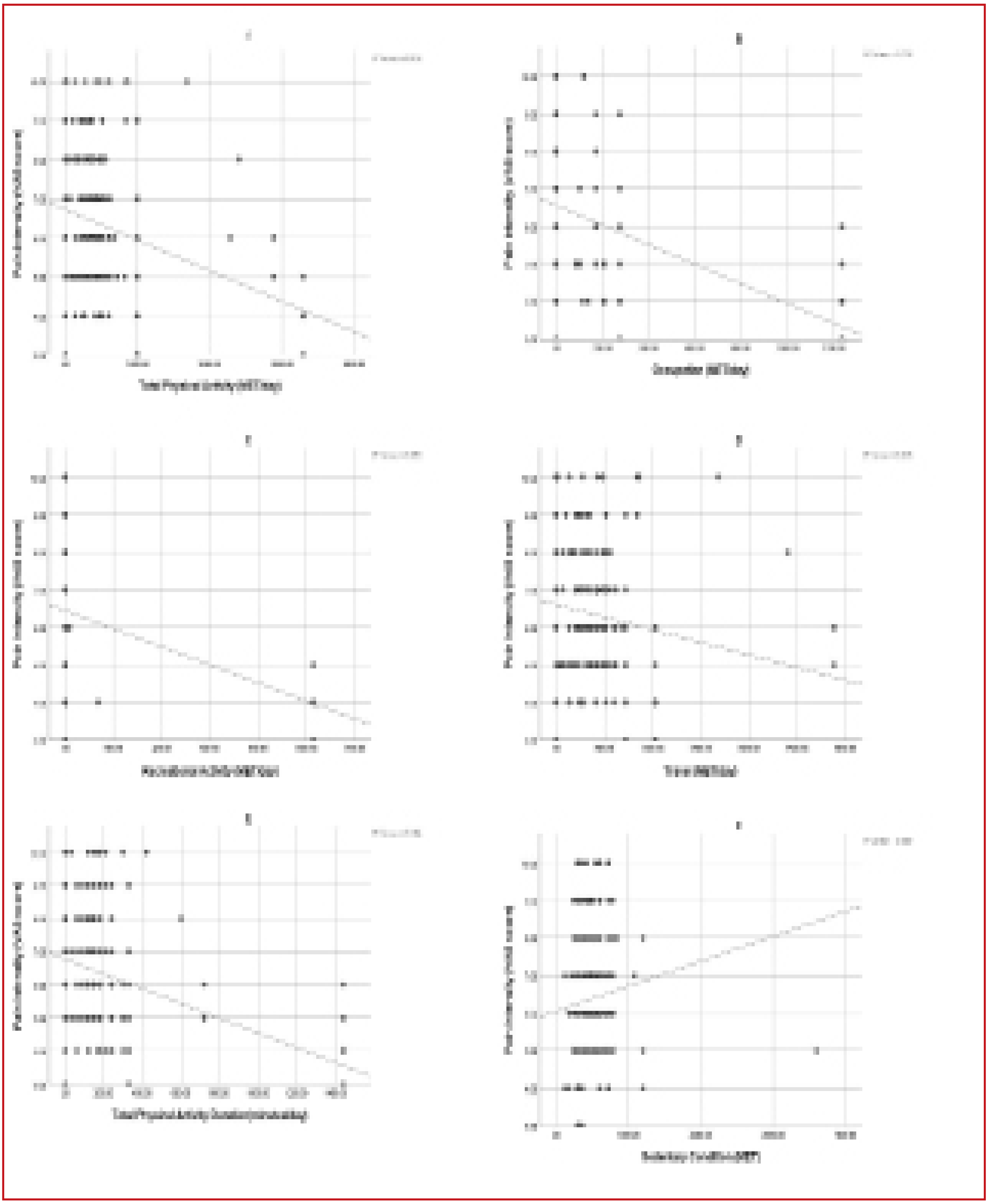

Figure 1. Correlation between maximum (post-operative) pain intensity (MPP; VAS score) with A: total physical activity (TPA; MET/day; r=-0.25, p=0.0005), B: occupation (MET/day; r= -0.491, p=0.0005), C: recreation (MET/day; r= -0.262, p=0.0005), D: travel activities (MET/day; r= -0.150, p=0.006), E: total physical activity duration (TPAD; minutes/day; r =-0.24, p=0.0005), and F; sedentary activity (SA) (r= 0.23, p=0.0005)

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Discussion

The purpose of this study was to investigate the relationship between physical activity during pregnancy and the highest post-cesarean pain intensity over 24 hours. Paracetamol was the common analgesic used in women (<80%). Over two days, the dose used in the high group was lower than that of the low group ($p = 0.017$) with a small effect size ($d = 0.02$). There was a significant relationship between physical activity and doses of analgesia received ($p=0.01$). Another study has suggested that the relationship between postoperative pain and analgesic consumption is nonlinear, and the predictors of analgesic consumption after cesarean section may differ in people (27).

There was also a significant increase in pain intensity ($p < 0.0005$) by decreasing TPA ($r = -0.25$), TPAD ($r = -0.24$), and occupation ($r = -0.491$). Also, there was a remarkable increase in pain score ($p < 0.0005$) by increasing sedentary condition ($r = 0.23$). When women were categorized according to the GPAQ guideline, there was a significant decrease in pain intensity in the high PA group compared to the moderate and low PA groups ($p < 0.0005$). Also, there was a significant decrease in pain intensity in the moderate PA group compared to the low PA group ($p = 0.042$). Similarly, a study indicated that recovery from pain and sedentary are tightly negatively correlated (28). There is also a link between inactivity and increased risk of chronic pain (29). On the other hand, pain tolerance and modulation are significant and more efficient in athletes (30). Studies examining the effect of physical stimuli on postoperative pain intensity found low pain perception in the experimental groups compared to the control group ($P < 0.05$) and needed fewer medications to control pain ($p \leq 0.05$) (11, 19- 21).

Overall, pain adjustment is probably significant in athletes (31). Exercise-induced analgesia appears to occur by activating central inhibitory pathways (32). Opioids, serotonin, and N-methyl-D-aspartate (NMDA) mechanisms promote exercise-related analgesia (32). It is proposed that in regular physical activity conditions, endogenous opioids increase in the rostral ventromedial medulla and activate μ-opioid (MOR). It reduces the phosphorylation of the NR1 subunit of the NMDA receptor after the expression of the serotonin transporter is reduced, which leads to reducing facilitation in neurons and less pain perception (32-34).

Some researchers also indicated that N-arachidonoylethanolamine circulation increase by exercise. It is involved in exercise-induced analgesia by activating cannabinoid-1 receptors in the brain (35- 37). Endocannabinoids also interact with opioids to produce analgesics (38). The strength of this study was the homogeneity of the groups and focusing on physical activity as a critical issue in health care research. Moreover, since researchers collected the data through the interview, we did not have any missing or improbable data. The limitation of the present study was over/underestimating the level of physical activity reported by participants (39), which we increased the sample size to reduce its effects. Our study was also restricted to one physical activity assessment tool (GPAQ). Therefore, we suggest using a collection of questionnaires or other instruments to report physical activity levels more accurately. Researchers may also measure psychological and chemical pain-related factors, e.g., stress, anxiety, depression, serotonin, and opioids, to define clearly analgesia mechanisms related to physical activity.

Conclusion

The findings of the present study illustrate that maternal physical activity negatively correlates with MPP and is related to less opioid use among post-cesarean section women. Hence, attention to maternal physical activity may be necessary as a non-pharmacological and cost-effective method of pain management.

Acknowledgement

Fasa University of Medical Sciences approved the study protocol in 2019-06-17 (Approval ID: IR.FUMS.REC.1398.043). The authors are very grateful to the patients who participated in the study.

Conflicts of Interest

The authors declare no competing interests.

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