Acta Biomed 2025; Vol. 96, N. 1: 16571 DOI: 10.23750/abm.v96i1.16571

Original article

Assessing physical activity and barriers before and during pregnancy: Insights from an Italian cross-sectional study

Camilla Lugli[1,2], *Lucia Palandri*[1,2], *Eleonora Ferrari*[1], *Elisabetta Fioretti*[3], *Domenico Maione*[4], *Fabio Facchinetti*[5], *Gabriella Aggazzotti*[1], *Elena Righi*[1]

[1]Section of Public Health, Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Modena, Italy; [2]Clinical and Experimental Medicine PhD Program, University of Modena and Reggio Emilia, Modena, Italy; [3]Public Hygiene Service, Public Health Department, Local Health Authority of Modena, Modena, Italy; [4]Food Hygiene and Nutrition Service, Public Health Department, Local Health Authority IRCCS of Reggio Emilia, Reggio Emilia, Italy; [5]Department of Medical and Surgical Sciences for Mother, Child and Adult, University of Modena and Reggio Emilia, Modena, Italy

Abstract. *Background and aim:* Physical activity (PA) during pregnancy is essential for maternal and fetal health, reducing the risk of complications such as gestational diabetes, hypertension, and excessive weight gain. Despite guidelines recommending 150 minutes of moderate-intensity PA per week, many pregnant women globally, fail to meet these recommendations. Limited studies have explored PA habits before and during pregnancy in Italy, revealing a gap in understanding PA adherence. *Methods:* We conducted a cross-sectional study of 390 women delivering a full-term baby at a University Hospital. Participants completed a questionnaire on sociodemographic, obstetric history, and PA habits before and during pregnancy. PA adherence was assessed based on duration (≥150 minutes/week) and intensity (≥3 MET). Descriptive statistics and logistic regression were used to explore associations between PA and sociodemographic factors. *Results:* 52% of the sample reported performing PA during pregnancy and 50% pre-pregnancy. Only 35% maintained their activity across both periods. PA prevalence varied throughout pregnancy, peaking in the second trimester (45%). Adherence to guidelines was low, with 21% meeting the 150 min/week threshold and 22% reaching the intensity cutoff during the third trimester. Regression identified performing pre-pregnancy PA as the strongest predictor of adherence during pregnancy, while having children was the lowest. *Conclusions:* Our study highlights the low prevalence of PA both before and during pregnancy an Italy and identifies barriers to achieving recommended activity levels. These findings emphasize the need for targeted health strategies encouraging PA during pregnancy, a pivotal time for adopting long-term healthy behaviours that benefit both maternal and fetal health. (www.actabiomedica.it)

Key words: physical activity, pregnancy, maternal health, health promotion, public health

Introduction

Promoting physical activity (PA) among pregnant women has become a key public health priority, attracting increasing attention due to its numerous health benefits. A growing body of evidence suggests that maintaining an active lifestyle during pregnancy, when there are no contraindications, offers protection for both maternal and foetal health. Regular PA has been associated with a reduced risk of excessive gestational weight gain, pre-eclampsia, gestational hypertension, gestational diabetes, and postpartum depression in mothers (1–4). Moreover, it contributes to better pregnancy outcomes, such as longer gestational

age, appropriate foetal weight, improved neurodevelopment, and a shorter duration of active labour (1,5,6). Importantly, recent research indicates that PA does not increase the risk of miscarriage, stillbirth, complications during delivery, low birth weight, or preterm birth (7–9). The World Health Organization's "Global Action Plan on PA 2018-2030" underscores pregnancy as a period where PA disparities may arise, advocating for equity in PA across the lifespan (10). WHO guidelines recommend that pregnant women engage in at least 150 minutes of moderate-intensity aerobic activity per week, distributed over several sessions, although any amount of PA is better than none. Similar recommendations are echoed in various international guidelines, including those from Canada, the United States, and Australia (7,11,14–17). The American College of Obstetricians and Gynaecologists (ACOG) specifically advises 30–60 minutes of moderate-intensity activity three to four times a week (18). Italian guidelines are aligned, recommending 150 minutes of moderate-intensity activity per week, at an intensity level of 3–6 Metabolic Equivalent of Task (MET) (19). METs, as defined in the Compendium of Physical Activities, serve as a standard measure of PA intensity, with light-intensity activities ranging from 1.5 to 3 METs, moderate-intensity activities from 3 to 5.9 METs, and vigorous-intensity activities classified as those over 6 METs (20). Despite these recommendations, studies have identified a global trend of insufficient PA among women of childbearing age. Alarmingly, one in three women fails to meet WHO's PA guidelines, and this trend shows no sign of improving over time (21,22). This issue persists during pregnancy, especially in the later stages, with a significant drop in PA levels. In the United States, less than 15% of pregnant women meet the recommended 150 minutes of moderate-intensity PA per week (23). Even when considering PA in terms of MET hours per week or MET minutes per day, many women fall short of the recommended thresholds (5,24). In Italy, the prevalence of physically active pregnant women is similarly low, and adherence to the 150-minute weekly recommendation is often achieved only through occupational and commuting activities (2,25,26). To date, few Italian studies investigated PA intensity and timing in relation to guideline adherence during pregnancy, and none evaluated PA habits both before and during pregnancy in the same women. Furthermore, methodological differences—such as variations in the trimester of evaluation, measurement techniques, or participant characteristics—limit the ability to compare or generalize findings across studies. This study aims to examine the PA habits of healthy, Italian-speaking women who delivered at the Obstetrics Department of a University Hospital in Northern Italy. Specifically, it seeks to describe their PA patterns before and during pregnancy, evaluate adherence to recommended guidelines in terms of frequency, type, and intensity of PA, and explore sociodemographic factors that may influence adherence to these guidelines.

Methods

Study design and participants

We conducted a cross-sectional study involving healthy, Italian-speaking women who delivered a singleton, full term baby at the Obstetrics Department of Modena's University Hospital. This hospital serves as a hub for obstetrics and gynaecology in the Province of Modena, accounting for approximately 52% of the area's deliveries. A total of 400 eligible women—representing about 5% of deliveries in the hospital—were randomly contacted, and 390 agreed to participate. Inclusion criteria required participants to have had a term delivery (37–41 weeks), delivered an appropriate-for-gestational-age (AGA) infant with an Apgar score >7 five minutes after birth, and to be residents of the Province of Modena. Exclusion criteria included mothers younger than 18 years old, mothers of twins or newborns with malformations or chromosomal anomalies, and non-Italian-speaking mothers (as the questionnaire was administered in Italian). The study received approval from the local ethics committee (protocol number 191/2015) and was conducted in accordance with the Helsinki Declaration. Informed written consent was obtained from all participants, and survey data were collected and analyzed anonymously.

Data collection

Trained interviewers randomly recruited participants two days per week during their hospital stay

immediately after delivery. The interviewers explained the study's purpose, and, following informed consent, mothers completed a structured, self-administered questionnaire. This questionnaire was adapted from a validated tool used in a national survey (2,27) examining lifestyle habits before and during pregnancy. It consisted of three sections: (1) general sociodemographic information (e.g., age, residence, employment status); (2) physiological and obstetric history; and (3) lifestyle behaviours. The lifestyle section included subsections on PA (PA) habits, smoking, and dietary behaviours. The PA subsection collected information on both pre-pregnancy and prenatal PA, including the type of activity, frequency per week, duration (in minutes), and perceived intensity (light, moderate, or vigorous). Intensity was defined by perceived changes in heart rate during activity. Each type of PA was assigned a Metabolic Equivalent of Task (MET) value, allowing classification into low, moderate, or vigorous intensity PA (20). Each participant's reported PA—both in terms of time and intensity—was summed to calculate the overall PA performed and to evaluate adherence to PA guidelines. Adherence was assessed using the following dichotomous (yes/no) variables:

- Physically Active Women (PAW): women performing any PA, regardless of intensity or duration.
- Timing Cutoff Reached (TCR): women performing ≥150 minutes of PA per week.
- Intensity Cutoff Reached (ICR): women performing PA with an intensity ≥3 MET.
- Both Cutoffs Reached (BCR): women meeting both the timing and intensity cutoffs.

The Italian Society of Gynaecology and Obstetrics (SIGO) guidelines were consulted to identify potential contraindications to PA during pregnancy (28).

Statistical analysis

Descriptive statistics were used to summarize the data, including medians (IQR) for continuous variables and absolute and relative frequencies for categorical variables. Descriptive analyses were conducted for the entire study population and subgroups of women without contraindications for PA, based on SIGO guidelines (28). To examine associations between maternal sociodemographic characteristics and PA adherence, multiple logistic regression models were employed to calculate adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs). Separate models were developed for different PA adherence categories (PAW, TCR, ICR, BCR) across the pre-pregnancy and pregnancy periods, as well as by trimester. Statistical analyses were performed using SPSS version 27.0. This study was reported according to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (29).

Results

Sociodemographic characteristic of the sample

A total of 390 women participated in the study, with a median age of 33 years at delivery (IQR: 30–37). Table 1 outlines the main sociodemographic and clinical characteristics of the cohort. Most participants were Italian nationals (82%), aged 31-36 years (37%), and resided in urban areas (77%). Nearly half of the women had a high level of education (49%), and the majority were employed (79%). Regarding smoking habits, 39% had a history of smoking, 8% were active smokers during pregnancy, and 27% were exposed to tobacco smoke at home. Over half of the participants were primiparas (56%), and 13% had contraindications to PA according to SIGO guidelines.

PA before and during pregnancy

Overall, 196 women (50%) engaged in PA before pregnancy, 204 (52%) reported being physically active during pregnancy, while 128 (33%) never engaged in PA. Pregnancy prompted changes in PA habits (Figure 1), with 138 women (35%) maintaining their activity levels both before and during pregnancy. Additionally, 66 previously inactive women (17%) began exercising during pregnancy, while 58 women (15%) ceased all activity during pregnancy.

PA prevalence fluctuated across pregnancy: 37% of women were active in the first trimester, rising to

Table 1. Characteristics of the study sample (N=390)

Characteristic	N (%)
Maternal age, categories	
≤25	31 (8)
26-30	85 (22)
31-35	143 (37)
36-40	99 (25)
>40	32 (8)
Nationality	
Italian	320 (82)
European	46 (12)
Extraeuropean	24 (6)
Educational level	
Mandatory schooling	58 (15)
High school	140 (36)
University	192 (49)
Employment Status	
Yes	310 (79)
No	80 (21)
Housing location	
Urban	302 (77)
Extra-urban	88 (23)
Pre-pregnancy BMI, categories	
<18.5	30 (8)
18.5 - 24.9	263 (67)
25 - 29.9	60 (15)
≥30	37 (10)
Reproductive history, parity	
First child	218 (56)
Other children	172 (44)
PA contraindications	
Absolute contraindications	52 (13)
No contraindications	338 (87)
Delivery mode	
Non-cesarean	267 (68)
Cesarean	123 (32)
Sex of the newborn	
Male	206 (53)
Female	184 (47)
Smoking History	
Yes	152 (39)
No	238 (61)
Active Smoking during pregnancy	
Yes	32 (8)
No	357 (92)
Tobacco smoke exposure	
Yes	105 (27)
No	285 (73)

45% in the second trimester before slightly declining to 43% in the third trimester. Only 116 women (30%) maintained regular PA throughout all trimesters. Before pregnancy, the most common forms of exercise were gymnastics (17%) and walking (15%). During pregnancy, as recommended by guidelines, women shifted towards lower-risk activities. Swimming and walking became more prevalent, with swimming increasing from 7% pre-pregnancy to 15% during pregnancy, and walking rising from 15% to 33%. Meanwhile, activities like gymnastics and bicycling gradually declined (Figure 2). Focusing on the 338 women without contraindications for PA, 55% were active during pregnancy. Among them, 18% initiated PA during pregnancy, while 37% continued their pre-pregnancy activities. Notably, 10% of women who had engaged in vigorous sports before pregnancy ceased these activities after conception. Among the 52 women with contraindications, 21% stopped PA during pregnancy, including all those involved in vigorous sports pre-pregnancy, however, interestingly, 10% of this group began walking or swimming during pregnancy. Adherence to PA guidelines is summarized in Figure 3. Considering the overall sample, before pregnancy, 27% of women met the timing threshold (≥150 minutes/week), while 20% met the timing cutoff during the first trimester, 21% in the second, and 21% in the third trimester. Adherence to the intensity threshold (≥3 MET) showed a similar trend: 20% of women met the standard pre-pregnancy, decreasing to 13% in the first trimester and rising to 22% by the third trimester. Meeting both timing and intensity thresholds dropped from 15% pre-pregnancy to 6% in the first trimester, with slight increases in the second (8%) and third (7%) trimesters. Although PA adherence improved during pregnancy, it remained below 50% for most thresholds.

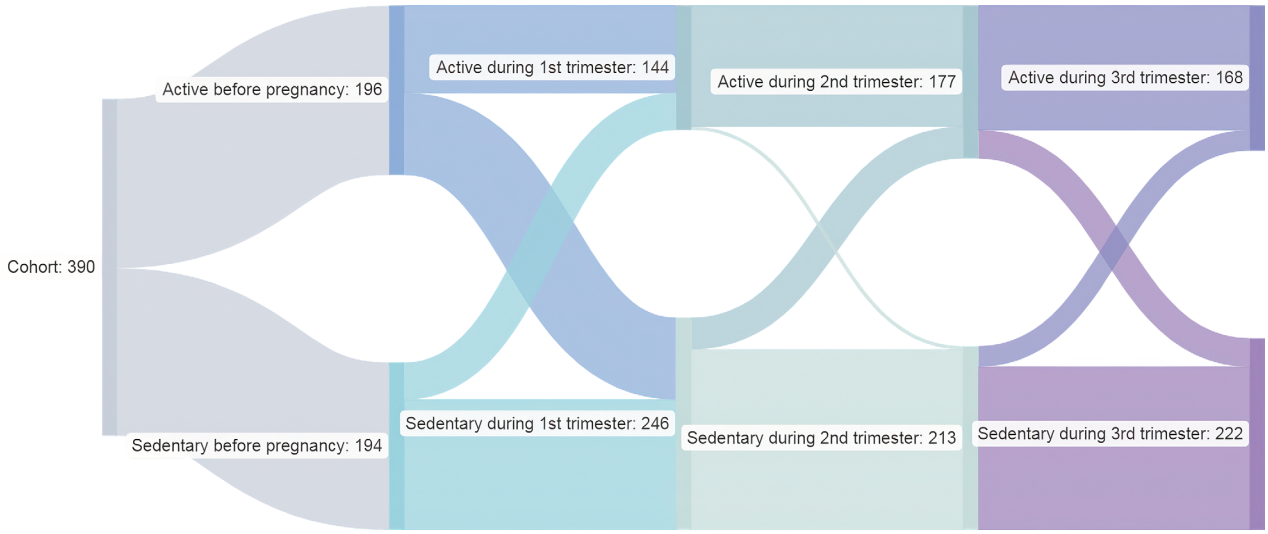

Figure 1. Sankey Diagram showing changes in PA habits throughout pregnancy.

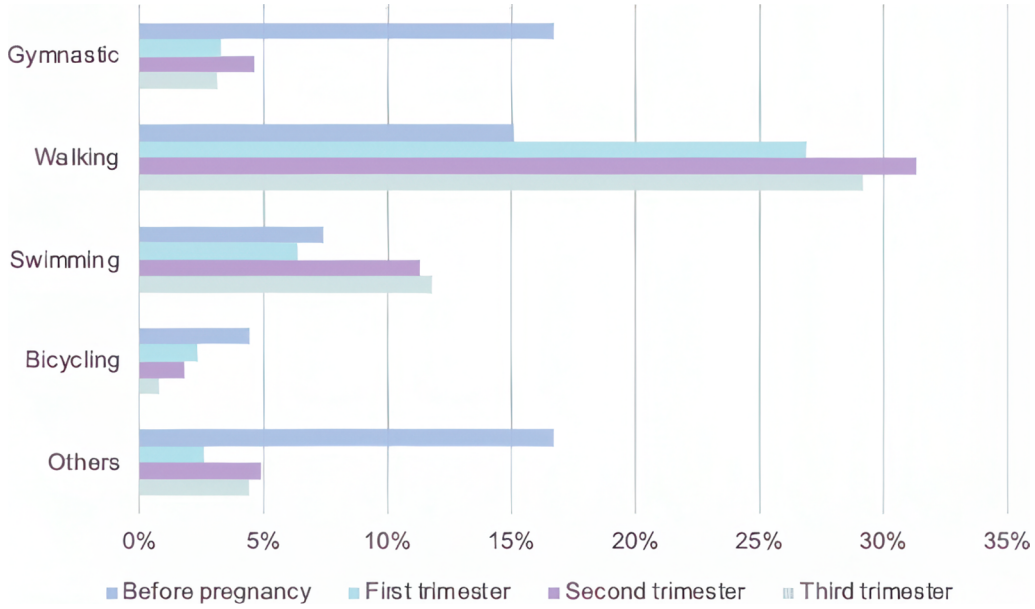

Figure 2. Type of exercise performed before and during pregnancy (*others: dancing, aerobics, tennis, heat gymnastics, running, hydrobike, pilates, volleyball, yoga, rollerskating, karatè, cyclette, zumba, football, crossfit).

Sociodemographic factors and PA before and during pregnancy

Multiple logistic regression analysis (Table 2) revealed that before pregnancy, having children was significantly associated with a lower likelihood of engaging in any PA (OR: 0.30, 95% CI: 0.25-0.57) and lower odds of meeting timing (OR: 0.48, 95% CI: 0.30-0.77), intensity (OR: 0.38, 95% CI: 0.24-0.62), or both cutoffs (OR: 0.30, 95% CI: 0.16-0.58). In contrast, higher educational attainment significantly increased the likelihood of meeting the intensity (OR: 2.06, 95% CI: 1.26-3.35) and both cutoffs (OR: 2.84, 95% CI: 1.49-5.43). During pregnancy (Table 3), performing PA prior pregnancy was the most influential factor for maintaining an active lifestyle, with women

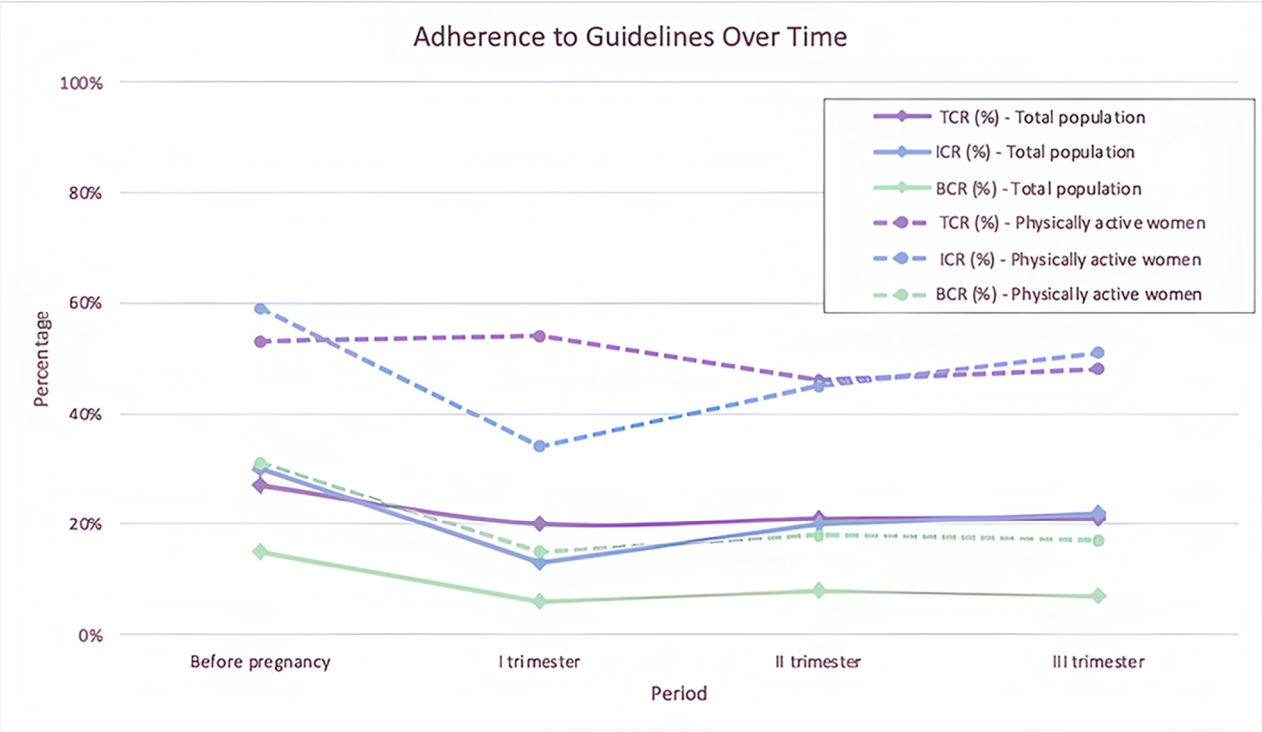

Figure 3. PA adherence (%) before and during pregnancy observed in the whole sample (n=390) and in women performing PA (Before pregnancy, n=196; I trimester, n=144; II trimester, n=177; III trimester, n=168). PAW: Physically active women, TCR: Timing Cutoff Reached (PA > 150min/week), ICR: Intensity Cutoff Reached (PA≥ 3 MET), BCR: Both cutoffs reached.

who were active before pregnancy significantly more likely to meet timing (OR: 3.91, 95% CI: 2.41-6.36), intensity (OR: 2.98, 95% CI: 1.76-5.04), and both cutoffs (OR: 5.29, 95% CI: 2.32-12.06). Italian nationality was also associated with a higher likelihood of engaging in any PA during pregnancy (OR: 2.72, 95% CI: 1.30-5.69).

Discussions

Key findings

Our results show that only half of the women were physically active at any level either before or during pregnancy. While pregnancy is often viewed as a time when women are motivated to adopt healthier behaviors, this transition had a limited effect on PA habits in our cohort of women. Specifically, only 17% of sedentary women started PA during pregnancy, while 15% of previously active women stopped, often without medical contraindications. The percentage of women meeting recommended PA levels was low, at just 15% before pregnancy and dropping to 6-8% during pregnancy. The strongest predictor of PA during pregnancy was being active beforehand, while being childless was associated with a higher likelihood of PA before pregnancy.

Interpretation

According to WHO guidelines, any PA during pregnancy is beneficial, even light intensity activity (8). However, consistent with other studies (23,24,30), our findings reveal that most women are not active enough during pregnancy to reap the health benefits of an active lifestyle. While it is encouraging that 17% of previously inactive women began exercising during pregnancy, a concerning 33% remained inactive before and during pregnancy, and 15% ceased all activity

Table 2. Adherence to PA recommendations before pregnancy: results of Multiple Logistic Regression analyses.

	Before Pregnancy (N: 390)											
	PAW			TCR			ICR			BCR		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Nationality												
Not Italian (ref.)												
Italian	1.86	0.96-3.61	0.066	1.23	0.58-2.61	0.583	1.48	0.68-3.22	0.322	0.67	0.26-1.70	0.40
Educational level												
High school or less (ref.)												
University or more	1.36	0.87-2.13	0.176	1.25	0.76-2.03	0.38	2.06	1.26-3.35	0.004	2.84	1.49-5.43	0.002
Housing location												
Urban (ref.)												
Non-urban	1.28	0.77-2.13	0.338	1.47	0.86-2.51	0.159	1.67	0.98-2.84	0.06	2.00	1.04-3.86	0.037
Employment Status												
No (ref.)												
Yes	1.89	1.07-3.34	0.029	1.23	0.65-2.33	0.530	1.20	0.63-2.31	0.57	1.23	0.52-2.87	0.64
Other children												
No (ref.)												
Yes	0.38	0.25-0.57	0.000	0.48	0.30-0.77	0.002	0.38	0.24-0.62	0.000	0.30	0.16-0.58	0.000
Smoking History												
No (ref.)												
Yes	0.85	0.55-1.32	0.467	1.38	0.86-2.23	0.179	0.95	0.59-1.53	0.83	1.52	0.83-2.76	0.17

Abbreviations: PAW: Physically Active Women; TCR: Timing Cutoff Reached (≥150 minutes/week); ICR: Intensity Cutoff Reached (PA≥ 3 MET); BCR: Both Cutoff Reached.

Table 3. Adherence to PA recommendations during pregnancy for women without contraindications: results of Multiple Logistic Regression analyses

	Pregnancy (N: 338)											
	PAW			TCR			ICR			BCR		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Nationality												
Not Italian (ref.)												
Italian	2.72	1.30-5.69	0.008	1.73	0.76-3.90	0.190	2.09	0.84-5.20	0.114	1.34	0.41-4.35	0.627
Educational level												
High school or less (ref.)												
University or more	1.07	0.65-1.77	0.796	0.77	0.46-1.29	0.323	1.18	0.70-1.99	0.534	0.99	0.50-1.95	0.974
Housing location												
Urban (ref.)												
Non-urban	0.93	0.51-1.67	0.803	1.00	0.55-1.83	0.986	0.79	0.42-1.48	0.460	0.78	0.34-1.78	0.560
Employment Status												
No (ref.)												
Yes	0.98	0.52-1.88	0.964	1.08	0.54-2.17	0.828	1.40	0.67-2.94	0.373	1.43	0.51-4.05	0.498
Other children												
No (ref.)												
Yes	0.71	0.44-1.15	0.165	0.92	0.55-1.52	0.741	0.62	0.37-1.04	0.069	0.79	0.40-1.57	0.504
Smoking History												
No (ref.)												
Yes	1.16	0.64-2.09	0.621	0.89	0.49-1.62	0.708	1.75	0.97-3.16	0.065	1.67	0.80-3.50	0.172
Active Smoking during pregnancy												
No (ref.)												
Yes	0.53	0.25-1.13	0.102	0.85	0.38-1.90	0.701	0.69	0.32-1.50	0.352	0.61	0.22-1.69	0.342
Physically Active before pregnancy												
No (ref.)												
Yes	3.91	2.41-6.36	0.000	2.98	1.76-5.04	0.000	2.82	1.66-4.79	0.000	5.29	2.32-12.06	0.000

Abbreviations: PAW: Physically Active Women; TCR: Timing Cutoff Reached (≥150 minutes/week); ICR: Intensity Cutoff Reached (PA≥ 3 MET); BCR: Both Cutoff Reached.

during pregnancy without contraindications. Meeting the full WHO recommendations for PA, defined as 150 minutes of moderate-intensity aerobic activity per week, was even more rare. Only 15% of women met both intensity and duration guidelines pre-pregnancy, and this rate was halved during pregnancy. When considering just one of these components (duration or intensity), adherence was slightly better, ranging from 20-22% throughout the trimesters. However, our findings highlight that only about one in four women met at least one recommendation, and the proportion of those meeting both recommendations remained low, even among those who were active. Still, our results are promising when compared with previous studies that reported a lower achievement of recommended PA weekly timing (2,31). Interestingly, the first trimester was the most critical period for reduced PA, as factors such as fatigue, nausea, and concern for the foetus often discourage exercise (32–34). This early decline is well-documented in the literature (35–39). Accordingly, our findings show that the percentage of women performing PA during first trimester decreases compared to the period before pregnancy. After the first trimester, PA rates increase slightly, reflecting a partial recovery of activity levels. Furthermore, many women adapted their exercise habits appropriately by avoiding activities involving physical contact, the supine position, or a risk of falling, as recommended by guidelines (8). Smaller proportions of pregnant women doing gymnastics or bicycling, and higher proportions of women swimming or walking are rightly observed during pregnancy compared with before pregnancy. PA during pregnancy is recommend only in the absence of specific contraindications (18). In women without contraindications, 55% engaged in some form of PA during pregnancy, with 18% initiating PA during gestation. However, 31% of this group remained inactive, and 14% ceased all PA. Most women with contraindications correctly stopped PA, but a small portion continued low-intensity activities, such as walking or swimming. These women should be closely monitored to ensure their safety during pregnancy (40). We evaluated the role played by different socioeconomic factors in facilitating or hampering the performance of PA before and during pregnancy. Our findings, in alignment with previous research (24,41), demonstrate that women who were physically active before pregnancy were more likely to maintain an active lifestyle during pregnancy, underlining the importance of promoting PA among women of reproductive age, irrespective of whether they are currently planning a pregnancy. Pre-pregnancy PA habits serve as a predictor of continued activity, which underscores the need to integrate PA counseling into routine care for all women, particularly those in the preconception period. Ensuring that PA becomes a habitual part of daily life can help reduce the perceived risks or discomforts associated with exercise during pregnancy (42). Additionally, the presence of children was associated with lower PA levels before pregnancy. Our results reveal that women with children were significantly less likely to meet the recommended PA thresholds, both in terms of duration and intensity. This highlights the difficulties faced by mothers, who may struggle to find time for self-care due to childcare responsibilities (33,43,44). This challenge is likely compounded by additional factors such as employment demands and household duties, which leave little room for exercise. The interaction between motherhood and employment represents a critical barrier, suggesting that interventions to promote PA among pregnant women should consider the broader context of women's lives, including family and work obligations. Programs designed to support PA may benefit from offering flexible, family-inclusive activities or providing resources for childcare during exercise sessions (45). Women with higher education were more likely to meet PA intensity thresholds and to reach both the intensity and duration cutoffs. This finding is consistent with previous literature that suggests higher education often correlates with better health literacy and greater awareness of the benefits of an active lifestyle (45). Other factors, such as nationality, and living in non-urban areas, played important roles, particularly before pregnancy, and should be considered in future interventions (41).

Limitations and strengths

Several limitations should be noted. The exclusion of non-Italian-speaking mothers due to the Italian-language questionnaire may have introduced selection bias. Additionally, recall bias may have influenced

self-reported data, especially regarding pre-pregnancy and first trimester PA levels. Measuring PA intensity based on perceived heart rate variations could also introduce inaccuracies. Finally. we did not account for leisure-time activities that could reduce sedentary behaviour, and the use of MET values based on non-pregnant populations might have led to energy expenditure miscalculations (46). Nonetheless, our study has important strengths. It involved a representative sample of approximately 400 women, capturing 4.6% of deliveries at the University Hospital. Moreover, few studies have assessed PA habits both before and during pregnancy (39), and our exploration of socioeconomic factors influencing PA across these periods provides valuable insights for future health interventions.

Implications

Our findings reinforce the importance of promoting PA among women well before pregnancy. By instilling active habits early, there is a greater likelihood that women will maintain PA during pregnancy. Public health campaigns should emphasize not only the benefits of PA but also educate women on the appropriate duration, intensity, and types of exercise to safely and effectively engage in PA during pregnancy. These efforts should address barriers such as childbearing responsibilities and the challenges faced during the first trimester (47–49). Collaboration across healthcare sectors, involving midwives, general practitioners, specialists, nurses, and educators, is essential to support women in maintaining PA during pregnancy (50). Pregnancy is a critical period for fostering healthy behaviours, and health equity must be prioritized to ensure all women, especially those with socioeconomic disadvantages, the opportunity to stay active across their reproductive lifespan (8).

Conclusions

In conclusion, our study adds to the growing body of evidence that highlights the low prevalence of PA among pregnant women in Italy and underscores the significant barriers to achieving recommended levels of PA during pregnancy. These findings offer valuable insights for developing effective health promotion strategies during a critical period when women are more likely to adopt healthier behaviours. By addressing these barriers, health interventions can play a crucial role in encouraging sustained PA, benefiting both maternal and foetal health over the long term.

Ethic Approval: The study received approval from the ethics committee of the University of Modena and Reggio Emilia (protocol number 191/2015) and was conducted in accordance with the Helsinki Declaration.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Authors Contribution: C.L., L.P., E.F., E.F., D.M., F.F., G.F., E.R. made a substantial contribution to the concept or design of the article; C.L., L.P., E.F made a substantial contribution to the acquisition, analysis, or interpretation of data for the article; C.L., L.P., E.R. drafted the article; C.L., L.P., E.F., E.F., D.M., F.F., E.R revised the article critically for important intellectual content; C.L., L.P., E.F., E.F., D.M., F.F., E.R. approved the version to be published; C.L., L.P., E.F., E.F., D.M., F.F., E.R. agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Declaration on the Use of AI: During the preparation of this work the authors used ChatGPT in order to improve language and readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Acknowledgments: The article is an 'In Memoriam' article honouring the memory of Prof. Guglielmina Fantuzzi, a mentor and a dearest friend.

Funding: None.

References

1. Morales-Suárez-Varela M, Clemente-Bosch E, Peraita-Costa I, Llopis-Morales A, Martínez I, Llopis-González A. Maternal Physical Activity During Pregnancy and the

Effect on the Mother and Newborn: A Systematic Review. J Phys Act Health. 2021 Jan 1;18(1):130–47. doi:10.1123/jpah.2019-0348.
2. Fantuzzi G, Righi E, Aggazzotti G. A Case-Control Study on Leisure Time Physical Activity (LTPA) during the Last Three Months of Pregnancy and Foetal Outcomes in Italy. Health (N Y). 2016 Jan 28;8(2):133–43. doi: 10.4236/health.2016.82016
3. Davenport MH, Ruchat SM, Poitras VJ, et al. Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: a systematic review and meta-analysis. Br J Sports Med. 2018 Nov;52(21):1367–75. doi: 10.1136/bjsports-2018-099355
4. Shuai Y, Wu J, Li C, Li D. Effect of different physical activity interventions on perinatal depression: a systematic review and network meta-analysis. BMC Public Health. 2024 Jul 31;24(1):2076. doi: 10.1186/s12889-024-19564-w
5. Bisson M, Croteau J, Guinhouya BC, et al. Physical activity during pregnancy and infant's birth weight: results from the 3D Birth Cohort. BMJ Open Sport Exerc Med. 2017;3(1):e000242. doi: 10.1136/bmjsem-2017-000242
6. Davenport MH, Meah VL, Ruchat SM, et al. Impact of prenatal exercise on neonatal and childhood outcomes: a systematic review and meta-analysis. Br J Sports Med. 2018 Nov;52(21):1386–96. doi: 10.1136/bjsports-2018-099836
7. Tsakiridis I, Bakaloudi DR, Oikonomidou AC, Dagklis T, Chourdakis M. Exercise during pregnancy: a comparative review of guidelines. J Perinat Med. 2020 Jul 28;48(6):519–25. doi: 10.1515/jpm-2019-0419
8. WHO Guidelines on Physical Activity and Sedentary Behaviour [Internet]. Geneva: World Health Organization; 2020 [cited 2024 Apr 26]. (WHO Guidelines Approved by the Guidelines Review Committee). Available from: http://www.ncbi.nlm.nih.gov/books/NBK566045/
9. Davenport MH, Ruchat SM, Sobierajski F, et al. Impact of prenatal exercise on maternal harms, labour and delivery outcomes: a systematic review and meta-analysis. Br J Sports Med. 2019 Jan;53(2):99–107. doi: 10.1136/bjsports-2018-099821
10. World Health Organization. Global action plan on physical activity 2018–2030: more active people for a healthier world [Internet]. Geneva: World Health Organization; 2018 [cited 2024 Apr 26]. 101 p. Available from: https://iris.who.int/handle/10665/272722
11. Evenson KR, Mottola MF, Artal R. Review of Recent Physical Activity Guidelines During Pregnancy to Facilitate Advice by Health Care Providers. Obstet Gynecol Surv. 2019 Aug;74(8):481–9. doi: 10.1097/OGX.0000000000000693
12. Evenson KR, Barakat R, Brown WJ, et al. Guidelines for Physical Activity during Pregnancy: Comparisons From Around the World. Am J Lifestyle Med. 2014 Mar;8(2):102–21. doi: 10.1177/1559827613498204
13. Cilar Budler L, Budler M. Physical activity during pregnancy: a systematic review for the assessment of current evidence with future recommendations. BMC Sports Sci Med Rehabil. 2022 Jul 16;14(1):133. doi: 10.1186/s13102-022-00524-z
14. Piercy KL, Troiano RP, Ballard RM, et al. The Physical Activity Guidelines for Americans. JAMA. 2018 Nov 20;320(19):2020–8. doi: 10.1001/jama.2018.14854
15. Mottola MF, Davenport MH, Ruchat SM, et al. 2019 Canadian guideline for physical activity throughout pregnancy. Br J Sports Med. 2018 Nov;52(21):1339–46. doi: 10.1136/bjsports-2018-100056
16. Brown WJ, Hayman M, Haakstad LAH, et al. Australian guidelines for physical activity in pregnancy and postpartum. J Sci Med Sport. 2022 Jun 1;25(6):511–9. doi: 10.1016/j.jsams.2022.03.008
17. Hayman M, Brown WJ, Brinson A, Budzynski-Seymour E, Bruce T, Evenson KR. Public health guidelines for physical activity during pregnancy from around the world: a scoping review. Br J Sports Med. 2023 Jul 1;57(14):940–7. doi: 10.1136/bjsports-2022-105777
18. Physical Activity and Exercise During Pregnancy and the Postpartum Period: ACOG Committee Opinion, Number 804. Obstet Gynecol. 2020 Apr;135(4):e178–88. doi: 10.1097/AOG.0000000000003772
19. Ministero della Salute. Linee di indirizzo sull'attività fisica. Revisione delle raccomandazioni per le differenti fasce d'età e situazioni fisiologiche e nuove raccomandazioni per specifiche patologie [Internet]. Ministero della Salute; 2021 [cited 2024 Apr 26]. Available from: https://www.salute.gov.it/portale/documentazione/p6_2_2_1.jsp?lingua=italiano&id=3285
20. Herrmann SD, Willis EA, Ainsworth BE, et al. 2024 Adult Compendium of Physical Activities: A third update of the energy costs of human activities. J Sport Health Sci. 2024 Jan 1;13(1):6–12. doi: 10.1016/j.jshs.2023.10.010
21. Dipietro L, Evenson KR, Bloodgood B, et al. Benefits of Physical Activity during Pregnancy and Postpartum: An Umbrella Review. Med Sci Sports Exerc. 2019 Jun;51(6):1292–302. doi: 10.1249/MSS.0000000000001941
22. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. Lancet Glob Health. 2018 Oct;6(10):e1077–86. doi: https:10.1016/S2214-109X(18)30357-7
23. Evenson KR, Wen F. National trends in self-reported physical activity and sedentary behaviors among pregnant women: NHANES 1999-2006. Prev Med. 2010 Mar;50(3):123–8. doi: 10.1016/j.ypmed.2009.12.015
24. Nascimento SL, Surita FG, Godoy AC, Kasawara KT, Morais SS. Physical Activity Patterns and Factors Related to Exercise during Pregnancy: A Cross Sectional Study. PloS One. 2015;10(6):e0128953. doi: 10.1371/journal.pone.0128953
25. Bacchi E, Bonin C, Zanolin ME, et al. Physical Activity Patterns in Normal-Weight and Overweight/Obese Pregnant Women. PloS One. 2016;11(11):e0166254. doi: 10.1371/journal.pone.0166254
26. Benvenuti MB, Bø K, Draghi S, Tandoi E, Haakstad LA. The weight of motherhood: Identifying obesity, gestational weight gain and physical activity level of Italian pregnant women.

Womens Health. 2021 May 25;17:17455065211016136. doi: 10.1177/17455065211016136
27. Barbone F, Valent F, Brussi V, et al. Assessing the exposure of pregnant women to drinking water disinfection byproducts. Epidemiol Camb Mass. 2002 Sep;13(5):540–4. doi: 10.1097/00001648-200209000-00009
28. Società Italiana di Ginecologia e Ostetricia (SIGO), Associazione Ostetrici Ginecologi Ospedalieri Italiani (AOGOI), Associazione Ginecologi Ginecologi Universitari Italiani (AGUI), Fondazione Confalonieri Ragunese. Raccomandazioni - Nutrizione in gravidanza e durante l'allattamento [Internet]. 2018 [cited 2024 Apr 26]. Available from: https://www.sigo.it/wp-content/uploads/2018/06/LG_NutrizioneinGravidanza.pdf
29. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007 Oct 20;335(7624):806–8. doi: 10.1136/bmj.39335.541782.AD
30. Gascoigne EL, Webster CM, West Honart A, Wang P, Smith-Ryan A, Manuck TA. Physical activity and pregnancy outcomes: An expert review. Am J Obstet Gynecol MFM. 2023 Jan;5(1):100758. doi: 10.1016/j.ajogmf.2022.100758
31. Evenson KR, Wen F. Prevalence and correlates of objectively measured physical activity and sedentary behavior among US pregnant women. Prev Med. 2011;53(1–2):39–43. doi: 10.1016/j.ypmed.2009.12.015
32. Hegaard HK, Ersbøll AS, Damm P. Exercise in Pregnancy: First Trimester Risks. Clin Obstet Gynecol. 2016 Sep;59(3):559–67. doi: 10.1097/GRF.0000000000000200
33. Evenson KR, Moos MK, Carrier K, Siega-Riz AM. Perceived barriers to physical activity among pregnant women. Matern Child Health J. 2009 May;13(3):364–75. doi: 10.1007/s10995-008-0359-8
34. Altaş ZM, Lüleci NE, Hıdıroğlu S. Evaluation of Physical Activity Level and Related Factors in Pregnancy During the COVID-19 Period. Int J Public Health. 2023;68:1605800. doi: 10.3389/ijph.2023.1605800
35. Owe KM, Nystad W, Bø K. Correlates of regular exercise during pregnancy: the Norwegian Mother and Child Cohort Study. Scand J Med Sci Sports. 2009 Oct;19(5):637–45. doi: 10.1111/j.1600-0838.2008.00840.x
36. Haakstad LAH, Bø K. Effect of regular exercise on prevention of excessive weight gain in pregnancy: a randomised controlled trial. Eur J Contracept Reprod Health Care Off J Eur Soc Contracept. 2011 Apr;16(2):116–25. doi: https: 10.3109/13625187.2011.560307
37. Haakstad LAH, Voldner N, Henriksen T, Bø K. Physical activity level and weight gain in a cohort of pregnant Norwegian women. Acta Obstet Gynecol Scand. 2007;86(5):559–64. doi: 10.1080/00016340601185301
38. Hegaard HK, Petersson K, Hedegaard M, et al. Sports and leisure-time physical activity in pregnancy and birth weight: a population-based study. Scand J Med Sci Sports. 2010 Feb;20(1):e96-102. doi: 10.1111/j.1600-0838.2009.00918.x
39. Román-Gálvez MR, Amezcua-Prieto C, Salcedo-Bellido I, et al. Physical activity before and during pregnancy: A cohort study. Int J Gynaecol Obstet Off Organ Int Fed Gynaecol Obstet. 2021 Mar;152(3):374–81. doi: 10.1002/ijgo.13387
40. Wang L, Wu Y. Current Understanding and Future Challenges in Physical Activity during Pregnancy. J Clin Med. 2023 Jun 12;12(12):3986. doi: 10.3390/jcm12123986
41. Zhang L, Piao J, Zhang W, et al. Physical activity changes and influencing factors among Chinese pregnant women: a longitudinal study. J Matern-Fetal Neonatal Med Off J Eur Assoc Perinat Med Fed Asia Ocean Perinat Soc Int Soc Perinat Obstet. 2024 Dec;37(1):2306190. doi: 10.1080/14767058.2024.2306190
42. Chan CWH, Au Yeung E, Law BMH. Effectiveness of Physical Activity Interventions on Pregnancy-Related Outcomes among Pregnant Women: A Systematic Review. Int J Environ Res Public Health. 2019 May 23;16(10):1840. doi: 10.3390/ijerph16101840
43. Muzigaba M, Kolbe-Alexander TL, Wong F. The perceived role and influencers of physical activity among pregnant women from low socioeconomic status communities in South Africa. J Phys Act Health. 2014 Sep;11(7):1276–83. doi: 10.1123/jpah.2012-0386
44. Righi E, Ferrari E, Lucaccioni L, et al. Parenting infants at the times of COVID-19: a cross-sectional study on parental stress in the province of Modena (Northern Italy). Acta Biomed Atenei Parm. 2024 Feb 28;95(1):e2024059–e2024059. doi: 10.23750/abm.v95i1.15344
45. Sun J, Piernicka M, Worska A, Szumilewicz A. A socio-ecological model of factors influencing physical activity in pregnant women: a systematic review. Front Public Health. 2023 Nov 20;11:1232625. doi: 10.3389/fpubh.2023.1232625
46. Campbell CG, Foster RC, Lanningham-Foster LM, Smith KM. The modified obstetric metabolic equivalent (MET): finding a MET that fits in pregnancy. J Dev Orig Health Dis. 2012 Jun;3(3):159–65. doi: 10.1017/S2040174412000025
47. Ruart S, Sinnapah S, Hue O, Janky E, Antoine-Jonville S. Physical Activity Counselling Received Throughout Pregnancy and Effect on Behaviours: A Quasi-Experimental Study. J Obstet Gynaecol Can JOGC J Obstet Gynecol Can JOGC. 2023 Aug;45(8):560–8. doi: 10.1016/j.jogc.2023.05.025
48. Lugli C, Ferrari F, Filippini T, et al. It's (not) rocket science: public health communication experience as expressed by participants to an international workshop. Popul Med. 2024-,6(July):20. doi: 10.18332/popmed/191254

49. Palandri L, Urbano T, Pezzuoli C, et al. The key role of public health in renovating Italian biomedical doctoral programs. Ann Ig Med Prev E Comunita. 2024;36(3): 353–62. doi: 10.7416/ai.2024.2592
50. Polster M, Olscamp K, Barnett EY, et al. Promoting Physical Activity During Pregnancy and the Postpartum Period. J Midwifery Womens Health. 2023;68(5):596–603. doi: 10.1111/jmwh.13513

Correspondence:
Received: 1 October 2024
Accepted: 12 November 2024
Lucia Palandri, Section of Public Health, Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Modena, Italy, Via Campi 287, 41125 Modena, Italy
E-mail: lucia.palandri@unimore.it
ORCID: 0000-0001-9787-7965