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Full length article

# Gestational weight gain and daily life impact of pregnancy symptoms in healthy women: A multivariable analysis

Rebeca Benito-Villena [a,b], Naomi Cano-Ibáñez [c,d,e,*], Rosario M. Román-Gálvez [f,g], Sandra Martín-Peláez [c,d], Khalid S. Khan [c,d], Juan Miguel Martínez-Galiano [d,h], Juan Mozas-Moreno [a,d,e,i], Carmen Amezcua-Prieto [c,d,e]

[a] Obstetrics and Gynecology Service, Hospital Materno-Infantil del Hospital Universitario Virgen de las Nieves, Granada, Spain
[b] PhD Program in Clinical Medicine and Public Health, International School for Posgraduate Studies, University of Granada, Granada, Spain
[c] Department of Preventive Medicine and Public Health Faculty of Medicine, University of Granada, Granada, Spain
[d] CIBER Epidemiología y Salud Pública (CIBERESP), Instituto de Salud Carlos III (ISCIII), Madrid, Spain
[e] Instituto de Investigación Biosanitaria de Granada (ibs.GRANADA), Granada, Spain
[f] Departament of Nursing, Faculty of Health Sciences, University of Granada, Granada, Spain
[g] Unidad Asistencial Alhama de Granada, Servicio Andaluz de Salud, Granada, Spain
[h] Department of Nursing, University of Jaén, Spain
[i] Departament of Obstetrics and Gynecology, University of Granada, Spain

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ABSTRACT

*Objective:* To study the relationship between gestational weight gain (GWG) and Daily Life Impact of Pregnancy Symptoms (DLIPS) scores.
*Methods:* A multivariable analysis of a clinical trial (the Walking Preg_Project (WPP), ClinicalTrials.gov NCT03735381) was conducted. The cohort data concerning GWG across gestational trimesters (T1, T2 and T3) was categorized into adequate, excessive, and reduced based on published criteria. DLIPS was measured using the pregnancy symptoms inventory (PSI) a validated tool, across the gestational trimesters. Univariable and multivariable analyses were employed to assess the association between the GWG categories and DLIPS scores in each trimester of pregnancy estimating the β-coefficients and 95% confidence intervals (CI).
*Results:* There were 221 participants in the cohort. DLIPS mean score in the overall sample and within adequate, excessive, and reduced GWG categories significantly increased across pregnancy ($p < 0.005$). DLIPS mean score was higher in the excessive GWG category compared to adequate and reduced GWG, in T1 and T2 ($p = 0.035$; $p = 0.031$, respectively). An excessive GWG at T1 [β-coefficient (95 % CI) = 3.88, (0.84, 6.93)] and T2 [β-coefficient (95 % CI) = 4.47 (1.24; 7.70)] was associated with higher DLIPS score compared to an adequate GWG.
*Conclusion:* The impact of pregnancy symptoms on daily life increased throughout pregnancy, overall. Excessive GWG was associated with daily life impact of pregnancy symptoms, particularly in the first and second trimester.

## Introduction

Pregnancy, a period of physical, hormonal, and emotional changes, may affect maternal wellbeing and daily life quality [1]. Pregnancy symptoms, such as nausea, vomiting, sleep problems, and psychological factors like anxiety, stress or depression during pregnancy [2] were previously thought to be normal physiological changes. It is now recognized that these symptoms may be associated with poor health and can impact quality of life [3], leading to absenteeism from work, the need for medical interventions, and an economic burden [4].

Gestational weight gain (GWG), defined as the amount of weight gained between conception and giving birth [5], is known to be adequate in only around a third of pregnancies worldwide, the rest being excessive or reduced in roughly a third each [6]. The GWG categories,

*Abbreviations:* BMI, Body Mass Index; CI, confidence intervals; DLIPS, Daily Life Impact of Pregnancy Symptoms; GWG, gestational weight gain; IOM, Institute of Medicine; IPAQ, International Physical Activity Questionnaire; PSI, pregnancy symptoms inventory; SD, standard deviation; WPP, Walking Preg_Project.

* Corresponding author at: Department of Preventive Medicine and Public Health, Faculty of Medicine, University of Granada, Spain.
*E-mail addresses:* ncaiba@ugr.es (N. Cano-Ibáñez), sandramartin@ugr.es (S. Martín-Peláez), jgaliano@ujaen.es (J.M. Martínez-Galiano), jmozas@ugr.es (J. Mozas-Moreno), carmezcua@ugr.es (C. Amezcua-Prieto).

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excessive and reduced, known to increase the risk to mother and offspring [7–12], impacting obstetric care and healthcare costs [13].

Some studies have reported the severity of specific pregnancy symptoms according to the GWG. For example, excessive GWG has been related to tiredness and anxiety, and reduced GWG to depression [12]. However, no studies have evaluated the impact of pregnancy symptoms on daily life regarding adequate, reduced and excessive GWG categories and trimesters of pregnancy. Therefore, we aimed to study the relationship between GWG categories and DLIPS scores in a cohort of healthy pregnant women across the gestational trimesters.

## Material and methods

### *Study design*

We conducted a secondary analysis of the Walking_Preg Project (WPP) trial, with the entire sample that had complete DLIPS and GWG data. The trial was registered with the U.S. National Library of Medicine Trials registry (www.ClinicalTrials.gov identifier NCT03735381, date of registration November 8, 2018). Briefly, WPP was a single centre, randomized parallel-group trial with three arms carried out on healthy Spanish pregnant women. The original aim of the WPP trial was to assess the effect of a walking program on the prevention of insomnia in pregnancy. A detailed description of the WPP design and methods can be found elsewhere [7]. Primary results of the effects of walking promotion on insomnia in pregnancy have been published [8].

### *Participants and data collection procedures*

Eligible participants were healthy adult pregnant women (18–49 years of age) attended in a public third level Maternity Hospital in Granada (Spain), with sedentary habits (< 5 days/week of moderate-vigorous physical activity at least > 30 min.; equivalent to < 7000 steps/day) and without insomnia or taking drugs for sleeping problems. Women with chronic diseases or with intellectual deficits or difficulty understanding the Spanish language were excluded. Furthermore, to be eligible, participants were required to have a mobile phone and an email account [7].

### *Anthropometry appraisal*

Prepregnancy weight (kg) and height (cm) were self-reported by pregnant women during the first antenatal visit at the hospital (T1), and prepregnancy body mass index (BMI) was calculated. In addition, at T1, T2 and T3, maternal weight (kg) and height (cm) were also measured, and Body Mass Index (BMI) was estimated. Weight and height were measured with calibrated scales and a wall-mounted stadiometer, respectively.

Total GWG (kg) was obtained as the difference in maternal weight between T3 and pre-pregnancy weight and classified following the IOM recommendations into reduced, adequate, or excessive GWG [5] (Appendix 1). *Adequate GWG* refers to weight gain during pregnancy that falls within the recommended range for a woman's pre-pregnancy BMI according to Institute of Medicine (IOM) guidelines [11]. *Excessive GWG* indicates a weight gain during pregnancy that exceeds the upper limit of the IOM's recommended range for a woman's pre-pregnancy BMI. *Reduced GWG* is the category that correspond to weight gain during pregnancy that drops below the lower limit of the IOM's recommended range for a woman's pre-pregnancy BMI. IOM Guidelines for weight gain is suitable for the Spanish population [11].

### *Daily life impact of pregnancy symptoms (DLIPS)*

Pregnancy symptoms inventory (PSI) is often used to measure pregnancy symptoms and daily life impact of pregnancy symptoms (DLIPS) [14]. The use of PSI is essential for systematically measuring and assessing these symptoms. The PSI allows healthcare providers to better understand the extent of a patient's symptoms and their impact on daily life, enabling more tailored and effective care.

DLIPS was assessed at first (T1), second (T2) and third trimester (T3), corresponding to 13th gestational week (T1), 19th gestational week (T2) and 32nd gestational week (T3), by trained staff using the Spanish version of the PSI questionnaire [10]. PSI was previously developed and validated by Foxcroft et al. [14].

PSI has been proved to be reliable (kappa coefficient range = 0.6–0.9) [10]. PSI is a 41-item Likert scale developed from a group of experts and focus groups. It registers the frequency of symptoms that appear in the last month (Likert scale from 0 to 3: 'Never', 'Rarely', 'Sometimes', 'Often') and its daily life impact (DLIPS) (Likert scale from 0 to 2: 'It does not limit me', 'It limits me a little', 'It limits me a lot'). The maximum score of the DLIPS is 82 points (Appendix 2).

### *Covariate assessment*

At T1, trained WPP trial staff collected information on lifestyle variables and sociodemographic data. The variables included were age, number of previous children (0/1/≥2), marital status (yes/no), and academic level (primary/high school/university). Furthermore, in each antenatal interview (T1, T2 and T3), other variables were collected, including smoking (yes/no) and physical activity (PA). PA was assessed through the short International Physical Activity Questionnaire (IPAQ) [15], which classify the participants into three categories according to their activity per week (light, moderate and vigorous).

### *Ethics approval and written informed consent*

This study was performed in line with the principles of the Declaration of Helsinki. Ethical approval for the planned study was obtained from Research Ethics Committee, in February 2019 (Peiba 1644-N-18). Written informed consent was requested from the participant women to a) be included in any of the study groups b) conduct personal interviews to complete the questionnaires used; c) consultation of their clinical history; d) telephone contact in the future; e) review of their data by other researchers, anonymously.

### *Statistical analysis*

We used the final database generated in the Walking Preg_Project in December 2021. Data are presented as the mean ± standard deviation (SD) for continuous variables or number and percentage for categorical variables. The normality of variables was assessed using the Kolmogorov-Smirnov test. Variables followed a normal distribution, allowing us to employ parametric statistical methods. Cut-off points for GWG were defined according to the IOM guidelines [5] (Appendix 1). The DLIPS scores were treated as a continuous variable rather than defining specific cutoff points. This methodological choice is supported by the literature [16] ANOVA test was applied to compare DLIPS mean score between reduced, adequate and excessive GWG categories in the three trimesters of pregnancy. A repeated-measures analysis of variance was used to compare mean DLIPS scores within GWG categories in different trimesters of pregnancy.

Regression coefficients (β) and their 95 % confidence intervals (CI) were calculated by applying backwards elimination, removing the least significant variables (the one with p-value ≥ 0.2), to evaluate across pregnancy the association between GWG categories and DLIPS score. The choice of covariates was informed by the aim to control for potential confounding factors while maintaining model parsimony. This approach allows to retain only those covariates that significantly contributed to the model's predictive power. The first regression model was applied to evaluate the association between adequate, reduced and excessive GWG categories and DLIPS score at T1. It was adjusted by age, number of previous children, academic level, and physical activity at baseline. The

second regression model, related to the association between GWG categories and DLIPS score at T2, was adjusted by age and number of previous children. Finally, the third model, regarding the association between GWG categories and DLIPS score at T3, was adjusted by age, number of previous children, academic level, and baseline physical activity. For all statistical analyses performed, the critical *P* value for significance was set at 0.05. Data were analysed using Stata (version 15.0, StataCorp LP, Tx. USA).

## Results

A total of 285 participants were assessed for eligibility. After applying the inclusion criteria, 270 women were included in the study. Five women in first trimester, T1: 13th gestational week, 32 women in second trimester, T2: 19th gestational week and 3 women in third trimester, T3: 32nd gestational week were excluded because no information about DLIPS was recorded. Weight at T3 was missing in 9 women. Ultimately, a sample of 221 women was analysed **(**Fig. 1**).**

### *Characteristics of the study sample*

An overview of the maternal sociodemographic, anthropometric and lifestyle variables according to GWG is shown in Table 1. According to the GWG, 89 (40.3 %) women had a reduced GWG, while 45 (20.4 %) showed an excessive GWG. There were no statistically significant differences in the distribution of sociodemographic and lifestyle characteristics between GWG categories. Compared to those with an adequate/reduced GWG, participants with an excessive GWG had a higher pre-pregnancy BMI at the baseline interview ($p < 0.001$).

### *DLIPS scores through pregnancy according to GWG*

In the overall sample, the DLIPS mean score significantly increased at the end of pregnancy, being lower in the second trimester of pregnancy (T1: 13.5 (SD ± 8.7), T2: 12.0 (SD ± 8.9), T3: 16.8 (SD ± 9.0): Repeated measures ANOVA $p < 0.001$), and this trend was similar in each GWG category ($p < 0.005$) (Table 2).

### *Association between GWG and DLIPS through pregnancy*

At T1 and T2, the mean DLIPS score was higher among women with excessive GWG than among those with reduced and adequate GWG (T1: 16.1 vs 13.8 vs 12.0; ANOVA p = 0.035; T2: 14.9 vs 12.2 vs 10.3; ANOVA p = 0.031) but not at T3 (19.6. vs 15.9 vs 16.3; ANOVA p = 0.071) (Table 2, Fig. 2). Compared to women who showed an adequate GWG, those with an excessive GWG experienced a worsening of daily life impact of pregnancy symptoms at T1.

[β-coefficient = 3.88 (95 % CI 0.84, 6.93)] and T2 [β-coefficient = 4.47 (95 % CI 1.24; 7.70)]. No significant association was found at T3 (Table 3).

## Discussion

To our knowledge, this is the first study evaluating the association between GWG and impact of pregnancy symptoms on the daily life of Spanish women. Four of ten women analysed had a reduced GWG, while two of ten had an excessive GWG [5]. Regardless of maternal GWG, it was found that the mean DLIPS score improved at 2nd trimester of pregnancy (T2), while it worsened at 3rd (T3). DLIPS score was higher among women with excessive GWG than among those with reduced and adequate GWG in the first half of pregnancy.

A similar trend of inappropriate gestational weight gain during pregnancy has been observed in a study involving a sample of 503 Spanish pregnant women [17]. It showed that 33.8 % and 25.5 % of the women analysed presented a reduced and excessive GWG.

Our results are in line with those of other authors, who point out that T3 is the time when the main physiological, anatomical, and hormonal changes occur, affecting the physical, mental, and social dimensions of pregnant woman, and decreasing her quality of life [2,18]. In addition, the improvement in DLIPS score during T2 compared to the onset of pregnancy may be due, among other factors, to the amelioration of common symptoms such as nausea, fatigue, and mood swings, as pointed out by Hirose et al. [19].

Considering GWG, the mean DLIPS score at T1 and T2 in women with an adequate GWG was statistically lower than in the reduced/excessive GWG groups. In line with our findings, recent studies have shown that inadequate GWG, across an uncomplicated pregnancy, was a warning sign of symptoms of tiredness and anxiety [12], urinary incontinence and sexual dysfunction [20].

The results from our study suggest differences in DLIPS scores among the reduced, adequate and excessive GWG categories at the beginning of pregnancy. DLIPS scores were higher at T3, for the three GWG categories, and slightly superior for the excessive GWG category, but differences were not significant. This is in line with an observational study,

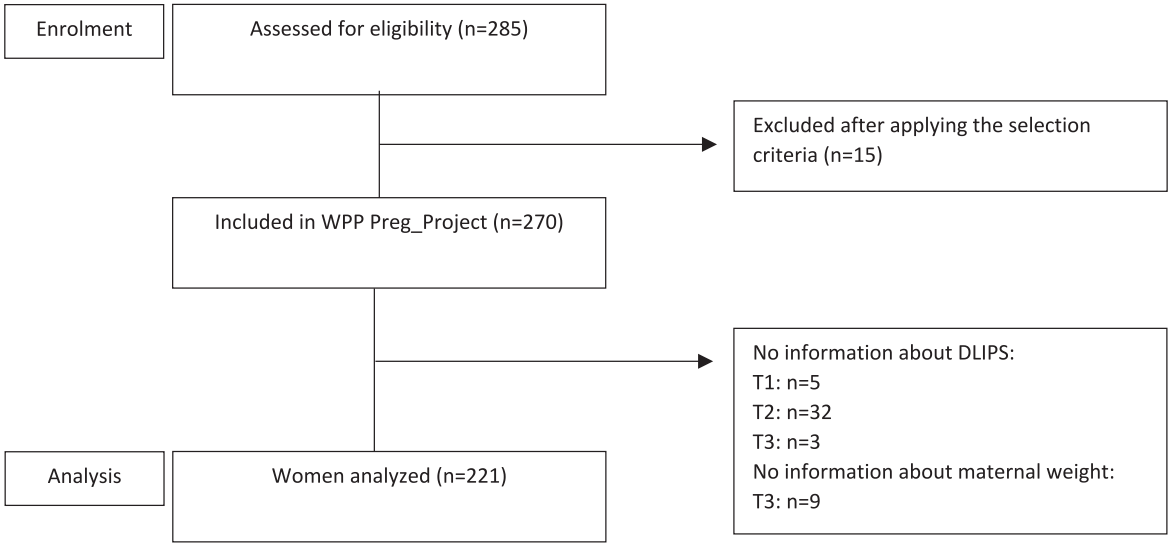


**Fig. 1.** Flowchart of the study participants. DLIPS = daily life impact pregnancy symptoms; T1 = first trimester of pregnancy; T2 = second trimester of pregnancy; T3 = third trimester of pregnancy.

**Table 1**
Baseline study sample characteristics (n = 221).

| | Overall Sample | | Reduced GWG | | Adequate GWG | | Excessive GWG | | P value* |
|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **N = 221** | | **n = 89** | | **n = 87** | | **n = 45** | | |
| Age in years, mean (SD) | 31.9 | (5.1) | 32.4 | (5.6) | 31.7 | (4.7) | 31.6 | (5.1) | 0.569 |
| Prepregnancy BMI, mean (SD) | 26.1 | (5.6) | 25.9 | (5.9) | 25.8 | (5.8) | 27.2 | (4.6) | 0.352 |
| Prepregnancy BMI, n (%) | | | | | | | | | |
| Underweight (<18.5 kg/m$^2$) | 4 | (1.8) | – | – | 1 | (1.2) | 3 | (6.7) | |
| Normal weight (18.5–24.9 kg/m$^2$) | 114 | (51.6) | 55 | (61.8) | 52 | (59.8) | 7 | (15.6) | |
| Overweight (25–29.9 kg/m$^2$) | 56 | (25.3) | 16 | (18.0) | 19 | (21.8) | 21 | (46.7) | **<0.001** |
| Obesity (≥30 kg/m2) | 47 | (21.3) | 18 | (20.2) | 15 | (17.2) | 14 | (31.0) | |
| GWG (kg), mean (SD) | 10.6 | (12.8) | 4.3 | (10.5) | 11.4 | (2.9) | 21.3 | (19.6) | **<0.001** |
| Number of previous children, n (%) | | | | | | | | | |
| 0 | 112 | (50.7) | 44 | (49.4) | 50.6 | (50.6) | 24 | (53.3) | |
| 1 | 78 | (35.3) | 33 | (37.1) | 35.6 | (35.6) | 14 | (31.1) | 0.974 |
| ≥2 | 31 | (14.0) | 12 | (13.5) | 13.8 | (13.8) | 7 | (15.6) | |
| Marital status, n (%) | | | | | | | | | |
| No | 12 | (5.4) | 1 | (1.1) | 5 | (5.8) | 6 | (13.3) | |
| Yes | 209 | (94.6) | 88 | (98.9) | 82 | (94.3) | 39 | (86.7) | **0.013** |
| Academic level, n (%) | | | | | | | | | |
| Primary | 49 | (22.2) | 17 | (19.1) | 20 | (23.0) | 12 | (26.7) | |
| High school | 80 | (36.2) | 31 | (34.8) | 30 | (34.5) | 19 | (42.2) | 0.555 |
| University | 92 | (41.6) | 41 | (46.1) | 37 | (42.5) | 14 | (31.1) | |
| Smoking, n (%) | 25 | (11.3) | 10 | (11.2) | 11 | (12.6) | 4 | (8.9) | 0.621 |
| Physical Activity at baseline (T1), n (%) | | | | | | | | | |
| Light | 64 | (29.0) | 25 | (28.1) | 24 | (27.6) | 15 | (33.3) | |
| Moderate | 125 | (56.5) | 48 | (53.9) | 52 | (59.8) | 25 | (55.6) | 0.743 |
| Vigorous | 32 | (14.5) | 16 | (18.0) | 11 | (12.6) | 5 | (11.1) | |

SD = standard deviation; BMI = body mass index; DLIPS = daily life impact pregnancy symptoms; GWG = gestational weight gain; T1 = first trimester.
p value: Pearson's chi-square test and ANOVA were performed to evaluate differences in categorical and continuous variables, respectively. Values presented in bold showed a statistically significant association ($p < 0.05$).

**Table 2**
Mean DLIPS scores through pregnancy according to GWG in the WPP Study (n = 221).

| | Overall sample | Reduced GWG | Adequate GWG | Excessive GWG | P value[1] |
|---|---|---|---|---|---|
| **Variable** | **n = 221** | **n = 89** | **n = 87** | **n = 45** | |
| **DLIPS at T1; mean (SD)** | 13.6 (8.7) | 13.8 (9.9) | 12.0 (7.4) | 16.1 (8.0) | *0.035* |
| **DLIPS at T2; mean (SD)** | 12.0 (8.9) | 12.2 (9.2) | 10.3 (7.3) | 14.9 (10.5) | *0.031* |
| **DLIPS at T3; mean (SD)** | 16.8 (9.0) | 15.9 (9.1) | 16.3 (8.8) | 19.6 (9.0) | *0.071* |
| **P value[2]** | *<0.001* | *<0.001* | *<0.001* | *0.004* | |

DLIPS = daily life impact symptoms; GWG = gestational weight gain; SD = standard deviation; T1 = first trimester; T2 = second trimester; T3 = third trimester. P value[1] for mean DLIPS scores differences between reduced, adequate and excessive groups in the three trimesters of pregnancy using ANOVA. P value[2] for mean DLIPS scores differences within GWG categories in the three trimesters of pregnancy using repeated-measures ANOVA.

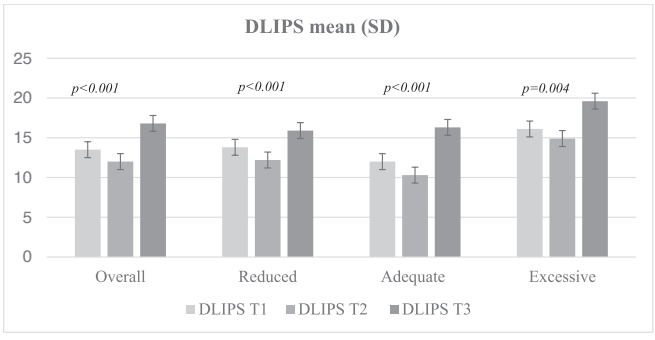


**Fig. 2.** Mean DLIPS score in overall and GWG categories through pregnancy. DLIPS = daily life impact pregnancy symptoms; T1 = first trimester of pregnancy; T2 = second trimester of pregnancy; T3 = third trimester of pregnancy.

**Table 3**
Association between GWG and DLIPS (in T1, T2 and T3) in WPP study (n = 221).

| **DLIPS T1** | **Adequate GWG** | **Reduced GWG** | **Excessive GWG** |
|---|---|---|---|
| Model 1 unadjusted | 0 (Ref.) | 1.80 (−0.78, 4.39) | 4.10 (0.97, 7.22) |
| Model 1 adjusted | 0 (Ref.) | 1.84 (−0.66, 4.36) | **3.88 (0.84, 6.93)** |
| **DLIPS T2** | **Adequate GWG** | **Reduced GWG** | **Excessive GWG** |
| Model 2 unadjusted | 0 (Ref.) | 1.87 (−0.84, 4.59) | **4.50 (1.14, 7.87)** |
| Model 2 adjusted | 0 (Ref.) | 2.00 (−0.61,4.61) | **4.47 (1.24, 7.70)** |
| **DLIPS T3** | **Adequate GWG** | **Reduced GWG** | **Excessive GWG** |
| Model 3 unadjusted | 0 (Ref.) | −0.41 (−3.08, 2.25) | 3.23 (−0.01, 6.48) |
| Model 3 adjusted | 0 (Ref.) | −0.11 (−2.71, 2.50) | 2.91 (−0.28, 6.09) |

Stepwise regression model with backward elimination: values are presented as β-coefficients and 95 % CI. GWG. **Model 1 adjusted** by age, previous number of children, academic level, and physical activity at baseline. **Model 2 adjusted** by age, previous number of children. **Model 3 adjusted** by age, previous number of children, academic level and physical activity at baseline. Values presented in bold show a statistically significant association ($p < 0.05$). GWG: Gestational Weight Gain; DLIPS: Daily Life Impact Pregnancy Symptoms. Negative score data indicate an improvement in DLIPS score.

by Lian et al., in which not significant differences in sexual activity, satisfaction, or quality of life among the three GWG categories were found. However, in that study, inappropriate GWG was associated with a greater risk of adverse perinatal outcomes and increased medical costs for delivery [20]. Other authors such as Roche et al., [21] pointed out that maternal well-being changes during pregnancy, mainly because maternal focus shifts toward childbirth and parenting, reducing the significance placed on GWG in relation to overall well-being. This fact could explain the lack of significant association between GWG and DLIPS at T3.

In our study, women with excessive GWG experienced a greater impact of pregnancy symptoms on daily life compared to those with adequate GWG. This aligns with Sahrakorpi et al. who found a significant decline in quality of life among women with excessive GWG [22].

Our study includes numerous strengths that reinforce the validity and consistency of the results obtained. First, a representative sample (221 pregnant women) from a reference population of approximately 120,000 healthy pregnant women who have provided exhaustive and specific information on the daily life impact of pregnancy symptoms across gestation. Second, the use of an interview to collect through the validated and adapted PSI questionnaire [10,14] assessing 41 symptoms of pregnancy (Appendix 2). Third, it is worth highlighting the evaluation of a significant amount of information collected using a standardized protocol that reduces the bias of information with respect to socio-demographic, lifestyle, anthropometric characteristics, and daily impact of several maternal symptoms.

However, the main limitation of this study is that it is a secondary analysis of a previous trial, and the sample size was slightly reduced from the original one when the inclusion criteria were applied. This also may explain the low frequency of overweight pregnant women compared to the Spanish population. Nonetheless, it is a sample that represents healthy pregnant women from a south-European country, from a higher-income status.

The findings of this study on gestational weight gain (GWG) and Daily Life Impact of Pregnancy Symptoms (DLIPS) have important clinical implications for maternal healthcare. The association between excessive GWG and higher DLIPS scores, especially in the first and second trimesters, highlights the need for targeted interventions to manage weight gain during pregnancy. Monitoring GWG should become a routine part of prenatal care, allowing healthcare providers to identify at-risk individuals early and implement strategies to reduce the negative effects of excessive weight gain on daily life. However, more research is needed to understand how these findings can be applied in real-world healthcare settings. Addressing this gap could significantly enhance support for pregnant individuals and improve their overall quality of life.

## Conclusions

Maternal pregnancy symptoms have an impact on daily life of women throughout pregnancy in both women with adequate and inappropriate weight gain in pregnancy. Our results show that excessive weight gain was associated with higher daily life impact of pregnancy symptoms in the first and second trimesters. Health professionals need to be aware of the connections between the symptoms of pregnancy and weight gain. They can inform women about the role of optimal weight gain in ameliorating the symptoms of pregnancy.

## Author contributions

CAP, NCI, and KK, made significant contributions in the design, elaboration of objectives, methodology and analysis. The manuscript was drafted by NCI, and CAP, while KK, RBV, SMP JMM, RRG and JMMG provided critical revision of the paper in terms of important intellectual content. All authors meet the criteria for authorship (NCI, RBV, RRG, SMP, KK, JMMG, JMM and CAP) and have approved the final submitted version.

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## CRediT authorship contribution statement

**Rebeca Benito-Villena:** Writing – review & editing. **Naomi Cano-Ibáñez:** Writing – original draft, Methodology, Formal analysis, Conceptualization. **Rosario M. Román-Gálvez:** Writing – review & editing. **Sandra Martín-Peláez:** Writing – review & editing. **Khalid S. Khan:** Writing – review & editing, Supervision, Conceptualization. **Juan Miguel Martínez-Galiano:** Writing – review & editing. **Juan Mozas-Moreno:** Writing – review & editing. **Carmen Amezcua-Prieto:** Writing – original draft, Methodology, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejogrb.2024.10.023.

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