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Assessment of Sleep Quality in Spanish Twin Pregnancy: An Observational Single-Center Study

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Abstract

Women with twin pregnancies experience greater sleep disturbance compared to women with singleton pregnancies. The aims of this study were to explore the sleep quality in women with twin pregnancies and to compare their sleep dimensions with coetaneous single pregnancies. This was an observational study in which women were enrolled at the end of pregnancy in the Obstetric Service of Hospital La Paz (Spain). The women were classified as single ($n = 143$) or twin pregnancy ($n = 62$). Pregnant women responded to the Pittsburgh Sleep Quality Index to evaluate sleep quality, latency, duration, efficiency, perturbation, use of medication, and daytime dysfunction. The higher the index, the greater the alteration of sleep quality. Without statistical differences, a poor sleep quality was higher in women with single (66.7%) than women with twin pregnancies (22.8%). The good sleeper slept 6.8 h/day in single pregnancy and 7.3 h/day in twin pregnancy. The sleep perturbation and dysfunctionality were higher in women with twin than single pregnancies. The use of medication to sleep was significantly lower in women with twin than single pregnancies. In women with twin pregnancy, the body weight gain during first trimester had a positive correlation with worse sleep quality and sleep perturbations. Twin pregnancy needed more than 7 h/day to have a high sleep quality, showing greater sleep perturbations and daytime dysfunction than single pregnancies. The control of gestational body weight can improve the sleep quality, disturbances, and duration in twin gestations. Sleep screening during pregnancy would be necessary to handle sleep issues and increase benefits in twin gestational outcomes.

Keywords: Sleep quality; Women mental health; Gestational weight gain; Healthy habits

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Poor sleep quality is a common characteristic among women during pregnancy. While 48% of nonpregnant women perceive a poor sleep quality, this perception can increase up to 60% in pregnant women (Ko et al., 2010). It has been demonstrated that sleep quality gradually declines throughout pregnancy, independently of other factors, more than 1.5 points from the second to third trimester (Sedov et al., 2018). In the context of pregnancy, poor sleep quality has been associated with increased odds of prematurity, gestational hypertension, or gestational diabetes (Meers & Nowakowski, 2022) and increased maternal mental illness (Choquez-Millan & Soto, 2021).

Many of the physiological changes linked to pregnancy may trouble the ability to rest during sleep. Progesterone, while promoting daytime sleepiness, also causes nocturnal sleep fragmentation (Pengo et al., 2018). Melatonin regulates pregnancy (Soliman et al., 2015), being secreted by the placenta without circadian rhythm control (Marseglia et al., 2016). Oxytocin peaks at night, causing sleep fragmentation in late pregnancy (Pengo et al., 2018). Additionally, pregnancy can be psychologically stressful. A women's role in society changes as they undergo

maternity, and she may lie awake during night worrying about labor, or the newborn's health (Ramiro-Cortijo et al., 2021). The National Sleep Foundation's Women and Sleep found that 78% of women reported more disturbed sleep during pregnancy than at any other times of their lives (Won, 2015). In addition, it is very common for pregnant women to experience nausea, nocturia and back pain, which may interfere with sleep. These conditions are more prevalent in twin than single pregnancies (Mitsuda et al., 2019), and twin pregnancy has a greater risk factor for developing maternal and obstetric complications (Santana et al., 2018).

One of the main proposed factors associated with sleep quality has been anthropometry. There is data that correlates the maternal body mass index (BMI) as a critical factor to determine sleep quality (Kennelly et al., 2011). Obese pregestational women could have more than 3.5-fold increased risk of sleep disturbance than normal-weight women (Guinhouya et al., 2019). Furthermore, higher BMI during pregnancy is also associated with poor sleep quality and duration (Tang et al., 2022), confirming the importance of women's body weight in sleep hygiene. However, although gestational weight gain (GWG) has conflicting results associated with sleep quality (Guinhouya et al., 2019), even in normal BMI prepregnancy, twin pregnancies may have more exhaustive GWG control than women with singleton pregnancies (Liu et al., 2021) and this may affect their sleep hygiene. However, although the prevalence of obstetric complications, gravida

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changes and worsening sleep hygiene is more pronounced in twin pregnancies than singleton pregnancies, there is limited information about sleep hygiene in twin pregnancies. This study aims to explore the sleep quality in women with twin pregnancy and to compare the sleep pattern in these women with single pregnancies.

Material and Methods

Study Design and Women's Enrollment

This was a pilot observational, prospective and exploratory study where pregnant women were enrolled in the Obstetrics Service in Hospital Universitario La Paz (HULP), Madrid, Spain. Pregnant women were recruited from October 2022 to April 2023 during the third trimester of gestation. The women were invited to participate in the study if their age was between 18–45 years and they had a good understanding of Spanish; their gestation was followed in the HULP. The exclusion criteria were more than two embryos, congenital fetal disorders (genetic or malformations), maternal diagnosis of mental disorder prior to pregnancy, maternal disorders that imply a specific nutritional pattern (e.g., diabetes mellitus, celiac disease, anemia, among others) and women with previously diagnosed sleep disorders (with or without treatment). Finally, a total of 205 pregnant women were recruited and classified as single ($n = 143$) or twin pregnancy ($n = 62$).

All women who participated in the study were informed by health staff and signed the informed consent form. The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Research Ethics Committee of Hospital Universitario La Paz (Spain; protocol codes PI-5477 and PI-5596 and on 28 February 2023). All data collected in this study has been treated strictly confidentially. In addition, this study adhered to the guidelines of Strengthening the Reporting of Observational studies in Epidemiology (STROBE statement; supplementary material) for observational studies.

Socioeconomic and Obstetric Variables

The women who participated in the study responded themselves to questions using an ad-hoc questionnaire designed by the research team that contain items about the woman's age (years), highest educational level achieved (classified as middle or high school and university degree), civil status (married or in a relationship, or unmarried), employment status, type of family, and monthly income level (considering the Spanish average, clustered in low income: <1000€/month; medium income: 1000€–2500€/month or 2501€–4000€/month; and high income: >4000€/month), tobacco habit (never smoked, ex-smoker <24 months, active smoker), sporadic alcohol consumption (wine, beer with alcohol, and distilled alcohol), and previous diseases diagnosed in the last 5 years. In addition, the perception of support during pregnancy was explored by the Postpartum Depression Predictors Inventory – Revised (PDPI-R) in its prenatal version. This scale determines what risk factors could be present in woman (Records *et al.*, 2007). The first 12 dichotomous items evaluate the social support perceived by the woman during the prenatal stage from her partner, family and friends, distinguishing between emotional and practical support. This instrument has a confidence of 86% (Ibarra-Yruegas *et al.*, 2018).

The obstetric variables were collected from the medical records, including gestational age (completed weeks), planned pregnancy (yes/no), use of assisted reproduction techniques (yes/no), number of previous gestations and miscarriages, pregestational BMI (kg/m²), gestational body weight gain by trimester (kg) and gestational weight

gain (GWG) in kg as the difference between second trimester minus first trimester (Δ_1), third trimester minus second trimester (Δ_2), and third trimester minus first trimester (Δ_3). In addition, the maternal complications were recorded following the obstetrics staff diagnoses, which follow the guidelines of the Spanish Society of Obstetrics and Gynecology, including hyperemesis gravidarum, thrombocytopenia, anemia, gestational diabetes, intrahepatic cholestasis, pregnancy hypertension, and preeclampsia. Due to the high incidence and risk for the fetus's health, the fetal complications recorded were intrauterine growth restriction and twin-to-twin transfusion syndrome (only in twin pregnancy). Similarly, the obstetric complication recorded was threat of premature birth. In addition, the prematurity rate was calculated as gestational age <37 weeks of gestation.

Perception of Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI) evaluates sleep quality and its alterations retrospectively for 1 month (Buysse *et al.*, 1989). The PSQI is intended to be a standardized sleep questionnaire for clinicians (Sedov *et al.*, 2018) and researchers (Okun *et al.*, 2018) to use with ease, and is used for multiple populations (Al-Musharaf, 2022), including Spanish women (Choquez-Millan & Soto, 2021). It consists of 19 self-reported items and 5 questions addressed by family members or main caregiver. The PSQI evaluates seven dimensions of sleep such as subjective quality (perception of the woman about her quality of sleep), latency (time elapsed until reaching sleep), duration (number of hours of sleep), efficiency (hours of sleep in relation to hours spent in bed), perturbation (frequency of sleep-disturbing events such as nocturnal awakenings, dyspnea, snoring, feeling of cold or heat, nightmares or pain), the use of medication (use of hypnotic medication) and daytime dysfunction (frequency of daytime sleepiness and asthenia). Each question is scored between 0 to 3 based on the frequency or intensity with which it is experienced. The global sleep score is calculated by the sum of the seven dimensions. Details of the instructions in PSQI correction can be found in the Center for Sleep and Circadian Science of University of Pittsburgh (Center for Sleep and Circadian Science, 2023). The higher the score, the greater alteration of sleep quality, considering a cut-off of greater than or equal to 5 as a poor sleep quality. The PSQI has good validity and reliability for assessing sleep quality in pregnant women (Qiu *et al.*, 2016).

Statistical Analyses

The data analysis was carried out with R software (version 4.2.2, R Core Team 2021, Vienna, Austria) within RStudio (Version 1.4.1717, RStudio, PBC, 2009–2021, Inc., Vienna, Austria) using *rio*, *dplyr*, *compareGroups*, *corr*, *pROC* and *tidyverse* packages.

The qualitative variables are summarized as frequencies (%) and sample size (n), analyzed using Fischer's exact test. The quantitative variables are described as the median and interquartile range (Q1; Q3). In addition, according to the variable distribution analyzed by Kolmogorov-Smirnov test, the univariate analysis was performed using the independent Mann-Whitney U test or Student's *t* test to compare the differences between groups (single vs. twin pregnancies). The Spearman coefficient (ρ) was extracted in the correlations between quantitative variables.

The receiver operator characteristic (ROC) analysis was used to extract the cut-off of hours/day spent in bed between high and poor sleep quality clustered in single and twin pregnancies. The 95% confidence interval (CI) of area under the curve (AUC), sensitivity,

Table 1. Sociodemographic variables based on single and twin pregnancies

	Single (<i>n</i> = 143)	Twin (<i>n</i> = 62)	<i>p</i> value
Maternal age (years)	35.0 (31.0; 38.0)	35.0 (31.0; 37.8)	.865
Educational level			.451
Middle school	1.4% (2)	0.0% (0)	
High school	21.8% (31)	16.1% (10)	
University	76.8% (109)	83.9% (52)	
Civil status			.236
Married/in a relationship	91.6% (131)	96.8% (60)	
Unmarried	8.4% (12)	3.2% (2)	
Employment status			.999
Employed	52.4% (75)	51.6% (32)	
Unemployed	47.6% (68)	48.4% (30)	
Family core			.642
Single parent	9.6% (13)	6.5% (4)	
Two-parent	90.4% (122)	93.5% (58)	
Income level (€/month)			.018
<1000	7.9% (11)	16.1% (10)	
1001-2500	33.6% (47)	16.1% (10)	
2501-4000	32.9% (46)	29.0% (18)	
>4000	25.7% (36)	38.7% (24)	
Tobacco habits			.310
Never smoker	85.2% (121)	77.4% (48)	
Ex-smoker (<24 months)	10.6% (15)	17.7% (11)	
Active smoker	4.2% (6)	4.8% (3)	
Sporadic alcoholic beer intake	11.9% (17)	16.1% (10)	.549
Sporadic wine intake	15.4% (22)	24.2% (15)	.191
Sporadic distilled alcohol intake	9.1% (9)	9.7% (6)	.999
Previous comorbidities	6.3% (9)	8.1% (5)	.764
Support during pregnancy (PDPI-R)	12.0 (11.0; 12.0)	12.0 (12.0; 12.0)	.257

Note: Data show median and interquartile range (Q1; Q3) for the quantitative variables; the *p* value was extracted using the Mann-Whitney U test. In qualitative variables, the percentage and sample size (*n*) are shown, with the *p* value extracted from Fisher's exact test. PDPI-R: postpartum depression predictors inventory-revised (prenatal version).

and specificity were extracted in the ROC analysis. A *p* value < .05 was considered as statistically significant.

Results

The median age of women was 35.0 (31.0, 38.0) years. Most women had university qualifications and the predominant civil status was married or in a stable relationship. The two-parent family was the most representative family core in the cohort, and more than 50% of the women were currently working at the time of the study. While other socioeconomic variables did not show significant differences between women with single or twin pregnancy, the income level was significantly different between groups. The women with a single pregnancy had a medium income (33.6%, *n* = 47; 1001–2500 €/month) compared to the higher income (38.7%, *n* = 24; >4000 €/month) of women with twin pregnancy (Table 1). No differences were observed in tobacco and alcohol consumption or previous comorbidities. The support during pregnancy obtained a maximum score of family and social support

perceived by the women in both groups, without differences between them (Table 1).

The gestational age was significantly lower in women with twin pregnancies compared to singleton pregnancies (Table 2); 74% (*n* = 148) of pregnancies were planned and the use of assisted reproduction techniques was higher in women with twin than single pregnancies, although this did not reach statistical significance. The women had an adequate weight gain during pregnancy without statistical differences between groups (Table 2). Regarding maternal-fetal and obstetric complications, no significant differences were observed in any of the analyzed groups, except for gestational diabetes, which was higher in single than twin pregnancies, and premature labor, which was significantly higher in twin than single pregnancies.

Of the cohort, 89.5% (*n* = 145) had poor sleep quality, this being higher in the women with a single pregnancy (66.7%, *n* = 108) than women with a twin pregnancy (22.8%, *n* = 37); however, there were no statistical differences between both groups ($\chi^2 = .507$; *p* = .477). No significant differences were found between adverse

Table 2. Obstetric follow-up and clinical variables classified by single and twin pregnancies

	Single (<i>n</i> = 143)	Twin (<i>n</i> = 62)	<i>p</i> value
Gestational age (weeks)	38.1 (35.7; 39.5)	34.4 (31.9; 35.7)	<.001
Planned pregnancy	71.9% (100)	78.7% (48)	.409
Assisted reproduction techniques	19.7% (28)	32.3% (20)	.078
Gravida	2.0 (1.0; 3.0)	1.0 (1.0; 2.0)	.250
Previous miscarriage	0.0 (0.0; 1.0)	0.0 (0.0; 1.0)	.921
Prepregnancy BMI (kg/m ²)	22.7 (20.6; 25.3)	22.5 (20.8; 24.9)	.992
First trimester body weight gain (kg)	2.0 (0.5; 3.0)	2.5 (0.9; 4.0)	.426
Second trimester body weight gain (kg)	4.0 (2.1; 5.0)	4.1 (2.8; 6.0)	.229
Third trimester body weight gain (kg)	5.0 (3.6; 10.0)	6.0 (2.8; 8.5)	.647
Δ ₁ gestational weight gain (kg)	1.5 (0.0; 4.4)	1.2 (0.0; 3.9)	.731
Δ ₂ gestational weight gain (kg)	0.5 (-1.0; 2.4)	1.0 (-1.8; 3.0)	.935
Δ ₃ gestational weight gain (kg)	2.5 (0.0; 6.0)	2.0 (0.0; 6.0)	.946
Maternal complications	86.0% (123)	74.2% (46)	.065
Hyperemesis gravidarum	32.9% (46)	38.7% (24)	.518
Thrombocytopenia	7.9% (11)	3.2% (2)	.352
Anemia	37.9% (53)	30.6% (19)	.408
Gestational diabetes	14.3% (20)	3.2% (3)	.037
Intrahepatic cholestasis	1.4% (2)	1.6% (1)	.999
Pregnancy hypertension	7.5% (9)	0.0% (0)	.113
Preeclampsia	7.1% (10)	3.2% (2)	.351
Fetal complications	12.6% (18)	17.7% (11)	.451
Intrauterine growth restriction	7.1% (10)	12.9% (8)	.290
Twin-to-twin transfusion syndrome	–	5.0% (2)	–
Obstetric complications (considering threat of premature birth)	0.0% (0)	9.1% (2)	.489
Prematurity	35.9% (47)	82.2% (37)	<.001

Note: Data show median and interquartile range (Q1; Q3) for the quantitative variables; the *p* value was extracted using the Mann-Whitney U test. In qualitative variables, the percentage and sample size (*n*) are shown, with the *p* value extracted from Fisher's exact test. The gestational weight gain was considered as the difference between second trimester minus first trimester (Δ₁), third trimester minus second trimester (Δ₂), and third trimester minus first trimester (Δ₃). BMI, Body mass index.

gestational outcomes and poor sleep quality. The time to fall asleep was also similar in both groups: single = 30.0 min (15.0; 40.0), twin = 27.5 min (15.0; 35.5); *p* = .793. In addition, the pregnant women slept a median of 6.0 h/day (5.0; 7.0) in both groups (*p* = .409). In both groups, women who had high sleep quality spent more time in bed. In addition, to have good sleep quality, women with twin pregnancies had a slightly higher hours/day cut-off point than women with singleton pregnancies (Table 3).

Regarding the PSQI score, no statistical differences were observed in global sleep score between groups. Furthermore, there was no significant difference in quality, latency, duration, and efficiency dimensions between women with single and twin pregnancies (Table 4). However, the sleep perturbation and dysfunctionality were significantly higher in women with twin than single pregnancies, and the use of medication to sleep was significantly lower in women with twin than single pregnancies (Table 4).

In women with single pregnancy, sleep latency showed significant and negative correlation with maternal age ($\rho = -0.23$; *p* = .011) and positive correlation with gestational age ($\rho = 0.20$; *p* = .030). Additionally, sleep quality was close to being

significant and positively correlated with gestational age ($\rho = 0.17$; *p* = .070). In women with twin pregnancy, the body weight gain during the first trimester had significant and positive correlation with sleep quality ($\rho = 0.52$; *p* = .013) and sleep perturbations ($\rho = 0.53$; *p* = .011), and it showed a tendency towards a significantly positive correlation with the global sleep index ($\rho = 0.40$; *p* = .062). Furthermore, the negative correlations between the completed gestational weight gain (Δ₃) and sleep duration ($\rho = -0.42$; *p* = .060) and global sleep index ($\rho = -0.39$; *p* = .077) were close to being significant. In addition, the gestational age was close to showing a significant positive correlation with sleep duration ($\rho = 0.31$; *p* = .055).

Discussion

The purpose of this study was to evaluate the sleep quality in women with twin pregnancy compared to single pregnancy in the third trimester, when sleep worsens. According to our data, close to 90% of the cohort had poor sleep quality, being far away from the 45.7% of poor-quality described by other authors (Sedov *et al.*, 2018). It should be considered that the data were recorded at the

Table 3. Differences between hours per day in bed between women with high and poor sleep quality in single and twin pregnancies

	High sleep quality (h/day)	Poor sleep quality (h/day)	<i>p</i> value	Cut-off	AUC 95% CI	Sensitivity	Specificity
Single	7.1 (6.8; 8.0)	6.0 (5.0; 7.0)	.003	6.8 h/d	0.74 [0.60, 0.89]	0.714	0.720
Twin	9.0 (8.5; 9.0)	6.0 (5.0; 6.5)	.005	7.3 h/d	0.99 [0.96, 0.99]	0.999	0.865

Note: Data show median and interquartile range (Q1; Q3). The *p* value was extracted using the Mann-Whitney U test. The hours/day cut-off was extracted by : receiver operator characteristic (ROC) analysis using high as control and poor sleep quality as case. The area under the curve (AUC) was considered 95% of confidence interval [CI].

Table 4. Dimensions of sleep quality in single and twin pregnancies

	Single (<i>n</i> = 123)	Twin (<i>n</i> = 40)	<i>p</i> value
Quality	2.0 (1.0; 2.0)	2.0 (1.0; 3.0)	.119
Latency	1.0 (1.0; 2.0)	1.0 (1.0; 2.0)	.742
Duration	1.0 (0.0; 2.0)	1.0 (0.0; 2.3)	.327
Efficiency	2.0 (1.0; 3.0)	2.0 (1.0; 3.0)	.287
Perturbation	2.0 (2.0; 2.0)	2.0 (2.0; 3.0)	.025
Medication	0.3 (0.0; 0.7)	0.0 (0.0; 0.2)	.002
Dysfunctionality	1.0 (0.0; 2.0)	1.0 (1.0; 2.0)	.042
Global sleep index	9.0 (6.3; 12.0)	10.0 (8.0; 13.0)	.180

Note: Data show median and interquartile range (Q1; Q3). The *p* value was extracted using the independent Student's *t* test. Sleep quality, latency, duration, efficiency, perturbation, use of medication, dysfunctionality dimensions and the global sleep score were obtained using the Pittsburgh Sleep Quality Index.

end of pregnancy, where anatomical and hormonal changes have reached their maximum manifestations. This would justify the finding that all pregnant women had alterations in sleep quality. In addition, the ratio between single-to-twin was 2.9 times worse in single pregnancies. The discrepancy found in the ratio of sleep quality may be because twin pregnancy can enhance discomfort during gestation, related to earlier and more intensive symptoms from twin than single pregnancy (Oliver et al., 2023). Twin pregnancies do not usually reach 40 weeks of gestation, as our data indicate, whereas singleton pregnancies do. It could be that in the last weeks of pregnancy, women lose even more quality of sleep.

The clinical relevance of sleep quality in pregnancy has been based on the association between poor sleep and increased preterm birth, gestational hypertension or gestational diabetes (Meers & Nowakowski, 2022). According to our data, there are no differences in the rates of maternal, fetal, or obstetric complications between singleton and twin pregnancies, possibly because twins are considered as high risk in our hospital, with administration of acetylsalicylic acid as a prophylactic treatment. With regard to nutritional patterns, we have already demonstrated the closer follow-up to prevent obesity (de la Calle et al., 2022). It is necessary to mention that the prematurity rate was different between twin and singleton pregnancies. Another study reported that sleep disturbance was linked with preterm birth (*OR* = 1.38; 95% CI [1.26, 1.51]), particularly in woman >30 years and who are overweight pregestational (Lu et al., 2021). Furthermore, short duration and sleep misbalance was also associated with increased risk of prematurity, particularly in the third trimester (Li et al., 2021). However, few studies have explored sleep in twin pregnancy, where the rate of premature birth is usually high, as we report. Sleep characteristics should be assessed during prenatal care to decrease adverse maternal and fetal outcomes, particularly in twin pregnancy.

Without significant differences, women with twin pregnancies scored worse in global sleep quality than single pregnancies. At the end of gestation, the gravida changes and hormonal levels have reached their greatest manifestation in the pregnant woman, worsening the sleep quality (Pengo et al., 2018). According to our data, gestational diabetes was higher in single than twin pregnancies. A plausible explanation would be that twin pregnancies have closer follow-up, which improves nutritional adherence. However, it has been postulated that poor sleep quality could affect glucose metabolism by overactivation of sympathetic system and inflammation (Knutson et al., 2011), also the sleep fragmentation can decrease the insulin sensitivity (Stamatakis & Punjabi, 2010). Other studies point out that the glucose control exhibiting U-shape dose-response relation between sleep duration and hemoglobin A1c (Lowe et al., 2012). A meta-analysis explained that confounding factors, such as maternal age or BMI, could conceal the association between sleep quality and gestational diabetes (Zhu et al., 2020). According to our results, other potential confounding factors would be the twin gestations. Another meta-analysis suggests that extreme sleep duration during pregnancy is also associated with increased risk of gestational diabetes (Xu et al., 2018). The effect that the quality or duration of sleep has on the risk to develop gestational diabetes in twin pregnancies remains controversial. It would be interesting to have systematized studies to determine the effect of sleep on twin gestation focus on glucose homeostasis.

Considering the sleep scores, twins had a 0.26 higher score in perturbation and a 0.36 higher score in dysfunctionality than single pregnancies. Sleep disturbance has been linked with adverse obstetric outcomes such as placental abruption (Qiu et al., 2015), or abortions (Bourjeily et al., 2017). In a Taiwan cohort, it was demonstrated that women during the third trimester had more sleep disturbances and daytime dysfunction compared to

nonpregnant women (Ko *et al.*, 2010). However, limited data has been reported in twin pregnancies. As far as we know, this is the first study conducted in Spain.

Furthermore, it is necessary to identify therapeutic options to improve sleep during pregnancy (Okun *et al.*, 2015). There are safe pharmacotherapy options for sleep disturbance during pregnancy (Miller *et al.*, 2020), without risk of congenital malformations or maternal adverse outcomes (Khazaie *et al.*, 2013). However, the fear of harming the fetus continues to dissuade from use of pharmacologic treatments for sleep disturbances. Pregnant women often prefer nonpharmacologic measures, such as cognitive behavioral therapy for insomnia (CBT-I), over medication (Miller *et al.*, 2020). In fact, the use of relaxing valerian infusions to help sleep is very widespread among Spanish pregnant women. According to our data, twin pregnant women score even lower in use of medication for sleep than single pregnant women. A randomized controlled trial showed that pregnant women undergoing CBT-I experienced a greater reduction and faster remission of insomnia compared with women assigned to a control intervention (Manber *et al.*, 2019). The daytime naps could be compensatory for poor nocturnal sleep, and a useful strategy to deal with sleep disturbances during pregnancy. Ebert *et al.* (2015) explored the nap frequency and duration on quality and quantity of nocturnal sleep and corroborated that napping did not impact nighttime sleep quality. However, the interventions to treat sleep issues in twin pregnancies remain to be examined.

Among other variables, the gestational age shows controversial results in the literature. Our data suggests that women with single pregnancy had worse sleep quality and latency as gestational age progresses. In a Chinese cohort, it was shown that short duration and worse sleep quality during the third trimester were associated with more than double the risks of preterm delivery (Li *et al.*, 2021). A meta-analysis demonstrated a U-shaped relationship between duration and risk of preterm birth. These authors considered pregnant women who slept 7 h/day as the reference (Shi *et al.*, 2022). According to our data, all women slept 6 h/day, but women with high sleep quality were those who spent more than 7 h/day in bed. Additionally, the cut-off for high sleep quality was established as 6.8 h/day for women with single pregnancy and even higher in women with twin pregnancies. Melatonin induces sleep and is synthesized by the placenta to regulate pregnancy (Soliman *et al.*, 2015). Women with a double placenta could have higher melatonin plasma levels than women with single pregnancy. Moreover, it has been shown that in monochorionic twin gestations, the placenta has larger dimensions than in a single gestation (Wegrzyn *et al.*, 2006). In a prospective study in single pregnancy women, the reduced melatonin level was associated with low sleep duration and frequency in a poor sleep quality group (Shimada *et al.*, 2016). However, the questions about what melatonin levels would be appropriate in women with twin pregnancies and whether melatonin intervention could improve the woman's sleep remains to be researched.

Sociodemographic factors could adjust this risk factor. According to our data, sleep latency was negatively correlated with maternal age, the worse latency being found in younger women. A study discussed how a stable family core and stable economic aspects of older women can contribute to decreasing pregnancy concerns (Ramiro-Cortijo *et al.*, 2021). Although our data showed social support during pregnancy and that more than 71% of pregnancies were planned, pregnancy concerns could be more pronounced in younger women, making it difficult for them to maintain sleep quality.

In twin pregnancies, sleep duration is affected by the gestational age: the duration shortens as the gestational age progresses. The pregnancy changes in women with twins are more pronounced than in single pregnancies, making them more uncomfortable in a lying position and shortening the rest. In fact, the correlations with sleep in women with twins are likely due to the gains and body changes during pregnancy. The effect of sleep on body changes during pregnancy has been studied in singleton pregnancies with controversial results. Some studies do not find an association (Guinhouya *et al.*, 2019). However, other authors have shown that pregnant women with an improved sleep quality gained more weight from the second to third trimester (our Δ_2), while those with a worsened sleep quality gained more weight during the first to second trimester (our Δ_1) (Balieiro *et al.*, 2019). Our data in twin pregnancies showed that reduced body weight gain during the first trimester was correlated with increased sleep quality, decreased perturbations and improved global sleep. But reduction of the overall GWG (Δ_3) was correlated with worsened sleep duration and global sleep scores. This contra intuitive fact may be related to the physiological pregestational BMI. At the beginning of twin gestation, restrictive weight control is key to proper sleep hygiene. However, once weight gain goals are achieved, the relationship with sleep is reversed, improving sleep hygiene as body weight increases. It should be noted that pregestational BMI and sociodemographic variables are of great importance to adjust the sleep hygiene, at least in singleton pregnancies. Pregnant women who maintained BMI over the pregnancy increased their sleep duration from the first to third trimester, while those that increased BMI worsened their sleep duration (Balieiro *et al.*, 2019). In our cohort, similar sociodemographic characteristics were found and did not show obesity at the beginning of pregnancy in any of the women. Additionally, we were aware of the uterine differences between singleton and twin pregnancies. Therefore, choosing a greater gestational age in single versus twin pregnancy (38 vs. 34 weeks) may mitigate the different uterus size in twin pregnancies.

To date, this is the first sleep study performed on Spanish pregnant women of sleep quality in twin pregnancies, and one of the first studies in this population worldwide. However, it is necessary to consider the homogeneity of the sociodemographic variables of the cohort. In addition, it is necessary to consider that our hospital is a reference hospital, and its high-risk unit is one of the largest in Spain, which is why the cohort there has a high rate of pregnant women of advanced age and with gestational diabetes.

Conclusively, at the end of a pregnancy the differences in sleep quality were not extreme between single and twin pregnancies. However, twin pregnancies showed greater sleep perturbations and daytime dysfunction than single pregnancies. In addition, women with twin pregnancies reported fewer use of medications to fall asleep. These changes were affected by maternal and gestational ages. Furthermore, in twin pregnancies, sleep quality, disturbances and duration may worsen if the maternal body weight, as well as gestational weight gain, is not controlled, especially during the first trimester of pregnancy. The study of sleep quality in pregnant women requires specific attention in primary healthcare, since simple screening can have great benefits in gestational outcomes.

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/thg.2024.13>.

Data availability. The data of this study are available upon request from the corresponding author. The availability of the data is restricted to investigators based in academic institutions.

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Author contribution. M.d.I.C.: Conceptualization, validation, writing of the original draft, and supervision. J.L.B.: validation, and review and editing. A.M.M.: methodology, software, investigation, data curation, and writing of the original draft. S.M.A.: review and editing, and supervision. D.R.-C.: conceptualization, software, validation, formal analysis, investigation, review and editing, visualization, supervision, and funding acquisition. All authors have read and agreed to the published version of the manuscript.

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Ethical standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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