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Original Research

Does Sleep Quality of Pregnant Women Influence Perinatal Outcomes in Poland?

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Abstract

Background: To assess sleep quality during the latest pregnancy and to investigate its relationship with perinatal outcomes. **Methods**: A cross-sectional survey with a self-composed questionnaire was performed. It included the Pittsburgh Sleep Quality Index (PSQI) and the Berlin Questionnaire. **Results**: 5890 women giving birth maximum one year before completing the survey were included. 87.8% of the respondents were assessed as having poor sleep according to the PSQI. Poor sleep increased the risk of preterm birth (adjusted odds ratio (aOR) 1.54, 95% confidence interval (CI) 1–2.3) and cesarean delivery (aOR 1.2, 95% CI 1–1.4), while it was not related to neonatal birthweight. 5.9% of the respondents were classified as being at a high risk of obstructive sleep apnea according to the Berlin Questionnaire. High risk of obstructive sleep apnea increased the risk of preterm birth (aOR 1.53, 95% CI 1–2.2) and low birth weight infant (aOR 1.64, 95% CI 1.1–2.5). **Conclusions**: Sleep quality and obstructive sleep apnea risk have an impact on perinatal outcomes.

Keywords: sleep quality; pregnancy; pregnancy outcome; preterm birth; low birth weight

1. Introduction

Sleeping disorders among pregnant women are widespread [1]. According to Sedov*et al*. [1] 14–27% of expectant mothers suffered from insomnia. Within the Polish population of pregnant women, the occurrence was estimated at 25–40%, while the overall sleep disorders (including excessive daytime sleepiness, obstructive sleep apnea, restless legs syndrome, narcolepsy, parasomnia, or circadian rhythm disorder) are rated at 84–90% [2,3]. Hormonal, anatomical, and psychological changes which occur during pregnancy, may have an adverse impact on sleep quality [4]. According to the available data, sleeping disorders not only disturb the course of night rest, but they also make pregnant women more prone to developing depression or anxiety [5,6]. Sleep problems during pregnancy turned out to be a risk factor for subsequent clinically significant postnatal depressive symptoms or anxiety disorders [7,8].

There are limited and often conflicting data on the possible relationship between maternal sleep and perinatal outcomes. The majority of studies investigated the impact of maternal sleep-disordered breathing on pregnancy outcome, while only few of them analyzed the impact of expecting mothers' sleep quality on the perinatal outcome. In a systematic review by August *et al*. [9] the authors found mixed results on the possible relationship of sleep disorders and neonatal birth weight, hypertension and preeclampsia, gestational diabetes mellitus or preterm birth. In a novel meta-analysis by Warland*et al*. [10] sleep quality was found to be a risk factor of preterm delivery, but not of delivering a neonate which was small for gestational age (SGA). However, most studies included in the review were rated as poor, which may induce bias.

2. Materials and Methods

A cross-sectional survey was performed. We created a self-composed questionnaire, which contained questions in the Polish language, and was distributed via the internet between February and March 2018 on web pages and Facebook groups. The questionnaire was addressed to all women giving birth to a single newborn maximum one year before completing the survey, regardless of inhabitancy. A link to the study was displayed on web pages supplying general information on motherhood and the care of a newborn. Women declaring being mothers of infants without any special requirements had access to Facebook groups.

The questionnaire included single-answer or multiple-choice closed questions and was divided into three parts. The first part of the questionnaire consisted of questions regarding sociodemographic data: age, height, weight, education, employment, inhabitancy, marital status, financial status, and information about the time to conceive regarding the last pregnancy. The course of pregnancy, ailments (nocturnal urination, back pain, leg cramps, fetal movements disturbing sleep or nausea) and the course of labor were investigated, including gestational age at delivery, vaginal or cesarean delivery neonatal birthweight, the occurrence of

gestational hypertension or gestational diabetes mellitus. A visual numerical scale from 0 to 10 was used to assess life stress level and satisfaction with the current relationship.

The second part of the questionnaire included the Pittsburgh Sleep Quality Index (PSQI) [11]. The PSQI is a commonly used tool for sleep quality measurement in adults' population [1]. It allows identify patients with "poor" or "good" sleep by assessing seven components: subjective sleep quality, sleep efficiency, sleep latency, sleep duration sleep disturbances, daytime dysfunction, and use of sleep medication. The classic PSQI questionnaire concerns the period of the last four weeks, while in our study we asked the respondents to give answers according to the period of pregnancy during which sleep problems were the most severe. The answers were given using a 4-grade scale (0–3 points) and the results were evaluated regarding the above components and assessed from 0 to 21 points in total. Results higher than 5 points indicated low sleep quality as the cut-off of 5 is used for the differentiation into "poor" and "good" sleep [1]. The PSQI questionnaire is characterized by high internal consistency, with the Cronbach's alpha index of 0.68–0.78 [12]. It was used in several studies to assess sleep quality in pregnant women [1]. The Polish version of the PSQI was validated and previously used by other researchers [13]. In the second part of the questionnaire the women's subjective opinions on the sleep quality and sleep-related problems were also investigated.

The third part of the questionnaire included the Berlin Questionnaire, which is a simple sleep apnea screening tool used for the rapid identification of the low or high risk of obstructive sleep apnea (OSA). It consists of ten questions plus information on height and weight arranged in three categories: snoring and cessation of breathing, symptoms of excessive daytime sleepiness, body mass index and hypertension, and height and weight information. Positive scores in two or three categories suggest a high risk of OSA [14]. The Berlin Questionnaire was tested in the pregnant population and at the threshold of $\geq$5 apnoea-hypopnea index (AHI) had high sensitivity and low specificity in the second as well as third trimesters (93% and 50% for the second trimester and 87% and 32% for the third trimester, respectively) [15]. According to Tantrakul*et al.* [16] its performance was poor to fair with pooled sensitivity and specificity of 0.66 (95% CI 0.45–0.83; I^2 = 78.65%) and 0.62 (95% CI 0.48–0.75; I^2 = 81.55%), respectively. In a systematic review and meta-analysis, the Berlin questionnaire was found to be useful as a clinical screening test and epidemiological tool in OSA screening in adults, although it did not include pregnant women subgroup [17].

Age >18 years old, delivery $\geq$24 weeks of gestation maximum one year prior to completing the questionnaire, and a singleton live birth were the inclusion criteria. Women with multiple pregnancies and those who miscarried were excluded from the study. There was considered in the analysis only these questionnaires which were filled completely. The answers were double-checked by the researchers and there was no found identical records.

Body mass index (BMI) was specified as the body weight divided by the square of the body height. Obesity was described as BMI $\geq$30. Preterm delivery was explained as one occurring at less than 37 completed weeks of gestation. Low birth weight (LBW) was determined as neonatal birth weight of less than 2500 g.

Data were shown as numbers and percentages or means and standard deviations. Statistical analyses were performed using Tibco Statistica version 13.3 (TIBCO Software Inc, Palo Alto, CA, USA). The Mann-Whitney test or Fisher's exact tests were used to compare the analysed variables. All tests were two tailed and $p < 0.05$ was considered significant. Logistic regression analysis was performed to assess which issues were independent risk factors of sleep problems during pregnancy and if sleep problems influenced the perinatal outcome.

The study protocol was granted the approval of the Ethics Committee of the Medical University of Warsaw (no 124/2018). The committee waived the obligation to secure a written or verbal consent to participate in the study as completing the questionnaire was deemed tantamount to giving consent.

3. Results

3.1 Characteristics of the Study Group

5890 women took part in the survey. Table 1 presents the basic characteristics of the study group.

3.2 Sleep Quality of the Study Group

87.8% of the respondents were assessed as having poor sleep according to the PSQI. When giving their subjective opinions, 57.3% of women assessed their sleep as average, 14.4% as good, 24.9% as insufficient and 3.4% as poor. 82.5% of the respondents declared to have had the poorest sleep during the third trimester of pregnancy, while 11% during the first and 6.5% during the second trimester. The most common sleep problems reported by all the respondents were frequent awakening (41.2%) and difficulties with falling asleep (40.8%). The women also reported shallow sleep (20.2%) and awakening too early (17.3%). Only 1.8% of the women declared to have consulted their sleep problems with a doctor. 47.5% of women reported their sleep pattern came back to normal after delivery and 20.4% reported persistent sleep problems after delivery. The average PSQI score in the study group was 7.52 (95% CI 3.2–16.4).

3.3 Characteristics of the Respondents Having Good and Poor Sleep Quality According to the PSQI

12.2% of the women were scored as having good quality sleep quality. According to the PSQI, the study group was further divided into two groups: having poor and good sleep. The characteristics of both subgroups are presented

Table 1. Characteristics of the study group (the respondents) with good and poor sleep quality according to the PSQI.

	Study group		Good sleep quality		Poor sleep quality		
	N = 5890		N = 720		N = 5170		
	n	%	n	%	n	%	*p*
Age (years)*	28	23–32	29	24–32	28	23–32	0.1
BMI (kg/m^2)*	24.1	19.4–28.9	24.3	19.5–29.9	24.0	19.7–29.1	0.2
Obesity	598	10.2	52	7.2	546	10.6	0.005
Time to conceive							
unplanned	1599	27.1	230	31.9	1369	26.5	0.002
0–6 months	3130	53.1	373	51.8	2757	53.3	0.5
6–12 months	690	11.7	74	10.3	616	11.9	0.2
>12 months	389	6.6	33	4.6	356	6.9	0.02
ART	81	1.5	9	1.4	72	1.4	0.9
Education							
Primary	61	1.0	9	1.4	52	1.0	0.5
Vocational	152	2.6	16	2.2	136	2.6	0.6
Secondary	1369	23.2	153	21.3	1216	23.5	0.2
Tertiary	4307	73.2	541	75.1	3766	72.9	0.2
Inhabitancy							
Village	1469	24.9	173	24.0	1296	25.1	0.6
<50 10^3 inh.	1262	21.4	154	21.4	1108	21.4	1
50–200 10^3 inh.	1344	22.8	150	20.8	1194	23.1	0.2
>200 10^3 inh.	1814	30.9	242	33.8	1572	30.4	0.09
Employment							
Unemployed	1214	20.6	141	19.6	1073	20.6	0.5
Studying	384	6.8	54	7.5	330	6.4	0.3
Employed	4291	72.6	524	72.9	3767	73	0.8
Financial status							
Poor	44	0.7	4	0.7	40	0.8	0.7
Sufficient	911	15.5	101	14.0	810	15.7	0.3
Good	3930	66.7	473	65.7	3457	66.9	0.5
Very good	1004	17.1	141	19.6	863	16.6	0.06
Marital status							
Single	59	1.0	10	1.5	49	0.9	0.2
In a relationship	1201	20.4	148	20.6	1053	20.4	0.9
Married	4629	78.6	561	77.9	4068	78.7	0.6
Stress level (points)*	5	2–7	4	2–6	5	3–8	<0.001
Assessment of relationship (points)*	8	6–9	9	7–9	8	5–9	0.04
Gestational age at delivery (weeks) *	39	38–41	39	37–41	39	38–41	0.9
Preterm delivery	354	6.0	30	4.2	324	6.3	0.02
Mode of delivery							
Vaginal	3576	60.7	464	64.4	3112	60.2	0.03
Cesarean	2314	39.3	256	35.6	2058	39.8	
Primiparity	4119	69.9	520	72.2	3599	69.6	0.2
Hypertension	539	9.2	60	8.3	479	9.3	0.4
GDM	499	8.5	63	8.8	436	8.4	0.6
Hypothyroidism	1334	22.6	163	22.6	1171	22.6	0.9
Hospitalization during pregnancy	2146	36.4	241	33.5	1905	36.8	0.08
Neonatal birth weight (kg)*	3.4	2.8–3.9	3.4	2.9–3.9	3.3	2.8–3.8	0.4
LBW	297	5.0	29	4.0	268	5.2	0.2

* — median/interquartile range. inh., inhabitants; BMI, body mass index; GDM, gestational diabetes mellitus; ICP, intrahepatic cholestasis of pregnancy; LBW, low birth weight; ART, assisted reproductive techniques. Stress level and assessment of relationship assessed with visual numerical scale from 0 to 10.

in Table 1. Women with poor sleep were more often obese, assessed their life stress level as higher and their satisfaction with the current relationship with a partner as lower. They had more often tried to conceive for over twelve months, while unintended pregnancy was reported less often.

3.4 Risk Factors of Poor Sleep During Pregnancy

Logistic regression analysis was performed to identify which factors increased the occurrence of poor sleep quality according to the PSQI during pregnancy. All factors which differed significantly between the groups of good and poor sleep quality were taken into consideration, but only those which were found independent risk factors are presented in Table 2.

Table 2. Logistic regression analysis of factors influencing the occurrence of poor sleep quality according to the PSQI.

	aOR	95% CI	*p*
Obesity	1.4	1.1–1.43	0.04
Unplanned pregnancy	0.87	0.81–0.92	0.02
Time to conceive >12 months	1.2	1.09–1.31	0.03
Life stress level	1.22	1.14–1.3	0.01
Assessment of relationship	0.94	0.91–0.98	0.04
Nocturnal urination	3.11	2.98–3.32	0.001
Back pain	1.91	1.68–2.21	0.001
Leg cramps	1.57	1.39–1.78	0.001
Fetal movements	2.44	2.1–3.03	0.001
Nausea	2.10	1.63–2.75	0.001

aOR, adjusted odds ratio; 95% CI, 95% confidence interval. Variables adjusted in the analysis: age, parity.

3.5 Relationship between Sleep Quality According to the PSQI and Perinatal Outcome

Women characterized by poor sleep during gestation delivered prematurely and via cesarean section significantly more often than respondents with good sleep quality. Sleep quality was not related to hypertension, gestational diabetes mellitus or LBW occurrence. No differences in neonatal birthweight between women with poor and good sleep quality were observed. The results are presented in Table 1. Logistic regression analysis was performed to assess which issues were influenced by sleep quality. Poor sleep increased the risk of preterm birth (adjusted odds ratio (aOR) 1.54, 95% confidence interval (CI) 1–2.3) and cesarean delivery (aOR 1.2, 95% CI 1–1.4) (variables were adjusted for age, parity, BMI).

Women with poor sleep significantly more often suffered from pregnancy ailments than those with good sleep during pregnancy: nocturnal urination (75.6% vs 12.4%, $p < 0.001$), back pain (49.6% vs 26.7%, $p < 0.001$), leg cramps (33% vs 18.2%, $p < 0.001$), fetal movements disturbing sleep (26.1% vs 10.8%, $p < 0.001$) and nausea (18% vs 9.2%, $p < 0.001$), respectively.

3.6 Risk of Sleep-Disordered Breathing According to the Berlin Questionnaire and Perinatal Outcome

5.7% of the respondents were classified as being at a high risk of OSA according to the Berlin Questionnaire. Both groups of poor and good sleep quality had similar rates of high OSA risk (5.9% vs 4.3%, $p = 0.1$). However, according to the women's subjective opinions breathing difficulties were more common in the group with poor sleep quality (25.6% vs 9.3%, $p < 0.001$). The characteristics of women with a high and low risk of OSA according to the Berlin questionnaire are presented in Table 3. Respondents at a high risk of OSA delivered preterm and LBW infants significantly more often. According to logistic regression analysis results, a high risk of OSA increased the risk of preterm birth (aOR 1.53, 95% CI 1–2.2) and LBW infant (aOR 1.64, 95% CI 1.1–2.5).

4. Discussion

In our study only 12.2% of women reported good sleep quality during pregnancy according to the PSQI and the average PSQI score in the study group was 7.52. It was higher than estimated by Sedov*et al.* [1]. In a systematic review of 24 studies, the authors determined the average PSQI score during pregnancy at 6.07 (95% CI 5.3–6.85) across all studies. The reported prevalence of poor sleep quality during gestation varied in published research. Christian *et al.* [18] investigated sleep quality in 133 women during each trimester of pregnancy and postpartum and found 71% of pregnant women to suffer from poor sleep. 92% reported poor overall sleep quality during at least one assessment, including 88% at some time during gestation. Similar results were reported by Mindell *et al.* [19]. In their study 2427 pregnant women completed an internet-based survey that included the PSQI. The authors found 31.5% of women to experience poor sleep quality. Conversely, other authors reported significantly lower rates of sleep problems among pregnant women. According to Gelaye*et al.* [20] only 17% of pregnant women had poor sleep quality in a group of 1298 pregnant women between 24 and 28 gestational weeks. Du *et al.* [21] found the prevalence of maternal poor sleep quality during early pregnancy to be 34.1%. According to the meta-analysis by Sedov*et al.* [1] 45.7% of women had poor sleep quality during pregnancy according to the PSQI. Our research group previously conducted a cross-sectional study of pregnant women in Poland and found 95.1% of the respondents in the first trimester, 93% in the second trimester and 94.8% in the third trimester to report poor sleep quality [22].

Specific pregnancy-related ailments may disturb sleep. The most frequently reported causes of sleep problems across all pregnancy is frequent urination, being unable to find a comfortable position, pelvic pain, back pain, reflux, and leg cramps [19]. Similar factors influencing the occurrence of poor sleep quality were found in our study.

Table 3. Characteristics and perinatal outcome of the study group (the respondents) with and without a high risk of obstructive sleep apnoea according to the Berlin Questionnaire.

	High risk of of sleep-disordered breathing		Low risk of ofsleep-disordered breathing		
	N = 335		N = 5555		
	n	%	n	%	*p*
Age (years)*	28	24–33	28	23–32	0.3
BMI (kg/m^2)*	24.2	19.9–32.7	24.1	19.4–31.2	0.2
Obesity	31	9.3	567	10.2	0.6
Gestational age at delivery (weeks)*	39	37–41	39	38–41	0.4
Preterm delivery	29	8.6	325	5.9	0.04
Mode of delivery: vaginal	192	57.3	3173	57.1	0.4
Mode of delivery: cesarean	143	42.7	2169	39.0	0.2
Primiparity	255	76.1	3864	69.6	0.01
Hypertension	31	9.3	508	9.2	0.5
GDM	21	6.3	478	8.6	0.2
ICP	5	1.5	95	1.7	0.7
Hypothyroidism	72	21.5	1262	22.7	0.2
Hospitalization during pregnancy	122	36.4	2024	36.4	0.9
Neonatal birth weight (kg)*	3.4	2.7–3.7	3.4	2.8–3.9	0.7
LBW	26	7.8	271	4.9	0.03

* — median/interquartile range. BMI, body mass index; GDM, gestational diabetes mellitus; ICP, intrahepatic cholestasis of pregnancy; LBW, low birth weight.

According to our study poor sleep quality increased the risk of preterm birth and cesarean delivery, while it did not influence other perinatal outcomes. Similar results were reported by Li *et al*. [23]. In their prospective study of 688 healthy women with singleton pregnancy poor sleep quality during the first (OR 1.87, 95% CI 1.02–3.43), second (OR 5.19, 95% CI 2.25–11.97), and third trimester (OR 1.82, 95% CI 1.18–2.80) increased the risk of cesarean delivery, while during the second (OR 5.35, 95% CI 2.10–13.63) and third trimester (OR 3.01, 95% CI 1.26–7.19) it increased the risk of preterm birth. In a study by Zafarghandi *et al*. [24] most mothers with good sleep quality had vaginal delivery and their neonates weighed ≥2500 g. Felder *et al*. [25] conducted an observational study of nearly 3 million women giving birth in California between 2007 and 2012. Basing on the available medical data the authors assessed the impact of sleep disorders on preterm birth and found insomnia to increase the risk of preterm delivery. Pregnant women suffering from insomnia delivered more often before completed 37 weeks of gestation (OR 1.3, 95% CI 1.0–1.7), especially before 34 weeks of gestation (OR 1.7, 95% CI 1.1–2.6). A higher risk of preterm birth in women with poor sleep quality was reported in another study by Li *et al*. [26]. Conversely, Tomfohr-Madsen *et al*. [27] demonstrated no direct associations between sleep quality or sleep duration and gestational length or preterm birth. In a recent meta-analysis several kinds of sleep disturbances were analyzed, including poor sleep quality, extreme sleep duration, insomnia symptoms, restless legs syndrome, subjective sleep-disordered breathing and diagnosed obstructive sleep apnea. Sleep problems increased the risk of preterm delivery (OR 1.38, 95% CI 1.26–15.1) and cesarean section (OR 1.47, 95% CI 1.31–1.64) [28].

The question on the pathways by which sleep problems increase the risk of preterm birth remains unanswered. One of the possible mechanisms is inflammation. Published data suggest that sleep disorders have impact on maternal immune system and intensify the inflammatory reaction [25]. According to Romero *et al*. [29] preterm birth etiology is complexed and inflammation is one of the major causes of premature rupture of membranes or preterm uterine contractions. Higher levels of IL-6, a pro-inflammatory serum cytokine which could stimulate prostaglandin production in gestational tissue, causing cervical ripening and promoting uterine contractions, is related to sleep disturbances. Therefore, inflammation induced by sleep disorders may be an indirect cause of preterm birth. Other possible mechanism of the influence of disordered sleep on preterm delivery is preterm activation of pituitary-adrenal axis. In case of stress increased level of cortisol induces prostaglandins' release and increase uterine activity [29]. Sleep disorders (especially insomnia) are related to increased level of stress and therefore may increase the risk of preterm delivery.

Similar question concerns the impact of sleep quality on the mode of delivery. In our study we found low sleep quality during pregnancy to be related with increased risk of cesarean delivery. It may be a result of permanent fatigue caused by low sleep quality. Reduced tolerance of physical effort due to lack of proper sleep may be related to decreased ability to complete exhaustive natural birth [23]. On the other hand, low sleep quality may be related

to higher level of stress and anxiety, which could increase the fear for vaginal delivery and this way affect the rate of cesarean deliveries as well.

We did not find sleep quality to impact pregnancy complications, like hypertension, diabetes mellitus or LBW occurrence. Similar results were reported by other authors. Howe *et al*. [30] conducted a survey including pregnant women in New Zealand and found no relationship between sleep quality and the delivery of a small for gestational age neonate. Sleep quality assessed by the PSQI did not influence neonatal birthweight in a prospective study by Sharma *et al*. [31] either. However, the impact on sleep quality on newborn birthweight may be more complex. In a recent study by Liu *et al*. [32]. PSQI scores were negatively correlated with birthweight of female infants, why no relation was observed between PSQI scores and male newborns' birthweight. Interesting findings concerning hypertension were reported by Tang *et al*. [33]. In their study a positive association between sleep quality represented by the PSQI score and diastolic blood pressure, and the mean arterial pressure during pregnancy was revealed. A relationship between sleep disturbances and maternal hyperglycemia was documented as well [34].

In our study, we found a significant correlation between OSA risk and the delivery of LBW infant. Most researchers reported no such correlation [35–37]. Franklin *et al*. [38] described the delivery of small for gestational age neonates in case of 7.1% of the infants of snoring mothers in comparison with 2.6% of non-snoring mothers ($p<$ 0.05). Snoring was a significant predictor of fetal growth restriction in multiple logistic regression, after adjustment for weight, age, and smoking habits. Higgins *et al*. [39] investigated over 4000 women presenting for delivery with the Berlin questionnaire. Surprisingly, they found women with a high risk of OSA to deliver newborns with higher birthweight. According to Bin *et al*. [36]. OSA in pregnancy did not increase the risk of delivering a large for gestational age neonate, contrary to a small for gestational age infant. In a meta-analysis by Warland*et al*. [10], 7 studies investigating objective sleep disordered-breathing and birthweight were included. The authors demonstrated an increased risk of delivering small for gestational age neonates in women with OSA (aOR 1.4, 95% CI 1.1–1.9).

We found a high risk of OSA to increase the risk of delivery before 37 weeks of gestation. Most studies reported a similar effect. According to Louis *et al*. [40]. OSA was associated with a more than twofold increased risk of preterm birth (OR 2.6, 95% CI 1.02–6.6). 6 studies investigating objectively diagnosed sleep disordered breathing were included in the meta-analysis by Warland*et al*. [10]. The authors found that OSA increased the risk of delivering prematurely (aOR 1.6, 95% CI 1.2–2.2). We hypothesized that the intermittent nocturnal hypoxemia which occurs during OSA may result in oxidative vascular injury and trophoblast hypoxia. If the placenta is hypoxic both LBW and preterm birth risks increase.

A large cohort of pregnant women is the great value of our study. No research on the relation between sleep problems in pregnancy and perinatal outcome in a population of central Europe pregnant women including such a large study group has been published till date. No studies reporting OSA risk in such a large cohort have been published worldwide so far either. The PSQI and Berlin questionnaire are objective tools for sleep assessment and were not previously validated in the pregnant population. Although a questionnaire is not an ideal tool for recognition of any sleep disorders, its anonymity, and the distribution of the survey via the internet might have aided the honesty of the answers. What is more, the use of polysomnography to recognize sleep disorders might lead to a significant reduction in the size of the study group. The sample of respondents was diverse regarding sociodemographic characteristics such as age, education, inhabitancy, and parity. However, there are some limitations of the study. It was distributed online, so the reliability of the results is a valid concern. No validation of questionnaire answers with perinatal medical records was available. Furthermore, neither PSQI nor Berlin questionnaire have not been validated in a population of pregnant women. As respondents up to one year after delivery were covered in the study, the accuracy of recalling information might decrease over time. The subjective nature of questionnaire can induce bias. Respondents could have understated the answers on snoring for example. Despite the survey's availability, without any special requirements and limitations except for the inclusion criteria, the study group was made up of women using the internet and Facebook. Therefore, it may not be universal for the whole population. Regarding the above limitations, we are of the opinion that additional analysis on this topic is necessary.

As preterm and cesarean delivery are related to poor sleep quality the assessment of sleep quality should be offered to all pregnant women. Nowadays screening for perinatal depression is obligatory in Poland. All pregnant women are assessed for depressive symptoms in the first and the third trimester of pregnancy, as well as after delivery. Analogous common sleep quality screening during pregnancy could diagnose sleep problems. Offering them proper care including sleep hygiene teaching, psychologic or psychiatric consultations, could influence perinatal outcomes and lower preterm birth rate. According to our study results almost 90% of women suffer from poor sleep quality during pregnancy. It may be the most common problem in gestation. Therefore, such a common problem should be taken seriously and involve equally large outlays in health care.

5. Conclusions

In conclusion, sleep problems concern almost all pregnant women in Poland. As sleep quality and OSA risk

have an impact on perinatal outcomes, the assessment of sleep problems during pregnancy could be helpful to consult pregnant women properly. Sleep hygiene should be discussed prior to and during pregnancy. Assessing sleep quality and sleep disordered breathing could play a role in the improvement of perinatal outcomes.

Abbreviations

PSQI, Pittsburgh Sleep Quality Index; OSA, obstructive sleep apnea; SGA, small for gestational age; BMI, body mass index; AHI, apnoea-hypopnea index; LBW, low birth weight; aOR, adjusted odds ratio; CI, confidence interval; inh, inhabitants; GDM, gestational diabetes mellitus; ICP, intrahepatic cholestasis of pregnancy; ART, assisted reproductive techniques.

Author Contributions

MS and KK-K designed the research study. NS-W and MZ performed the research. MW provided help and advice on draft. KK-K analyzed the data. MS and KK-K wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

The study protocol obtained the approval of the Ethics Committee of the Medical University of Warsaw (no 124/2018). The committee waived the obligation to secure a written or verbal consent to participate in the study as completing the questionnaire was deemed tantamount to giving consent.

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Conflict of Interest

The authors declare no conflict of interest.

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