

# Prevalence and determinants of poor sleep quality and depression among postpartum women: a community-based study in Ramechhap district, Nepal

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**Background:** Due to the limited number of studies in low- and middle-income countries (LMICs), this study aimed to identify the prevalence and determinants of postpartum poor maternal sleep and depression.

**Methods:** This cross-sectional study was conducted with 380 women who were 2–12 months postpartum in March and April 2017 in Ramechhap district, Nepal. Multiple logistic regression was used to identify the associated factors.

**Results:** The prevalence of poor sleep quality and depression was 28.2% and 18.7%, respectively. Poor sleep quality was associated with having an occupation (in government or business, odds ratio [OR] 6.69; in agriculture/labour, OR 15.5), a male infant (OR 2.37), home delivery (OR 2.17), mental illness during pregnancy (OR 5.87), complications after delivery (OR 5.58) and postpartum depression (OR 2.86). Meanwhile, postpartum depression was associated with having no post-natal care (OR 98.7), living in a nuclear family (OR 48.5), living in a rural area (OR 26.6), having a male infant (OR 4.61), having complications after delivery (OR 21.9), introducing complementary foods before 6 months of age (OR 4.71) and having poor sleep quality (OR 3.20).

**Conclusions:** A relatively high prevalence of depression and poor sleep quality were found. The close positive association between poor sleep quality and depression suggests the need for early identification and support for women at risk of poor sleep quality and depression in Nepal.

**Keywords:** depression, determinants, postpartum mothers, sleep quality, Nepal

## Introduction

The promotion of mental health and well-being is one of the United Nation's Sustainable Development Goals.<sup>1</sup> Postpartum depression, one of the common mental illnesses, has serious health consequences on the quality of life of the mothers and their children.<sup>2</sup> It remains underrecognized and undertreated in maternal and child health (MCH) programs, particularly in low- and middle-income countries (LMICs).<sup>3</sup>

A meta-analysis estimated an average prevalence rate of 10–15% for non-psychotic postpartum depression.<sup>4</sup> In Nepal, the estimated prevalence ranged from 4.9 to 30%,<sup>5–8</sup> depending on the study populations and methodological issues.<sup>4</sup> Most of the studies on postpartum depression in Nepal have been undertaken among women attending post-natal clinics at health institutions<sup>5,7–9</sup> and

there are limited studies on its determinants.<sup>8,10</sup> As the majority of Nepalese mothers deliver at home, there is a need for community-based studies on the prevalence and determinants of postpartum depression in Nepal.

Poor sleep quality, a common phenomenon during the postpartum period<sup>11</sup> due to night-time feeding and the frequent nocturnal awakenings of infants,<sup>12</sup> may be an important indicator of women's physical and mental health.<sup>12,13</sup> A longitudinal population-based study in Norway showed that sleep duration decreased after childbirth and sleep problems, such as sleep-onset latency, waking after sleep onset and sleep efficiency were substantially higher at week 8 postpartum than at week 3 of pregnancy and at year 2 postpartum.<sup>11</sup> Insufficient and disrupted sleep after delivery was strongly associated with post-natal depression,<sup>14,15</sup> while postpartum depression might lead

to disturbed sleep.<sup>16</sup> In addition, poor sleep quality was found to be associated with stressful life events, a poor partner relationship<sup>12,15</sup> and inadequate physical and emotional care for the child.<sup>13</sup> However, poor sleep quality is frequently dismissed by health professionals and there is a lack of studies in LMICs such as Nepal.

Nepal has made substantial progress in reducing maternal mortality, due to improvements in women's utilization of maternal health care services. However, access to maternal health care and provisions for maternal mental illness remain poor. Continuous efforts are needed to improve the mental health as well as the physical health of mothers through screening or preventive interventions for depression and poor sleep quality within MCH services. This cross-sectional study aimed to assess health care needs by evaluating the prevalence and determinants of poor sleep quality and depression and their association among postpartum mothers in Ramechhap district, Nepal. This study also aimed to provide evidence for public health policy to manage postpartum depression and poor sleep quality among women in Nepal.

## Methods

### Study design and participants

This cross-sectional community-based study was conducted in Ramechhap district, Nepal in March and April 2017. Manthali municipality was purposively selected from Ramechhap district due to a lower prevalence of post-natal care (PNC) utilization compared with that of other municipalities. Four of seven village development committees (VDCs) and mothers from each VDC were randomly selected. Mothers who had an infant and who were at least 6 weeks post-natal (2–12 months of child's age) were invited, while mothers who were mute, had a hearing impairment, were unwilling to participate or were migrants were excluded. Prior to undertaking the study, the study design and purpose were discussed with the community leader of each VDC and their approvals were obtained. Based on the Krejcie and Morgan formula, the sample size was estimated using a 95% confidence interval, an acceptable error of 4.4% and a sleep problem rate of 25%<sup>17</sup> and then was increased by 10% to allow for incorrectly completed questionnaires. This calculation determined a required sample size of 380. Trained researchers collected data via face-to-face interviews. Ethical approval was obtained from the Mahidol University Ethical Committee and the District Health Office of Ramechhap. Study objectives were explained to the participants prior to the interviews. Participants were assured of confidentiality and were told that they could terminate participation at any time without prejudice. A consent form was read to the mothers and a written/verbal consent before the interview was obtained. All data were treated anonymously using study identification numbers.

### Measures of variables

The Pittsburgh Sleep Quality Index (PSQI) is a widely used measure that assesses clinical and subjective sleep complaints the previous month, using Likert and open-ended response formats.<sup>18</sup> Nineteen individual items generate seven components, including

subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. Component scores range from 0 to 3 and are summed to obtain a global score, which ranges from 0 to 21. Higher scores indicate more sleep disturbance experienced and a global score >5 indicates a significant sleep disturbance. Cronbach's  $\alpha$  was 0.80 (0.83 in the original sample<sup>18</sup>).

Postpartum depression was assessed with the Patient Health Questionnaire-2 (PHQ-2), which performed well for identifying depression in primary care centres with large samples.<sup>19</sup> The two questions used to identify postpartum depression in the PHQ-2 are 'Over the past 2 weeks, how often have you been bothered by any of the following problems? 1) Little interest or pleasure in doing things; 2) Feeling down, depressed or hopeless.' The response options were i) not at all, ii) several days, iii) more than half the days and iv) nearly every day. Each question item has a score ranging from 0 to 3. The total score ranges from 0 to 6. The mothers with a score  $\geq 3$  as the optimal cut-off point for screening purposes were considered as depressed. All covariates were obtained by face-to-face interviews.

Sociodemographic variables including maternal education and occupation, monthly family income, type of family, residence, age at last delivery, number of children <5 y of age, age of infant and sex of infant were collected by means of a questionnaire. Ante- and perinatal factors included having mental problems like depression during pregnancy, antenatal care visits at least once, place of delivery, delivery mode and experiencing complications of the mother or the child during pregnancy or delivery. Mental problems during pregnancy were assessed with a question, 'Did you have any mental distress like depression during pregnancy?' ('yes' or 'no'). Experiencing complications of the mother or the child during pregnancy or delivery was assessed with a question, 'Did you experience any complications during pregnancy or delivery?' ('yes' or 'no'). Post-natal factors included experiencing complications of the mother or the child after delivery, PNC visits at least once, child still being breastfed and timing of introducing complementary food. Experiencing complications of the mother or the child after delivery was also measured with one question, 'Did you experience any complications after delivery?' ('yes' or 'no').

### Data analysis

Descriptive statistics were used to analyse proportions or means of participants' general characteristics. Associations between dependent variables, such as poor sleep quality and depression, and other factors were assessed using the  $\chi^2$  test and statistical significance was a p-value <0.05. Covariates with a p-value <0.05 in univariate analysis were entered into final multiple logistic regression using a stepwise method to identify predictors of the dependent variables. All analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC, USA).

## Results

### General characteristics of study subjects

The mean ( $\pm$ standard deviation) age at the last delivery of a total of 380 mothers was  $30 \pm 3.9$  y (range 19–42 y) and that of

their children was  $6.2 \pm 3.2$  months. About two-thirds of mothers lived in rural areas, in a joint/extended family, had no formal education or had a primary education and with a monthly family income of  $\leq 30\,000$  rupees (approximately  $\leq \text{US}\$288$ ) (Table 1). A total of 13.7% of mothers had a history of mental illness, such as depression, during pregnancy and 22.4% and 28.2% had complications before and after delivery, respectively. The rates of postpartum poor sleep quality and depression were 28.2% and 18.7%, respectively.

In univariate associations, shown in Table 1, mothers with poor sleep quality were more likely to be illiterate, to be involved in agriculture/labour work, to have a low monthly family income, to reside in rural areas, to be  $\geq 30$  y of age at the last delivery and to have two or more children and a male infant ( $p < 0.05$ ). For the ante- and post-natal factors, they were more likely to have mental illness such as depression during

pregnancy and maternal and infant medical complications after delivery but were less likely to have antenatal care (ANC) and PNC visits and institutional delivery. Meanwhile, mothers with postpartum depression were more likely to be involved in agriculture/labour work, to live in a nuclear family and in rural areas and to have a male infant. For the ante- and post-natal factors, they were less likely to have ANC and PNC visits and institutional delivery but were more likely to have maternal or infant medical complications after delivery and to introduce complementary food before babies were 6 months of age.

Table 2 shows that the mean score of sleep quality was statistically significantly higher in those who were depressed than those who were not ( $p < 0.0001$ ). Among the seven subcomponents, while the duration of sleep and sleep disturbance were not associated with postpartum depression, the other five subcomponents (sleep quality, sleep latency, sleep efficiency, sleep

**Table 1.** Bivariate association between depression and status of sleep quality and covariates

Factors	Total		Poor sleep quality				p-Value	Depression				p-Value
			Yes (>5)		No ( $\leq 5$ )			Yes ( $\geq 3$ )		No (<3)		
	n	%	n	%	n	%	n	%	n	%		
<b>Sociodemographic factors</b>												
<b>Education</b>												
Illiterate	134	35.3	50	46.7	84	30.8	<b>0.0137</b>	29	40.9	105	34.0	0.0733
Primary	105	27.6	24	22.4	81	29.7		24	33.8	81	26.2	
Secondary or above	141	37.1	33	30.8	108	39.6		18	25.4	123	39.8	
<b>Occupation</b>												
Agriculture/labour	199	52.4	87	81.3	112	41.0	<b>&lt;0.0001</b>	55	77.5	144	46.6	<b>&lt;0.0001</b>
Government/private business	97	25.5	16	15.0	81	29.7		4	5.6	93	30.1	
Housewife	84	22.1	4	3.7	80	29.3		12	16.9	72	23.3	
Monthly family income (>30 000 rupees <sup>a</sup> )	140	36.8	26	24.3	114	41.8	<b>0.0015</b>	24	33.8	116	37.5	0.5560
Type of family (nuclear family)	126	33.2	39	36.5	87	31.9	0.3936	34	47.9	92	29.8	<b>0.0035</b>
Residence (rural)	258	67.9	89	83.2	169	61.9	<b>0.0098</b>	69	97.2	189	61.2	<b>&lt;0.0001</b>
Age at last delivery ( $\geq 30$ y)	233	61.3	75	70.1	158	57.9	<b>0.0278</b>	39	54.9	194	62.8	0.2205
No. of children <5 y of age ( $\geq 2$ )	277	72.9	89	83.2	188	68.9	<b>0.0048</b>	55	77.5	222	71.8	0.3367
Sex of newborn (boy)	191	50.3	68	63.6	123	45.1	<b>0.0012</b>	54	76.1	137	44.3	<b>&lt;0.0001</b>
Age of newborn (2–6 months)	165	43.4	39	36.5	126	46.2	0.0860	31	43.7	134	43.4	0.9638
<b>Ante- and perinatal factors</b>												
Mental illness (depression) during pregnancy (yes)	52	13.7	28	26.2	24	8.8	<b>&lt;0.0001</b>	13	18.3	39	12.6	0.2085
ANC visits (at least once)	179	47.1	41	38.3	138	50.6	<b>0.0317</b>	24	33.8	155	50.2	<b>0.0128</b>
Place of delivery (home)	131	34.5	55	51.4	76	27.8	<b>&lt;0.0001</b>	43	60.6	88	28.5	<b>&lt;0.0001</b>
Delivery mode (vaginal)	336	88.4	95	88.8	241	88.3	0.8896	67	94.4	269	87.1	0.0825
Complications during pregnancy/delivery (yes)	85	22.4	33	30.8	74	27.1	0.4666	14	19.7	71	23.0	0.5523
<b>Post-natal factors</b>												
Complications after delivery (yes)	107	28.2	14	13.1	71	26.0	<b>0.0065</b>	36	50.7	71	23.0	<b>&lt;0.0001</b>
PNC visits (at least once)	108	28.4	23	21.5	85	31.1	<b>0.0609</b>	6	8.5	102	33.0	<b>&lt;0.0001</b>
Still being breastfed (yes)	285	75.0	82	76.6	203	74.4	0.6448	48	67.6	237	76.7	0.1106
Timing of complementary food (<6 months)	285	75.0	77	72.0	208	76.2	0.3920	34	47.9	251	81.2	<b>&lt;0.0001</b>
Poor sleep quality (yes)	107	28.2	–	–	–	–	–	44	62.0	94	30.4	<b>&lt;0.0001</b>
Depression (yes)	71	18.7	44	41.1	27	9.9	<b>&lt;0.0001</b>	–	–	–	–	–

<sup>a</sup> US\$1=102.5 rupees.

Significant p-values in bold.

**Table 2.** Sleep quality for women at 2–12 months postpartum with depression status

Sleep quality	Total		Depression				p-Value
			Yes ( $\geq 3$ )		No ( $< 3$ )		
	Mean	SD	Mean	SD	Mean	SD	
Total score (0–21)	4.09	2.37	5.89	2.79	3.68	2.06	<b>&lt;0.0001</b>
Components							
Sleep quality (0–3)	1.21	0.62	<b>1.61</b>	0.52	1.11	0.60	<b>&lt;0.0001</b>
Sleep latency (0–3)	0.80	0.61	<b>1.15</b>	0.73	0.72	0.55	<b>&lt;0.0001</b>
Sleep duration (0–3)	0.57	0.60	0.48	0.50	0.60	0.62	0.0952
Sleep efficiency (0–3)	0.19	0.42	<b>0.30</b>	0.49	0.17	0.39	<b>0.0491</b>
Sleep disturbances (0–3)	0.72	0.47	0.80	0.40	0.71	0.48	0.1120
Sleep medications (0–3)	0.41	0.66	<b>0.97</b>	0.86	0.28	0.53	<b>&lt;0.0001</b>
Daytime dysfunction (0–3)	0.19	0.41	<b>0.58</b>	0.50	0.10	0.33	<b>&lt;0.0001</b>

Significant p-values in bold.

SD: standard deviation.

medications and daytime dysfunction) were strongly associated with postpartum depression.

The factors associated with poor sleep quality are shown in Table 3 and include mother's occupation of government or business (odds ratio [OR] 6.69 [95% confidence interval {CI} 1.93 to 23.2]) and of agriculture/labour (OR 15.5 [95% CI 5.10 to 47.2]), having a male infant (OR 2.37 [95% CI 1.29 to 4.33]), home delivery (OR 2.17 [95% CI 1.20 to 3.93]), mental illness during pregnancy (OR 5.87 [95% CI 2.72 to 12.7]), medical complications of mother or baby after delivery (OR 5.58 [95% CI 2.64 to 11.8]) and postpartum depression (OR 2.86 [95% CI 1.49 to 5.49]).

The factors associated with postpartum depression (Table 4) include living in a nuclear family (OR 48.5 [95% CI 15.3 to 154]) and in rural areas (OR 26.6 [95% CI 5.34 to 132]), having a male infant (OR 4.61 [95% CI 1.84 to 11.5]), no PNC visit (OR 98.7 [95% CI 19.4 to 503]), experiencing complications after delivery (OR 21.9 [95% CI 7.30 to 65.9]), early introduction of complementary foods before 6 months of age (OR 4.71 [95% CI 1.88 to 11.8]) and poor sleep quality in the postpartum period (OR 3.20 [95% CI 1.34 to 7.61]).

## Discussion

This cross-sectional community-based study aimed to assess the prevalence and determinants of poor maternal sleep and depression among postpartum women in Ramechhap district, Nepal. This study showed that among the 380 postpartum women surveyed, about 28% of them had poor sleep quality and 19% experienced postpartum depression. Factors positively associated with poor sleep quality were working mothers, having a male infant, home delivery, mental illness during pregnancy, experiencing medical complications after delivery and postpartum depression. Living in a nuclear family, living in rural areas, having a male infant, having post-natal complications, no PNC visits, early

**Table 3.** Determinants of poor sleep quality among the mothers at 2–12 months postpartum

Characteristic	Poor sleep quality	
	OR	95% CI
Occupation		
Agriculture/labour	<b>15.5</b>	<b>5.10 to 47.2</b>
Government/private business	<b>6.69</b>	<b>1.93 to 23.2</b>
Housewife	1.00	
Sex of infant		
Girl	1.00	
Boy	<b>2.37</b>	<b>1.29 to 4.33</b>
Place of delivery		
Home	<b>2.17</b>	<b>1.20 to 3.93</b>
Health facilities	1.00	
Mental illness like depression during pregnancy		
No	1.00	
Yes	<b>5.87</b>	<b>2.72 to 12.7</b>
Complications after delivery		
No	1.00	
Yes	<b>5.58</b>	<b>2.64 to 11.8</b>
Postpartum depression		
No	1.00	
Yes	<b>2.86</b>	<b>1.49 to 5.49</b>

Significant values in bold.

introduction of complementary foods before 6 months of age and postpartum poor sleep quality were positively associated with postpartum depression. This study showed that depression

**Table 4.** Determinants of depression among the mothers at 2–12 months postpartum

Determinant	Depression	
	OR	95% CI
Type of family		
Nuclear	<b>48.5</b>	<b>15.3 to 154</b>
Joint/extended	1.00	
Residence		
Urban	1.00	
Rural	<b>26.6</b>	<b>5.34 to 132</b>
Sex of infant		
Girl	1.00	
Boy	<b>4.61</b>	<b>1.84 to 11.5</b>
PNC visits (at least once)		
No	<b>98.7</b>	<b>19.4 to 503</b>
Yes	1.00	
Complications after delivery		
No	1.00	
Yes	<b>21.9</b>	<b>7.30 to 65.9</b>
Timing of complementary food		
<6 months	<b>4.71</b>	<b>1.88 to 11.8</b>
≥6 months	1.00	
Poor sleep quality		
No	1.00	
Yes	<b>3.20</b>	<b>1.34 to 7.61</b>

Significant values in bold.

and poor sleep quality are closely interrelated in postpartum mothers. Health care professionals should be aware of the high prevalence of postpartum poor sleep quality and depression and their associations and should not overlook their symptoms among postpartum women. This study highlights the need to develop a comprehensive public health policy to ensure improvement of self- and social awareness, universal psychosocial assessment and active social support for post-natal women, particularly disadvantaged women and those living in rural areas, are undertaken within MCH programs in Nepal.

### Prevalence of poor sleep quality and depression

The prevalence of poor sleep quality was relatively lower (28%) among 380 mothers at 2–12 months postpartum in this study compared with other studies in other countries. Other studies assessed sleep quality among mothers who delivered in health facilities just after delivery in Taiwan (87.5%),<sup>12</sup> at postpartum 2–4 months in Iran (53%)<sup>14</sup> and in Norway (58%),<sup>15</sup> when newborn care requires frequent night-time waking due to night-time feedings. The differences can be explained partly because this study investigated women up to 6 months postpartum.

This study showed that 18.7% of 380 women had postpartum depression at 2–12 months postpartum in communities of Ramechhap district using PHD-2, which is a well-studied

screening measure of depression and is often used in primary care.<sup>19</sup> Compared with other Nepalese studies, despite the use of a different measure using the Edinburgh Postnatal Depression Scale (EPDS) at a cut-off of ≥13, the prevalence ranged from 3.9%<sup>5</sup> to 17%<sup>9</sup> to 30%<sup>7</sup> in hospital-based studies and from 3.9%<sup>5</sup> to 12.3%<sup>6</sup> in community-based studies. The incidence using the same criteria was 19.4% at 6 weeks and 22.2% at 10 weeks postpartum in a hospital in Kathmandu, Nepal. The differences in prevalence of postpartum depression among Nepalese women could be due to variations in methodological design<sup>4</sup> and diverse ethnicity, as Nepal is a country with great diversity in terms of economy, geography, culture and ethnicity.<sup>5</sup>

### Associations between poor sleep quality and depression

This study confirms previous findings<sup>14–16,20</sup> that depression and poor sleep quality are closely interrelated in postpartum mothers. The associations between depression and poor sleep quality have been studied using a cross-sectional design<sup>14,15</sup> and case-control design.<sup>16,20</sup> A case-control study among Norwegian women at 2 months postpartum reported no difference between women with depression and those without depression when measuring sleep quality with objective actigraphy or a sleep diary.<sup>20</sup> Another matched case-control study among 44 women who were 6–26 weeks postpartum in Philadelphia, Pennsylvania, USA showed that women with depression had poorer sleep quality, based on objective measures using wrist actigraphy, than those without depression and that there was a positive linear association between poor sleep quality and depression symptom severity.<sup>16</sup> Despite limited findings on the association between sleep disturbance and depressive symptoms during this period, many studies have noted that those with postpartum depression seem more likely to experience more waking after sleep onset and more night-time demands.<sup>16</sup> On the other hand, women who had poor sleep quality in the postpartum period had increased odds of depression.<sup>14</sup> Our study showed that while the duration of sleep and sleep disturbance were not associated with postpartum depression, the other five subcomponents of sleep quality were strongly associated with postpartum depression. Further, this study shows that maternal and infant medical complications after delivery and a history of antenatal or post-natal mental illness (e.g. depression) may be associated with an increased likelihood of poor sleep quality. Studies<sup>15,21</sup> have shown that the strongest determinant of postpartum depression is psychological distress during the previous year. Familial support for night-time infant care and receiving information on effective sleep strategies from health professionals should be provided to reduce both sleep problems and depression, particularly when mothers have depression.<sup>16</sup>

### Other determinants of poor sleep quality

This study found that delivering babies at home was a determinant of poor sleep quality. In Nepal, the majority of women in rural areas deliver at home, by preference<sup>22</sup> and because of the barrier of high financial cost in accessing health services and

delivering at a facility.<sup>23</sup> Our study also shows a positive association of poor sleep quality and mothers having agriculture/labour occupations and residing in rural areas. Home deliveries are also common in urban areas, where maternity services are relatively easily accessible.<sup>22</sup> As with those in agriculture/labour occupations, those working in government or business tend to return to work within a short time after childbirth, exposing themselves to additional job-related stress and eliminating the opportunity for napping during the day. Moreover, after work, working Nepalese mothers handle domestic tasks, such as child care and household chores, unless husbands help with these tasks. This study showed that women of lower socio-economic backgrounds are more likely to have poor sleep quality,<sup>24</sup> and health professionals should provide effective strategies to help solve sleep problems within the MCH programs, particularly for deprived women. Further, having a male infant was inversely associated with sleep quality, consistent with other studies,<sup>13,15</sup> probably due to infants being temperamentally difficult.<sup>13</sup> Although mothers who had caesarean sections were reported to have poorer sleep quality than those with a normal delivery,<sup>25</sup> our finding did not show significant associations between poor sleep quality and delivery mode or the timing of introducing complementary food.

### Other determinants of postpartum depression

It is interesting to note that those living in a nuclear family were strongly associated with having postpartum depression in Nepal, where the rapid nuclearization of families is occurring. In Nepalese culture, support, such as taking care of children, provided by women's mothers and mothers-in-law during the postpartum period is important. Support from a woman's mother to her daughter on practical and emotional issues after childbirth are limited to the first several weeks, particularly in a nuclear family. Moreover, this may be even more difficult if a postpartum woman has experienced both medical complications (her own or her baby) after delivery and poor sleep quality, which are strongly associated with postpartum depression.<sup>14,15</sup>

Findings from our study indicate that antenatal depression and maternal and infant complications and poor sleep quality after delivery can be predictive of postpartum depression. In addition, those residing in rural areas and receiving no PNC had a higher likelihood of depression. In Nepal, high proportions of women lack access to PNC or make fewer than the recommended number of visits. Generally, health institutions are inaccessible to the majority who live in rural areas and to those who cannot pay for PNC. As the risk of depression increases over the postpartum period, with peaks documented through 6 months,<sup>26</sup> screening should be integrated into routine practice and repeated either during the mothers' postpartum visits<sup>27</sup> or during the infants' well-child visits<sup>26</sup> up to at least 6 months postpartum. Special attention should be paid to mothers living in rural areas and disadvantaged mothers through outreach and to train local lay people to provide support. It may require considerable effort to improve the uptake of PNC visits and the provision of effective and practical guidelines within PNC, including provisions to care for maternal physical and mental illnesses after childbirth and for associated parenting difficulties, such as

infant feeding practices and infant sleep problems. Our study found that having a male infant was associated with depression as seen in a Norwegian study,<sup>15</sup> while other studies have shown that depression is higher in mothers of girls in India<sup>28</sup> and in Iran.<sup>29</sup> As the association between a child's sex and postpartum depression has not yet been elucidated, further studies should be conducted.

### Strengths and limitations

The study has certain limitations that should be noted when interpreting the findings. First, since our findings came from a cross-sectional survey with a small sample, we cannot establish causality. Second, there may concern about the measurement tools, as data collection was undertaken with a single-question, short-term, self-reported assessment, which may contribute to measurement errors and imprecise estimates due to reliance on women's memory. Therefore the results may be subject to recall bias and reduced accuracy compared with objective measures of sleep. Given these limitations, the use of a community-based sample may be advantageous, as it permits more precise estimation of the prevalence of poor sleep quality and depression at a community level.

### Conclusions

This cross-sectional study of 380 women in Ramechhap district, Nepal revealed 28% of the women had poor sleep quality and 19% experienced postpartum depression. There was a close positive association between poor sleep quality and depression among women at 2–12 months postpartum. The findings suggest that supporting the mental health of mothers should be highlighted in the MCH program, with specific efforts to identify depression and poor sleep quality early on and to provide effective and tailored care from pregnancy to postpartum.

**Author's contributions:** SAH and RK contributed in the conception of the work. RK supervised data collection. SAH and RK analysed the data and drafted the manuscript. SAH and Y-SC critically revised the manuscript for intellectual content. All authors read and approved the final manuscript.

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**Ethical approval:** Before commencement of the study, ethical approval was granted by the Mahidol University Ethics Committee and the District Health Office of Ramechhap. The protocol was explained in detail in the local language and informed consent was obtained from all individual participants included in the study. All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with

the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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