

ORIGINAL ARTICLE

Maternal mental health and social support from online communities during pregnancy*

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Email: z.zhu@kent.ac.uk**Abstract**

Social determinants of public health have gained increasing attention. This paper studied whether social support from online communities related to maternal mental health. We focused on online maternity communities that group users with a similar prenatal status to facilitate their exchange of personal experiences and knowledge about maternal caring during pregnancy. Such online maternity communities are getting increasingly popular and can be found across countries and societies. We invited users—currently pregnant and gave birth within 1 year at the time of the study—from one such community in China to participate in a survey. The survey measured their perceived social support (PSS) exclusively from the peer group in the online community, their mental health and newborns' birth outcomes ($N = 500$). Users reported high score in PSS from the online peer group which was comparable to the ones from family, significant other and friends in other studies. We used linear regression models to examine the effects of PSS on mental health and birth outcomes. We found that a one-point increase in the PSS score was associated with a 0.19-point ($p < 0.1$) decrease in the prenatal depression and a 0.26-point ($p < 0.01$) decrease in the postnatal depression, which was equivalent to 3% and 4.5% of the average respectively. Moreover, a one-point increase in the PSS score was associated with a 14.49-gram increase in a newborn's weight ($p < 0.01$).

KEYWORDS

maternal mental health, online community, peer groups, perceived social support

1 | INTRODUCTION

Childbearing is one of the most significant life events that bring not only joy but also anxiety and stress. The World Health Organisation (WHO, 2004) reported that worldwide about 10% of pregnant women and 13% of women who had just given birth experience a mental disorder, primarily depression. In developing countries this share was even higher, that is, 15.6% during pregnancy and 19.8%

after childbirth. Moreover, perinatal depression and stress are also related to several adverse child outcomes (Aizer et al., 2016; Carlson, 2015; Persson & Rossin-Slater, 2018).

One well-known intervention to improve maternal well-being and child development was the Home Visiting Program (HVP) that offered perinatal and parental support to disadvantaged first-time mothers. It had been implemented in the United States (Olds et al., 2019), the United Kingdom (Robling et al., 2016), Ireland

*We obtained ethical approval for this study from the University of Essex.

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(Doyle et al., 2015) and Germany (Sandner et al., 2018). Sandner et al. (2018) suggested that one of the mechanisms behind the success of HVP was compensating the lack of social support during maternity. Literature also showed that lack of prenatal social support presented a strong risk factor for depression during pregnancy and the postpartum period, as well as the mental health of the next generation (Collins et al., 1993; Elsenbruch et al., 2007; Hodnett & Fredericks, 2003).

In this paper, we investigated an emerging source of prenatal social support: online maternity communities that are open to the general population of pregnant women with internet access. The main feature of such online communities is to group users according to their pregnancy status to facilitate their information exchange of personal experiences, information and knowledge about maternal caring during pregnancy. Such online maternity communities are getting increasingly popular and can be found across countries and societies. We invited users who were currently (or had been) members of a large online maternity community in China to participate in a survey. We first measured how users perceived the social support from the peer groups in the online community. Subsequently, we used linear regression models and empirically analysed how perceived social support from these peer groups related to the maternal mental health and newborns' health outcomes.

This online maternity community studied here is one of the largest in China. Its core service is to provide a platform that allows geographically heterogeneous women, who have no prior acquaintance, to connect and exchange advice, information and support about maternal caring. At its root, the online community is built upon dedicated online peer groups (aka *birth clubs*) at monthly frequency. Each online peer group is essentially an internet forum with an allocated URL within the domain of the community platform. For example, <http://domain-name/community/club201803/> is for the peer group of March 2018. The users of such a peer group can hold conversations (aka *threads*) by posts and responses and the web page is presented as a list of hyperlinked conversations in reverse-chronological order. Each peer group has a few moderators who help manage and organise the conversations when needed (e.g., promoting instructive or informative content or responding to issues reported by users).

The online community assigns pregnant users into peer groups based on the month of their estimated due date (EDD). The main activity in the online peer groups is exchanging information and experiences about maternal caring. A user can exchange information in the peer groups by either initiating a post or responding to a post. A post typically initiates information exchange by either sharing own experience or asking a question; A response typically extends information exchange by either answering a question or asking a follow-up question (Jiang & Zhu, 2022).

To give a picture of the content and intensity of the activities in the peer groups, we tracked the online activities of three peer groups, March 2018, April 2018 and May 2018 with a complete pregnancy cycle (i.e., 10 months). We focused on posts with at

What is known about this topic?

- Worldwide about 10% of pregnant women and 13% of women who have just given birth experience mental health problems, and this share is even higher in developing countries.
- Lack of prenatal social support presents a strong risk factor for depression during pregnancy and the postpartum period, as well as the mental health of the next generation.
- Interventions such as the Home Visiting Program can partially compensate the lack of social support during maternity but are only targeted to a small fraction of disadvantaged mothers.

What does this paper add?

- Investigates to what extent the information and knowledge exchange during pregnancy in online maternity communities is perceived as social support by the pregnant users.
- Presents evidence that perceived social support from the online maternity communities is positively associated with both prenatal and postnatal mental health of the mothers, as well as newborns' birth weight.
- Gains a better understanding of an emerging and increasingly popular source of social support and suggests that more cost-effective interventions can be designed and targeted to the online maternity communities.

least one response (which helps filter out those with commercial purposes), which yielded 68,079 anonymous posts in the peer groups. We used these posts to generate a word cloud in the original language presented in Figure 1a. Figure 1b lists the top 20 most frequent words (in Chinese original followed by English translation) mentioned in the posts in the peer groups. Apart from the most frequent words 'pregnant, baby and mom(s)', other frequently discussed topics were 'last menstrual period, four-dimensional ultrasound, belly size, foetal heart, foetal pole and gender'. The verbs such as 'whether (be), take a look, and help' were clear demonstration of asking for confirmation, consultation and help from peers.

To give an idea of how the amount of information exchange was distributed among users in the peer groups, we looked at the distribution of all the posts and responses among the 67,774 anonymous users in the three tracked peer groups. On average, there were 85,754.3 posts and 433,621.3 responses per peer group over the period of 10 months. Figure 2 plots the cumulative posts and responses for each percentile of the users (Lorenz curves). If every user contributed equally to the information exchange in the peer groups, it would plot a 45 degree line. However, the curves show that the majority of the posts and responses were concentrated within a few

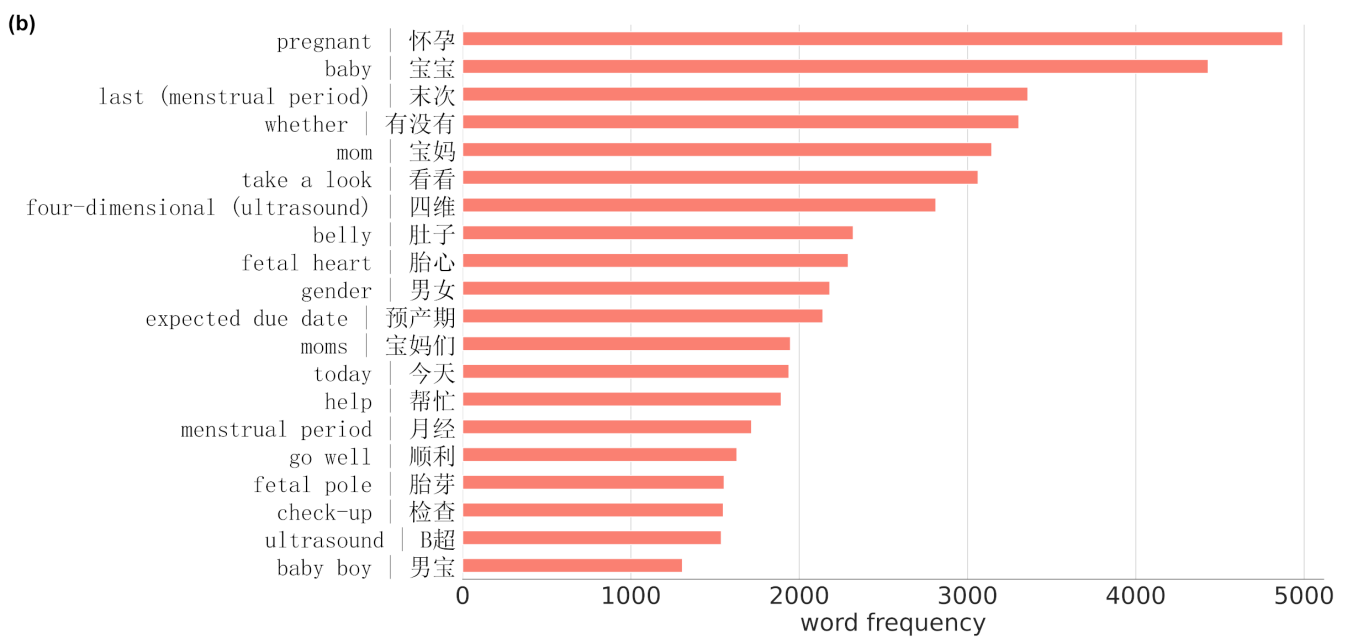


FIGURE 1 Word cloud.

users. The Gini coefficients of posts and responses were 0.588 and 0.822, respectively, indicating a high level of inequality in the active exchange among users.

2 | METHODS

Our study was based on an online survey. We obtained ethical approval from the Social Sciences Ethics Committee of the University of Essex (ETH1920-1453). Each online survey participant provided informed consent before proceeding to the questionnaire

2.1 | The survey

The survey was conducted in June 2020. We used the Chinese professional online survey platform <https://idiaoyan.com/> to invite mothers-to-be or mothers on a voluntary basis. The participants of our survey needed to meet either of the following criteria: (1) currently pregnant and was a member of the studied online maternity community, or (2) had been a member of the studied online maternity community and gave birth within 1 year at the time of the survey. Note that we controlled the numbers of the two types of participants, with the quotas of 300 and 200, respectively. That is,

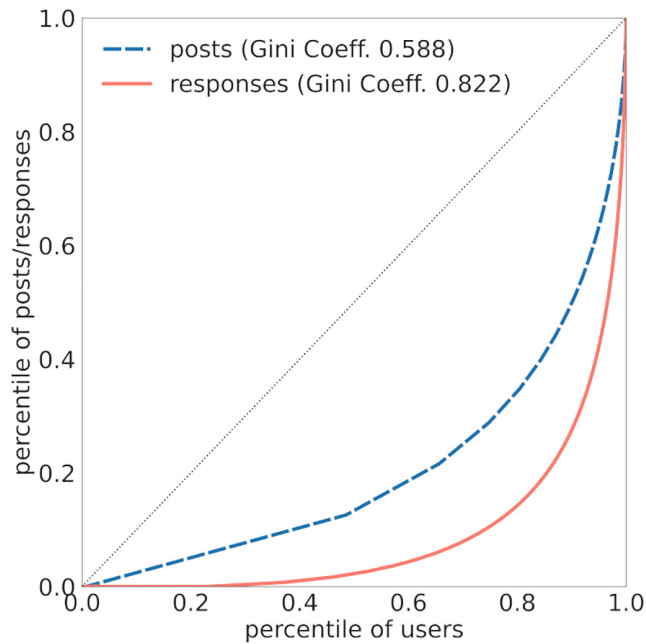


FIGURE 2 Lorenz curves of posts and responses.

the survey was automatically closed once the quota was met. As a result, our whole sample had 500 participants. The two sub-samples allowed us to measure the well-being of users who were during pregnancy as well as users who just gave birth, and the newborns' birth outcomes of the latter. Before the survey went alive to collect data, the commissioned online survey platform <https://idiaoyan.com/> implemented standard pilot tests to ensure question clarity, user interface consistency and data quality. The full questionnaire can be found in section A.1 in the Appendix.

The key instruments in the questionnaire are (i) users' perceived social support in the peer groups measured by a modified *Multidimensional Scale of Perceived Social Support*, (ii) their mental health measured by the *Edinburgh Depression Scale* and (iii) newborns' birth outcomes (weight, whether breastfeeding and whether planned natural birth) among those who gave birth within 1 year.

Table 1 reports the background statistics of the survey participants. Column (1) is the sub-sample of 300 pregnant users, Column (2) is the sub-sample of 200 participants who gave birth within 1 year and were users during their pregnancy and Column (3) is the full sample of 500 participants. The average day of EDD was about 16. The pregnant users were, on average, in their 6th month of the pregnancy. Note that the average day of EDD was around the middle of a month and the pregnancy month average was around the middle of the pregnancy cycle (typically 10 months in total), which suggests that our samples were representative as they were uniformly distributed along these dimensions. The users rated an average of 6.1 in both samples for the statement 'This community is my main source of knowledge and information about pregnancy'. on a scale from 1 to 7. This indicates that the users had a high level of trust in the source of pregnancy-related

information in this community. The average age of the users was slightly above 28 years old in both samples. Finally, we also asked about three health indicators: a binary variable of whether smoke or drink, and two categorical variables for hours of sleep and hours of physical exercise. Only two users (0.67%) smoked or drank during pregnancy and none after childbirth. Most users had adequate sleep and moderate exercise both during pregnancy and after childbirth.

2.2 | Instruments

2.2.1 | Measuring perceived social support in peer groups

There has been a surge in the evaluation of social support as a well-being indicator. The *Multidimensional Scale of Perceived Social Support* (MSPSS) (Zimet et al., 1988) has evolved as one of the most extensively translated and validated measures for social support outcome (Chou, 2000; Dahlem et al., 1991; Ma, 2020; Zhang & Norvilitis, 2002). The original test consisted of 12 items and was designed to assess the perceptions of social support from three specific sources: family, friends and significant other. The original 12 items can be found in section A.2 in the Appendix, where four items referred to the family, four items referred to friends and four items referred to the significant other/a special person. Some of the items are overlapping in the main content except for the sources of the support, for example, 'My family really tries to help me'. and 'My friends really try to help me'. Therefore, we only selected five relevant items and replaced the original sources with the *people in the peer group* which is the source of interest in our study. The detailed rationale for the added and modified items is provided below. We highlight the content that is relevant for our context in **bold**, which is the main reason why these items are selected.

1. I have **learned useful information** from others in the peer group. [added item]
The reasons why we added item (1) to the measure are (i) the core of this online community is an information-sharing network. It provides a common space for pregnant women to exchange information and knowledge among themselves throughout the entire pregnancy; (ii) The information exchange constitutes the essence of social support, defined as interpersonal exchange of potentially useful information or things (Cohen & Syme, 1985).
2. There are some people in the peer group who are **a real source of comfort** to me. [modified item]
This item is linked to the original item [5] where we replaced 'a special person' with 'some people in the peer group'.
3. There are some people in the peer group who are **around when I am in need**. [modified item]
This item is linked to the original item [1] where we replaced 'a special person' with 'some people in the peer group'.

TABLE 1 Survey descriptive statistics

	(1)	(2)	(3)
Variables	Pregnant	After childbirth	Full sample
Day of EDD (1st–30th/31st)	16.747 (7.313)	15.925 (7.627)	16.418 (7.443)
Xth-Month since pregnancy ^a	6.647 (1.539)	16.455 (2.703)	10.570 (5.241)
Community as main source of info ^b	6.127 (0.774)	6.130 (0.804)	6.128 (0.785)
Age	28.107 (2.006)	28.450 (2.175)	28.244 (2.080)
Health indicators ^c			
Whether smoke or drink	0.006 (0.082)	0 (0)	0.004 (0.063)
Hours of sleep (categories 1–4)	3.600 (0.617)	3.345 (0.713)	3.498 (0.668)
Physical exercise (categories 1–4)	2.013 (0.649)	1.830 (0.619)	1.940 (0.643)
Observations	300	200	500

Note: Means reported with standard deviations in parentheses.

^aFor all users (pregnant or after childbirth), it indicates the number of months since they were pregnant.

^bA scale (1–7) of using this community as the main source of pregnancy-related information.

^cHours of sleep is a categorical variable ranging from below 5, 5–6, 6–7, to above 7 hours; Physical exercise is a categorical variable ranging from below 30, 30–60, 60–120, to above 120 min.

4. I get the **emotional help and support** I need from others in the peer group. [modified item]

This item is linked to the original item [4] where we replaced 'my family' with 'others in the peer group'.

5. I can **talk about my problems** in the peer group. [modified item]

This item is linked to the original item [8,12] where we replaced 'with my family/friends' with 'in the peer group'.

6. People in the peer group are willing to **help me make some decisions**. [modified item]

This item is linked to the original item [11] where we replaced 'my family' with 'people in the peer group'.

Therefore, the perceived social support we measured using the modified MSPSS items exclusively refer to the *peer groups* in our context. The amount of social support was rated on a seven-point Likert scale, with responses ranging from 'very strongly disagree' (=1) to 'very strongly agree' (=7), that is, the higher the score, the greater the amount of perceived social support.

Figure 3 presents the scores of each item in the two sub-samples. Overall, there was no significant difference between the two sub-samples in the scores. The scores were also comparable to the ones from the female sample in the work by Zimet et al. (1988) which were 5.9 from family, 6.08 from the significant other and 6.16 from friends. The item means of the MSPSS all fell well above the mid-point of 4, suggesting that online social support was well received by the participants in the peer groups.

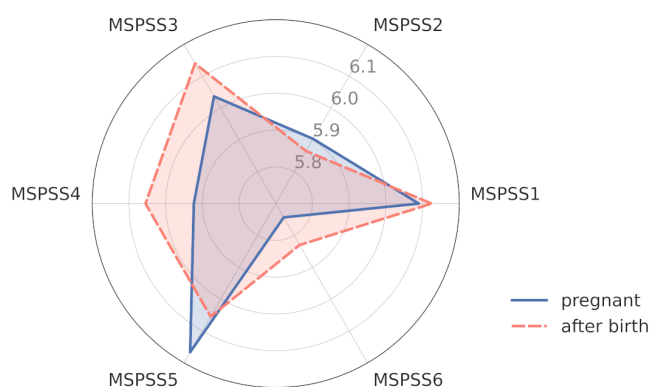


FIGURE 3 MSPSS by item.

2.2.2 | Measuring mental health

We used the *Edinburgh Depression Scale* (EDS) (Murray & Cox, 1990) to measure users' mental health. Initially, this 10-item self-report measure was developed for postnatal period (Cox et al., 1987) and was called *Edinburgh Postnatal Depression Scale*. Later, Murray and Cox (1990) validated it also for prenatal period and renamed to *Edinburgh Depression Scale*. Since then, it was used to screen for symptoms of emotional distress both during pregnancy and in the postnatal period. The EDS was translated and validated in a wide

range of languages (Marshall & Bethell, 2006). We used the Chinese version that was validated by Lee et al. (1998) in our survey. The test was referred to the feeling in the past 7 days. Therefore, in our survey, it screened for *prenatal depression* in the sample of users during pregnancy and *postnatal depression* in the sample of users after childbirth, respectively. Each item has a range of score from 0 to 3 and the total score is 30. A score between 10 and 12 depression indicates the presence of symptoms of distress that may be discomforting; A score above 12 requires further evaluation and possible referral to a perinatal mental health specialist. The complete items of the EDS in our survey sample can be found in section A.3 in the Appendix.

Figure 4 shows the distribution of the scores of each item in the EDS for both sub-samples. The size of each bubble indicates the number of participants. The average total EDS score for users during pregnancy (after childbirth) in our survey was 6.69 (5.78) with a standard deviation of 4.26 (3.74), suggesting a healthy level of mental status overall.

Note that both instruments provided comparable results to previous studies. We further checked the internal consistency of the instruments with Cronbach's alpha (Cronbach, 1951). The alpha coefficient of reliability was valued at 0.67 for the modified MSPSS items and 0.83 for the EDS items, respectively, both being above the acceptable level in the literature (Wongpakaran et al., 2011). The detailed statistics are reported in Tables 2 and 3 below. Therefore, the validity and reliability of the instruments were well justified.

2.3 | Hypotheses

Figure 5 illustrates the four hypotheses to be tested in the linear regression models. The question of key interest is whether the information

exchange in online peer groups during pregnancy serves as genuine prenatal social support. First, as we have seen in Figure 2, the majority of the active information exchange was concentrated within a few users. This suggests that although the information exchange serves as a public good in the peer groups, most of the users were passive information recipients or lurking (i.e. possibly read but rarely post or respond) in the peer groups. Therefore, having access to the information exchange may not necessarily equal to having received social support. Second, the observed information exchange in the peer groups is just a proxy of quantitative measures of social support. Lin (1986, 2001) distinguishes the objective and subjective dimension, and emphasises 'perceived or actual' social support. Most studies find perceived social support to be a better predictor of psychological status than objectively measured social support (see a summary by Zimet et al. (1988)).

Our first hypothesis thus bridges the objective information exchange and subjective social support. We hypothesised that the information exchange among pregnant users in online peer groups provided effective social support.

Hypothesis 1 The information exchange in online peer groups during pregnancy is well perceived as social support.

Social support is one of the most well-documented psychosocial factors linked to both physical health and mental health (Berkman et al., 2000; Holt-Lunstad et al., 2010). (Also see a critical and comprehensive review of evidence linking social support to health outcome by Uchino et al. (Uchino et al., 2012)). Overall, a positive relationship between social support and health is found in various populations and contexts (Irwin et al., 2008; Kumar et al., 2012; Langford et al., 1997; Lee et al., 2004, 2018; McKenzie et al., 2002; Mulvaney-Day et al., 2007; Schroevers et al., 2003). Our second and third hypotheses thus related perceived social support during

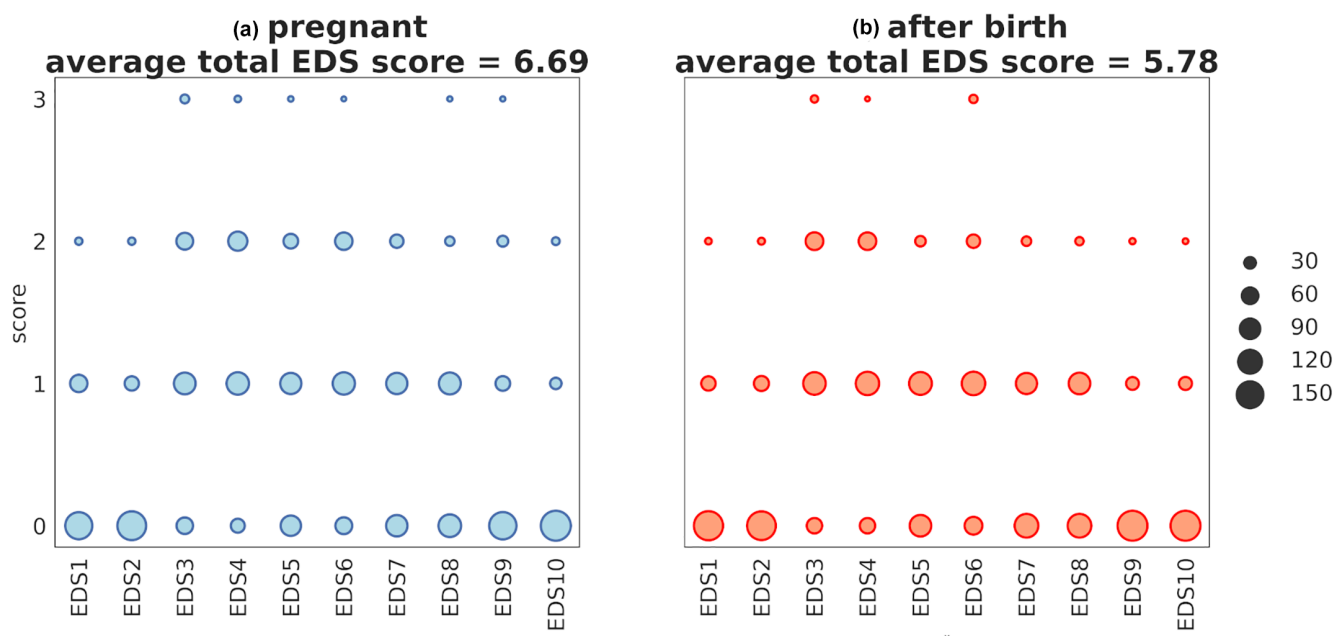


FIGURE 4 EDS by question.

TABLE 2 Cronbach's alpha for modified MSPSS items

Item	Obs	Sign	Inter-test correlation	Inter-rest correlation	Average interitem covariance	Alpha
MSPSS1	500	+	0.6590	0.4963	0.1684573	0.6003
MSPSS2	500	+	0.6851	0.4688	0.1526192	0.6004
MSPSS3	500	+	0.5749	0.3581	0.1839018	0.6406
MSPSS4	500	+	0.5736	0.3453	0.1838032	0.6454
MSPSS5	500	+	0.5972	0.3787	0.1779723	0.6339
MSPSS6	500	+	0.6045	0.3634	0.1751844	0.6409
Test scale					0.1736564	0.6689

TABLE 3 Cronbach's alpha for EDS items

Item	Obs	Sign	Inter-test correlation	Inter-rest correlation	Average interitem covariance	Alpha
EDS1	500	+	0.5199	0.4179	0.1491366	0.8191
EDS2	500	+	0.5323	0.4351	0.148905	0.8178
EDS3	500	+	0.5546	0.3909	0.1392947	0.8276
EDS4	500	+	0.6859	0.5709	0.1300821	0.804
EDS5	500	+	0.7260	0.6242	0.127321	0.7978
EDS6	500	+	0.6410	0.5089	0.132877	0.8116
EDS7	500	+	0.7121	0.6131	0.1300251	0.7994
EDS8	500	+	0.7092	0.6195	0.1328529	0.7998
EDS9	500	+	0.6551	0.5563	0.1372496	0.8062
EDS10	500	+	0.5353	0.4481	0.1502806	0.8175
Test scale					0.1378024	0.8261

pregnancy to maternal mental health during pregnancy and after childbirth.

Hypothesis 2 Greater levels of prenatal social support from the on-line peer groups are associated with better prenatal mental health (contemporaneous effects).

Hypothesis 3 Greater levels of prenatal social support from the on-line peer groups are associated with better postnatal mental health (lasting effects).

Finally, the literature in child development suggests that prenatal environment and maternal well-being have significant consequences for children's health and development (Doyle et al., 2009, 2015; Francesconi & Heckman, 2016; Heckman & Mosso, 2014). We thus linked the perceived social support during pregnancy to three birth outcomes—weight, whether breastfeeding, and whether planned natural birth—according to the WHO technical consultation on newborn health indicators (WHO & UNICEF, 2015). We expected that a higher level of prenatal social support was associated with heavier birth weight, and a higher likelihood of breastfeeding and planned natural birth.

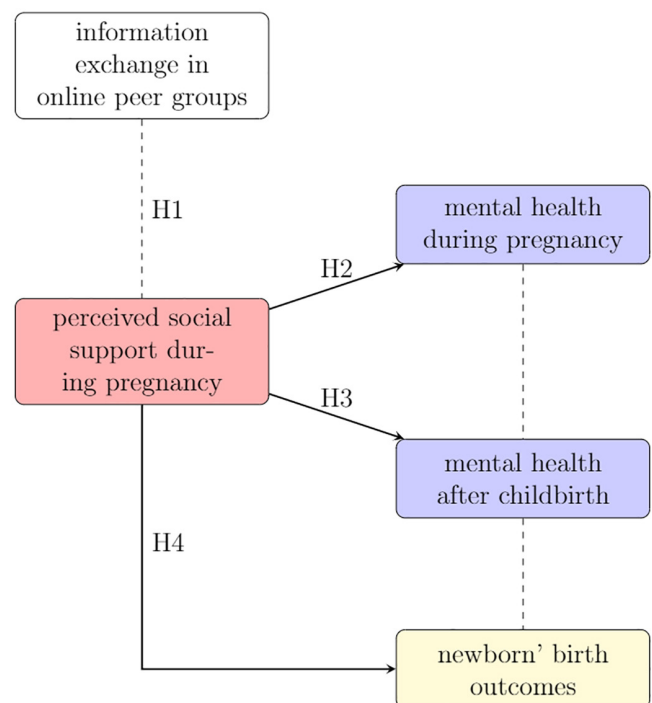


FIGURE 5 Hypotheses.

Hypothesis 4 Greater levels of prenatal social support from the virtual peer groups are associated with better newborns' birth outcomes.

3 | LINEAR REGRESSION MODELS AND RESULTS

3.1 | Perceived social support and maternal mental health

We regressed mental health on perceived social support from the peer groups as in Equation 1. The main explanatory variable is the total score of perceived social support from the peer groups during pregnancy, measured by the MSPSS. We controlled for three health indicators (whether smoke or drink alcohol, hours of sleep and physical exercise), age, as well as the fixed effects of the X-th month since pregnancy in one of the specifications.

$$\text{Mental health}_i = \beta_0 + \beta_1 \text{MSPSS}_i + \beta_2 \text{Health indicators}_i + \beta_3 \text{Age}_i + \alpha_m + \varepsilon_i \quad (1)$$

As explained in section 2.2.2, the EDS test screened for *prenatal depression* in the sample of users during pregnancy and *postnatal depression* in the sample of users after childbirth, respectively. In other words, there are two versions of Equation (1): the first version associates the contemporaneous

role of perceived social support from the peer groups with prenatal mental health when the peer groups were still active (i.e., during pregnancy); the second version associates its lasting role with postnatal mental health when the peer groups were no longer active (i.e., after childbirth).

Table 4 reports the results. Columns (1)–(2) are the sub-sample of the users during pregnancy without and with the fixed effects of the X-month since pregnancy, Column (3) is the sub-sample of the users after childbirth and Column (4) is the full sample. In the sample of the users during pregnancy, a one-point increase in the MSPSS score was associated with a 0.19-point ($p < 0.1$) decrease in the EDS score which was equivalent to 3% of the mean EDS. That is, higher perceived social support from the peer groups was associated with lower prenatal depression. In the sample of the users after childbirth, a one-point increase in the MSPSS score was associated with a 0.26-point ($p < 0.01$) decrease in the EDS score which was equivalent to 4.5% of the mean EDS. That is, higher perceived social support from the peer groups during pregnancy was also associated with lower postnatal depression.

Finally, the users who smoked or drank alcohol score around 6 points higher in the prenatal depression, and the users who had more hours of sleep had lower scores in both prenatal and postnatal depression. Physical exercise and age did not seem to matter for depression either during or within 1 year after pregnancy.

To provide further insight, we regressed mental health on each item of the MSPSS, individually. Since there were six items, the

	(1)	(2)	(3)	(4)
Variables	Pregnant	Pregnant	After childbirth	Full sample
MSPSS	-0.190*	-0.197*	-0.258***	-0.247***
	(0.104)	(0.110)	(0.0839)	(0.0667)
Whether smoke or drink	6.569***	5.918***	-	6.774***
	(0.560)	(0.957)	-	(0.467)
Hours of sleep	-1.629***	-1.668***	-1.119***	-1.212***
	(0.372)	(0.375)	(0.357)	(0.263)
Physical exercise	0.513	0.595	-0.681	0.235
	(0.369)	(0.371)	(0.459)	(0.287)
Age	-0.141	-0.107	0.192	-0.0224
	(0.133)	(0.129)	(0.133)	(0.0946)
Constant	22.26***	23.30***	14.63**	19.58***
	(5.406)	(5.455)	(5.876)	(4.011)
X-th month since pregnancy FE	No	Yes	No	No
Observations	300	300	200	500
R-squared	0.104	0.133	0.127	0.088

Note: Robust standard errors in parentheses.

MSPSS: The total score of a modified 6-item multidimensional Perceived Social Support Scale, ranging from 0 to 42 points. The variable 'whether smoke or drink' is omitted in Column (3) as no users report smoking or drinking after childbirth. Hours of sleep is a categorical variable ranging from below 5, 5–6, 6–7, to above 7 h. Physical exercise is a categorical variable ranging from below 30, 30–60, 60–120, to above 120 min.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

TABLE 4 Mental health measured by EDS

probability of having at least one significant result at the significance level of 0.05 due to pure chance is $1 - (1 - 0.05)^6$ which was above 26%. For the sake of caution, we applied the Bonferroni correction for the multiple testing (Bland & Altman, 1995).

Table 5 reports the results in the full sample. All six items had negative coefficients, however, only the coefficients of items 1, 4 and 5 were statistically significant. This was an interesting pattern. What items 1, 4 and 5 have in common and differ from other items is that the subject pronouns are 'I'. While we did not intend to overinterpret this pattern, it seemed that the items where the ego was presented more salient such as 'I can learn; I get help and support; I can talk' had a stronger and more significant association with the mental health. Other variables remain qualitatively the same as in Table 4 where the aggregated score was used as the explanatory variable.

3.2 | Perceived social support and newborns' birth outcomes

We selected three newborns' birth outcomes according to the WHO technical consultation on newborn health indicators (WHO & UNICEF, 2015): birth weight, whether being breastfed, and whether planned natural birth. We regressed newborns' birth outcomes on perceived social support from the peer groups during pregnancy, using the sample of users after childbirth as in Equation (2).

$$\text{Birth outcomes}_i = \delta_0 + \delta_1 \text{MSPSS}_i + \delta_2 \text{Health indicators}_i + \delta_3 \text{Age}_i + \alpha_m + \mu_i \quad (2)$$

Table 6 reports the results. The babies born to the mothers with higher perceived social support during pregnancy were heavier. A one-point

TABLE 5 Mental health measured by EDS (extended)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
MSPSS1	-1.071*** (0.267)					
MSPSS2		-0.452 (0.218)				
MSPSS3			-0.297 (0.225)			
MSPSS4				-0.935*** (0.213)		
MSPSS5					-0.595* (0.226)	
MSPSS6						-0.208 (0.179)
Whether smoke or drink	7.155*** (0.791)	6.768*** (0.362)	6.834*** (0.423)	6.262*** (0.393)	6.715*** (0.828)	6.626*** (0.508)
Hours of sleep	-1.169*** (0.263)	-1.253*** (0.268)	-1.211*** (0.272)	-1.295*** (0.268)	-1.223*** (0.265)	-1.232*** (0.271)
Physical exercise	0.233 (0.287)	0.241 (0.293)	0.262 (0.289)	0.306 (0.288)	0.301 (0.288)	0.251 (0.293)
Age	-0.00382 (0.0954)	-0.0129 (0.0961)	0.00102 (0.0971)	-0.00726 (0.0962)	-0.0236 (0.0970)	0.00420 (0.0969)
Constant	16.58*** (3.496)	13.24*** (3.428)	11.81*** (3.429)	16.03*** (3.278)	14.30*** (3.565)	11.21*** (3.280)
Observations	500	500	500	500	500	500
R-squared	0.087	0.064	0.057	0.090	0.068	0.056

Note: Robust standard errors in parentheses.

We apply the Bonferroni correction for multiple testing, that is, the significance levels are reported after each coefficient's p -value is multiplied by 6, the number of tests here.

MSPSS1: I have learned useful information from others in the peer group.

MSPSS2: There are some people in the peer group who are a real source of comfort to me.

MSPSS3: There are some people in the peer group who are around when I am in need.

MSPSS4: I get the emotional help and support I need from others in the peer group.

MSPSS5: I can talk about my problems in the peer group.

MSPSS6: People in the peer group are willing to help me make some decisions.

*** $p < 0.01$; * $p < 0.1$.

TABLE 6 Newborns' birth outcomes

Variables	(1) Newborn's weight (gram)	(2) Breastfeeding	(3) Planned natural birth
MSPSS	14.49 ^{***} (4.552)	-0.0398 (0.0340)	0.0363 (0.0285)
Hours of sleep	-1.872 (37.51)	0.156 (0.139)	0.150 (0.154)
Physical exercise	-145.7 ^{***} (41.09)	-0.282 [*] (0.162)	0.204 (0.198)
Age	-14.36 (11.26)	0.0217 (0.0497)	0.0539 (0.0569)
Constant	3494 ^{***} (403.5)	1.579 (2.082)	-2.506 (2.069)
Observations	200	200	200
R-squared	0.083	0.027	0.035

Note: Robust standard errors in parentheses.

The variable 'whether smoke or drink' is omitted as no users report smoking or drinking after childbirth. Hours of sleep is a categorical variable ranging from below 5, 5-6, 6-7, to above 7 h. Physical exercise is a categorical variable ranging from below 30, 30-60, 60-120, to above 120 min.

*** $p < 0.01$; * $p < 0.1$.

increase in the MSPSS score was associated with a 14.49-gram increase in the newborns' weight ($p < 0.01$). All the newborns' weight in our sample was within the normal range of birth weight reported in previous studies (Dai et al., 2014; Janssen et al., 2007). The mothers doing more physical exercises had lighter newborns. Perceived social support from the peer groups during pregnancy and other control variables did not seem to affect the decisions of breastfeeding and planned natural birth.

4 | DISCUSSION

The online maternity community we focused on in this study assigned pregnant users into peer groups according to the month of their estimated due date (EDD). The peer groups were active throughout the entire pregnancy. The creation of peer groups provided a common space for users who were at the same stage of pregnancy to exchange relevant information among themselves. The users typically exchanged information about their pregnancy symptoms and pregnancy status. The exchange often involved asking for confirmation, consultation and help from other peers in the group. Such information exchange among pregnant women constituted the essence of social support defined as *interpersonal exchange of potentially useful information or things* (Cohen & Syme, 1985; Shumaker & Brownell, 1984).

Our study added new evidence to the literature that links social support and individual well-being (Berkman et al., 2000; Holt-Lunstad et al., 2010; Irwin et al., 2008; Kumar et al., 2012; Langford et al., 1997; Lee et al., 2004, 2018; McKenzie et al., 2002; Mulvaney-Day et al., 2007; Schroevers et al., 2003). The social science

literature has long recognised the important role of peer groups in various contexts (Bruhin et al., 2020; Cornelissen et al., 2017; Jiang, 2020; Sacerdote, 2001). The users in the peer groups studied here were not only the recipients but also the providers of the support as they used their own experiences and knowledge to help themselves and others. To some extent, it was a self-contained form of social support which differed from the third-party support (e.g., home visiting programs) where individuals were typically solely the recipients. With the development of digital technologies, online peer support has emerged and become more and more widely accepted. Recently, more studies have looked at online social support (Drentea & Moren-Cross, 2005; Han et al., 2018; Oh et al., 2014; Utz & Breuer, 2017; White, 2001). In a study closely related to ours, Drentea and Moren-Cross (2005) examined a women's online board and found qualitative evidence that the online community provided the means for instrumental and emotional support and enhances mothers' social capital. Han et al. (2018) found that a population with HIV perceive significantly higher levels of online social support than through offline social support from family and friends, and both forms of perceived social support were positively associated with their subjective well-being. Utz and Breuer (2017) found that social network site users reported more online social support than non-users did in a longitudinal study. However, online social support was not related to higher life satisfaction or reduced stress 6 months later. Our study instead focused on a well-defined emerging source of online social support. We specifically measured the perceived social support from self-contained peer groups in a large online maternity community by surveying 500 users.

We contributed especially to the vibrant literature that investigates the link between maternal social support and the well-being

of mothers as well as child development (Collins et al., 1993; Cunha et al., 2006; Elsenbruch et al., 2007; Francesconi & Heckman, 2016; Heckman & Mosso, 2014; Hodnett & Fredericks, 2003). Norbeck et al. (1996) conducted a randomised trial of a social support intervention (four standardised face-to-face sessions at 2-week intervals and telephone contact in the intervening weeks) and found that the intervention was effective in reducing the rate of low birth weight among low-income African American pregnant women. Harley and Eskenazi (2006) found that higher social support was associated with better quality of diet, increased likelihood of using prenatal vitamins and decreased likelihood of smoking during pregnancy among women of Mexican descent living in the US. Olds et al. (2019) investigated the long-term effects of prenatal and infancy nurse home visiting on mothers. However, they did not find evidence that the program affects maternal substance abuse and depression. Our study added value to the literature by establishing the link between prenatal perceived social support and both prenatal and postnatal well-being as well as newborns' birth outcomes at the same time.

Our study also has a few limitations. First, while we found significant links between perceived social support from peer groups and mental health in two different stages of maternity, we did not claim causality. The causality could be identified with carefully designed randomised controlled trials (RCT) or longitudinal study with an instrumental variables approach. Second, an ideal study would have included a direct comparison with the offline counterparts of the peer groups where members can meet and interact with each other in person. Traditional events and activities providing social support have been increasingly transformed into digital versions. The online peer groups studied here are just one example. Whereas both virtual and real communities could function as platforms for social support, they differ in important ways. While it is relatively convenient and non-costly to organise large groups of individuals in the online platform, the capacity of arranging comparable groups offline is often much more limited. The offline counterparts, although having their unique advantages, are likely to be much smaller, more homogeneous, interact less frequently (potentially more intensively) and subject to other physical constraints for the meet-up.

5 | CONCLUSIONS

Social support is one of the key social determinants of health as emphasised by the (WHO, 2004). In this paper, we investigated a potential source of prenatal social support from online peer groups formed by pregnant women and its link to their maternal mental health. We designed a survey questionnaire targeting users of a large online maternity community. Our empirical analysis based on linear regression models yielded three main findings. First, the information and knowledge exchange during pregnancy within the online peer groups was well perceived as social support by the members in the groups. The scores in the MSPSS from the peer groups were comparable to the ones from family, significant other and friends in other studies. Second, the perceived social support from the peer groups

was positively associated with not only the prenatal but also the postnatal mental health of the mothers. In particular, among all the items in the scale of perceived social support, the items in which the ego was presented more salient seemed to have a stronger and more significant association with the mental health. Third, a higher level of perceived social support was associated with heavier weights of the newborns.

The online community studied here is a large-scale anonymous platform, whereas there are other popular but smaller-scale online maternity peer groups based on social media applications such as Facebook and WhatsApp. Future research can explore different online settings and investigate how they may affect the effectiveness of the provision of social support and individual well-being.

AUTHOR CONTRIBUTIONS

Lingqing Jiang and Zhen Zhu conceptualised and designed this paper. Both authors conducted the data analysis and wrote the manuscript.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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