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Postnatal Mental Health, Handwashing Practices, and Infant Illness in Rural China

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Abstract

Background: Maternal mental health problems are a major burden to global public health and play an important role in infant wellbeing. While western countries have extensively studied the associations between maternal mental disorders, infant health, and hygiene practices, little is known in developing settings. This study investigates the correlations between postnatal mental health problems and infant illness as well as handwashing practices of mothers in rural western China.

Methods: The research team followed a multi-stage random cluster sampling method to select a total of 720 mothers of infants aged 0-6 months from poverty counties in rural western China. Surveys questions about mental health were based on the Depression, Anxiety, and Stress Scale-21 (DASS-21), and questions about infant illness and handwashing practices followed evaluative surveys of prior studies. Adjusted ordinary least squares (OLS) regressions were run to examine how postnatal mental health problems (including depression, anxiety, and stress symptoms) are associated with infant illnesses and maternal handwashing practices.

Results: We found significant associations between all three symptoms of postnatal mental health and whether the infant had shown symptoms of illness twice in the past two weeks; depression and anxiety symptoms are significantly associated with whether the infant had been taken to the doctor in the past two weeks. Additionally, depression symptoms had a significant negative association with all categories of handwashing practices, and symptoms of anxiety and stress were significantly associated with handwashing count and frequently washing hands after cleaning infant's bottom.

Conclusion: These results indicate that postnatal mental health problems are significantly associated with infant illness and suggest that postnatal mental health interventions may be effective in mitigating poor infant health outcomes.

Keywords: postnatal mental health, depression, anxiety, stress, hygiene practices, handwashing practices, infant illness, rural China

Background

Studies have found that a child's health in the earliest years of development is essential for lifelong health and development [1]. However, as many as 5.2 million children under 5 years old die from preventable illnesses each year, the majority of which reside in low and middle income countries (LMICs), including China [2]. In LMICs, the chance of child and infant illness is much higher due to a number of risk factors such poor access to clean water and fewer cleaning agents. Additionally, the rate of recovery from preventable illness is much lower due to fewer resources and a lack of adequate healthcare [2]. Similarly, in rural China, as many as 22% of all infant deaths were found to be associated with diarrheal illness and as many as 71% of rural infant deaths were associated with acute respiratory infections in 2015 [3]. Such high rates of fatality due to preventable infant illness requires further study and intervention.

Furthermore, the international literature has established that mother and caregiver hygiene practices are a key factor in child and infant health outcomes in LMICs. For example, the World Health Organization (WHO) has predicted that better hygiene practices could improve over half of diarrheal illnesses worldwide [4]. International studies similarly show that poor hygiene practices, particularly among caregivers, are associated with infant and child illnesses [5]. A study in Ethiopia found that children under 5 whose mothers had poor handwashing practices were more likely to be admitted to the hospital for episodes of diarrhea [6]. Conversely, a study in South Africa found that infants whose caregivers frequently engaged in handwashing practices had reduced incidences of diarrhea and pneumonia [7].

Beyond the relationship between caregiver hygiene practices and child health, postnatal mental health has been linked to infant health outcomes in LMICs. Because infants are most dependent on mothers for care [8], postnatal mental health issues which may

manifest in poor hygiene practices, have been associated with higher rates of infections, diarrheal diseases and hospital visits among infants [9–13]. In addition, there is evidence that postnatal mental health issues are associated with higher rates of admission to neonatal care units [14,15].

While there is not definitive evidence connecting postnatal mental health and the hygiene practices of mothers, studies conducted LMICs did find significant relationships between adolescent mental health and hygiene practices [16,17]. However, to our knowledge, only one study has examined the association between postnatal mental health and hygiene practices. This study, conducted in Ethiopia, Bangladesh, and Vietnam, found that postnatal mental health issues were significantly associated with poor hygiene practices in the household; however, hygiene was not a significant focus of the paper [18]. With this in mind, the hygiene scores presented in the study were limited in their scope and the hygiene standards listed were vague. Therefore, more thorough research in developing settings, is necessary to confirm the correlations between postnatal mental health and hygiene practices.

Like many LMICs, research has found high rates of infant illnesses and poor postnatal mental health in rural areas of China, thus making it an ideal site to examine postnatal mental health and hygiene practices. A study of child. illnesses in rural areas of China found that among rural children under five, 48% had experienced diarrhea, 50% had experienced fevers, and 60% had spells of coughing in the two-week period before the survey [19]. These rates are comparable to, and in some cases even higher than, other developing countries, where rates of illness in any given two-week period tend to be around 40–50% for diarrhea [20,21], 10-50% for fever, and 10-20% for coughing spells [22,23]. Research on postnatal mental health in China has also discovered rates of depression to be around 20-25% [24–26], which is higher than both the 13% global rate of maternal mental disorders and similar to the rate of mental disorders among women in other LMICs (20%) [27].

In this study, the research team aims to investigate the association between postnatal mental health problems, handwashing practices, and infant illness in rural China. More specifically, the study seeks to achieve three objectives. First, we describe the prevalence of postnatal mental health problems, maternal handwashing practices, and infant illness in rural western China. Second, we investigate the correlations between postnatal mental health problems and infant illness. Finally, we examine the correlations between postnatal mental health problems and handwashing practices.

Methods

This study was conducted among low-income families residing in rural areas of Nanchong prefecture in Sichuan Province. According to the National Bureau of Statistics of China, 48% of Sichuan's population are rural residents [28]. The average per capita disposable annual income in rural areas of Sichuan is RMB 13,331 ($1906), far lower than the national average of RMB 28,228 ($4,033) (CNBS, 2019). These factors allow us to define our study sample as being rural, low-income participants.

This study received ethical approval from the Stanford University Institutional Review Board (Protocol # 44312). All participants provided informed consent for participation in this study. All methods were performed in accordance with the relevant guidelines and regulations.

Sampling

The research team followed a multi-stage random cluster sampling method. First, within Nanchong prefecture, four nationally designated "poverty counties" were randomly selected. Next, sample townships were selected from within each county. The research team excluded all non-rural townships and rural townships with populations less than 10,000. Of

the remaining townships, 20 townships per county were randomly selected to reach a total of 80 townships.

Third, sample households were selected for participation in the study. The research team obtained a list of eligible households (households with pregnant women beyond the second trimester or new mothers with infants under six months) in each township from the local county-level Maternal and Child Hospital. The research team aimed to recruit 25 such households from each township. If a township had more than 25 eligible households, 25 households were randomly selected for inclusions. In townships that did not have enough eligible households, the research team included all eligible households in the township and expanded the sampling frame to include villages surrounding the township. Because this study aims to identify the role of the mother's mental health in handwashing practices and infant health outcomes, we excluded 353 households whose respondents were pregnant women and 41 households whose respondents were not the mothers of the infants. After dropping mothers with missing key data, our analytical sample totalled 720 mothers and their infants in 80 rural townships.

Data collection

The research team surveyed sample households from November to December 2019. One-on-one survey interviews were conducted with each participant by survey enumerators who were trained to implement the survey instruments for each of the study's main components. The survey collected four blocks of data: postnatal mental health (depression, anxiety, and stress symptoms), infant illness outcomes, caregiver handwashing practices, and demographic variables.

Postnatal mental health

To measure the mental health of sampled mothers, enumerators administered the Depression, Anxiety, and Stress Scale-21 (DASS-21). DASS-21 is a 21-item, short-form

version of the DASS-42 created by Lovibond and Lovibond [29] and validated in China [30,31]. Participants were read a total of 21 statements about their emotions in the past week: with seven items corresponding to depression, seven to anxiety and seven to stress. Participants were then asked to rank each statement on a scale from 0 to 3 (where 0=did not apply to me at all and 3=applied to me most of the time). Scores for depression, anxiety and stress were calculated by totalling the item scores for each subscale and multiplying by two. Hence, the scores for each subscale could range from 0 to 42. According to the DASS manual, individuals are considered symptomatic of a given mental health issue if they scored above 9 for depression, 7 for anxiety, and 14 for stress. It is important to note, however, that the DASS-21 only evaluates the symptoms of mental illness and cannot be used as a clinical diagnosis.

Infant illness outcomes

To assess infant illness outcomes mothers were asked to report whether their infant had exhibited specific symptoms twice in the two weeks prior to the survey. Symptoms included fever, cough, runny nose, blood in the stool, diarrhoea, vomiting, difficulty breathing, skin rash, scrapes, bruising, burning, lethargy, ear or eye irritation or persistent crying in the past two weeks. Infants were considered symptomatic if they answered yes to any of the items. For infants who did have symptoms of illness, enumerators then asked the mother whether the infant had visited a doctor or for the symptoms. Questions were derived from China Health and Nutrition Survey and the International Food Policy Research Institute (IFPRI) Alive & Thrive baseline survey [32,33].

Handwashing practices

To assess handwashing practices, enumerators asked caregivers questions related to handwashing. The enumerator's questions were based on measures used in other studies to evaluate hygiene practices [16,17,34]. In the past, studies have looked at hygiene by checking

for frequency of handwashing at critical times and by asking for a recall of handwashing times. In this study, participants were similarly asked to recall when they had washed their hands in the previous day (e.g. before or after going to the bathroom, before or after cooking, before or after handling the baby). The survey then counted the number of times they remembered washing their hands in the previous day to create an overall handwashing count for each mother. Additionally, mothers were asked how often (always, often, rarely, or never) they washed their hands when feeding the baby and after cleaning their infant's bottom. The research team then converted these into binary variables, assigning participants who answered "often" or "always" as "frequent" and any other answer as "infrequent". Enumerators also collected observational data on whether a cleansing agent (such as soap or hand sanitizer) was available in the place of handwashing.

Demographic characteristics

The final survey block collected data on the infant and family demographic characteristics. Infant characteristics were obtained from each infant's birth certificate and included the infant's gender, age in months, premature birth status, and whether the infant was born with a low birth weight. Family characteristics collected included mother's age, whether the infant's mother and father had graduated from high school, and the value of family assets. To provide a quantifiable estimate of family assets, enumerators asked whether the family owned or had access to certain household items, such as tap water, computer, internet, or a car. A standardized family asset index was then calculated using principal component analysis [35].

Statistical analysis

Our statistical analysis is composed of three parts. First, the research team calculated the overall prevalence of maternal depression, anxiety, and stress symptoms, as well as the overall prevalence of infant illness and maternal handwashing practices. Second, an adjusted

ordinary least squares (OLS) regression was run to examine the associations between mental health issues and infant illness, while controlling for other potential confounders. The specification of the regression model is:

$$Infant\_illess_i = \beta_0 + \beta_1 Mental\_health_i + Control_i + \epsilon_i \quad (1)$$

where $Infant\_illess_i$ refers to infant illness outcomes, including whether infant i has shown symptoms of illness at least twice in the last two weeks, or whether infant i has been taken to the doctor for said symptoms in the last two weeks. $Mental\_health_i$ is a dummy variable for whether the mother of infant i shows symptoms of mental health issues (including depression, anxiety or stress). $Control_i$ represents a set of control variables for infant and household characteristics, including infant gender and age, whether the infant was premature, whether the infant had low birth weight, maternal age, maternal and paternal and education level, and family asset index.

Finally, an adjusted OLS regression was used to identify the correlations between mental health problems and hygiene practices:

$$Handwashing\_practice_i = \beta_0 + \beta_1 Mental\_health_i + Control_i + \epsilon_i \quad (2)$$

where $Handwashing\_practice_i$ refers to the hygiene practices of mother i, which includes the handwashing count, whether mother i frequently washed her hands before feeding the infant, whether mother i frequently washed her hands before cleaning the infant's bottom, and whether the household of mother i has soap, detergent, or other cleaning agents at the place of handwashing. $Mental\_health_i$ and $Control_i$ are the same as described in model (1).

Results

Table 1 reports the demographic characteristics of our sample. Among 720 infants, 393 infants (55.0%) were boys, and the average age of the sample was 2.7 months at the time of the survey. Only 27 infants (3.8%) were born prematurely, and 22 (3.1%) were born with

low birth weight. Among sample mothers, the average age was 28 years old. Only 283 mothers (39.3%), and 325 fathers (45.1%) had graduated from high school.

Table 1. Descriptive statistics of demographic characteristics (N=720).

	N (%) or Mean (SD)
Boys, N (%)	393 (55.0)
Infant age (months), Mean (SD)	2.7 (2.0)
Premature, N (%)	27 (3.8)
Low birth weight, N (%)	22 (3.1)
Maternal age (years), Mean (SD)	28.02 (4.95)
Mother graduated high school, N (%)	283 (39.3)
Father graduated high school, N (%)	325 (45.1)
Family assets (factor scores), Mean (SD)	-0.02 (0.99)

The prevalence of mental health problems is presented in Panel A of Table 2. Within our sample, 93 mothers (12.9%) scored above the cut-off, indicating symptoms of depression. There were 110 mothers (15.3%) who scored above the cut-off for symptoms of anxiety, and 68 mothers (9.4%) who scored above the cut-off for symptoms of stress.

The health outcomes of infants and the hygiene practices of their mothers in our sample are presented in Panel B and C of Table 2. Panel B presents infant health outcomes. The results show that 282 infants (39.1%) showed symptoms of illness at least twice in the last two weeks. Among infants with symptoms of illness, 217 infants (30.1%) had been taken to a doctor for their symptoms. Panel C presents the handwashing practices of mothers. The data show that, on average, mothers washed their hands about 6.2 times in the past day. Additionally, 571 mothers (79.3%) stated that they frequently washed their hands before feeding their infants, and 663 mothers (92.1%) reported that they frequently washed their hands after cleaning their infant's bottom. Enumerator observations also show that 565 households (78.5%) had some type of cleaning agent at the place of handwashing.

Table 2. Descriptive statistics of mental health, infant illness and handwashing practices (N=720).

	N (%) or Mean (SD)
Panel A. Mental health problems	
Mother has symptoms of depression, N (%)	93 (12.9)
Mother has symptoms of anxiety, N (%)	110 (15.3)
Mother has symptoms of stress, N (%)	68 (9.4)
Panel B. Infant illness outcomes	
The infant has shown different symptoms at least twice in the last two weeks, N (%)	282 (39.1)
The infant has visited the doctor for said symptoms in the last two weeks, N (%)	217 (30.1)
Panel C. Handwashing practices	
Handwashing yesterday (times)	6.2 (3.5)
Frequent handwashing before feeding the infant N (%)	571 (79.3)
Frequent handwashing after cleaning the infant's bottom, N (%)	663 (92.1)
Has cleaning agent at the place of handwashing, N (%)	565 (78.5)

Table 3 presents the results of the OLS regression analysis of correlations between postnatal mental health problems (depression, anxiety, and stress symptoms) and infant illness outcomes (symptoms of illness and doctor visits). A mother showing symptoms of depression in the past week was shown to have a significant positive association with the infant showing symptoms of illness at least twice in past two weeks (p=0.004), and the infant visiting the doctor in the past two weeks (p=0.041). Similarly, mothers with symptoms of anxiety were significantly more likely to have an infant who showed symptoms of illness or required doctor visits in the past two weeks (p=0.011, p=0.047, respectively). Finally, mothers who displayed symptoms of stress were significantly associated with infants displaying symptoms of illness at least twice in the past two weeks (p=0.042).

Table 3. Associations between mental health problems and infant illness (N=720).

	Infant had illness at least twice in past two weeks	Infant visited doctors in the past two weeks
Symptoms of depression	0.190***	0.104*
	(0.053)	(0.051)
Symptoms of anxiety	0.163**	0.130**
	(0.050)	(0.047)
Symptoms of stress	0.125*	0.044
	(0.061)	(0.059)

Table 4 reports the OLS correlations between postnatal mental health problems and handwashing practices. Depressive symptoms were significantly negatively associated with handwashing count the previous day ($p<0.001$), frequently washing hands before feeding the infant ($p=0.020$), frequently washing hands after cleaning infant's bottom ($p=0.006$) and having a cleaning agent at the place of handwashing ($p=0.030$). Symptoms of anxiety were negatively associated with handwashing count the previous day ($p=0.006$) and frequently washing hands after cleaning infant's bottom ($p=0.017$). In addition, symptoms of stress were negatively associated with handwashing count the previous day ($p<0.001$) and frequently washing hands after cleaning infant's bottom ($p=0.024$).

Table 4. Associations between mental health problems and handwashing practices (N=720).

	Handwashing count the previous day	Frequently washing hands before feeding the infant	Frequently washing hands after cleaning infant's bottom	Has cleaning agent at the place of handwashing
Symptoms of depression	-1.582***	-0.103*	-0.081**	-0.086*
	(0.384)	(0.044)	(0.030)	(0.040)

Symptoms of anxiety	-0.989** (0.361)	-0.025 (0.041)	-0.067* (0.028)	-0.020 (0.036)
Symptoms of stress	-1.595*** (0.433)	-0.072 (0.051)	-0.078* (0.034)	-0.031 [0.045)

Discussion

This study examined the associations between postnatal mental health, handwashing practices, and child illness outcomes using extensive survey data from 720 new mothers with infants aged 0-6 months. We found that there were significant negative associations between most of the postnatal mental health problems and infant illness and doctor visits. We also found postnatal mental health problems were significantly correlated to maternal handwashing practices, especially handwashing count and frequently washing hands after cleaning infant's bottom. Collectively, these results suggest that postnatal mental health is significantly related to infant care and infant health outcomes. In order to improve maternal hygiene practices, policymakers should consider implementing postnatal mental health interventions.

When looking at the prevalence of infant illness, our analyses showed that more than one-third (39%) of infants had displayed at least two different symptoms of illnesses in the last two weeks. Given this high rate of illness, it is unsurprising that the observed hygiene practices in our sample of rural China were generally poorer than those of high-income countries. Of the fourteen possible handwashing counts, the data show that on average mothers washed their hands 6.2 times. In contrast, when Americans were asked to give an average handwashing count on any given day, the average answer was 8.6 [36]. Moreover, and more specifically, our results show that mothers in our sample washed their hands infrequently, with a substantial percentage not washing their hands before feeding the infant or after cleaning their infant's bottom, and some mothers not having any cleaning agent near their sinks. These infrequent hygiene practices are likely contributing to the spread of disease.

These findings are consistent with a study conducted in rural China that found that only 23.8% of rural adults practice proper handwashing behaviours, in that they frequently handwashed at key times, used soap, and didn't share a towel with family members after handwashing [37].

When investigating the associations between postnatal mental health problems and infant health, we found that mothers showing symptoms of depression, anxiety, and stress were more likely to have an infant who had an illness at least twice in the past two weeks. We also found that that mothers showing symptoms of depression, anxiety, and stress were more likely to have taken their infants to the doctor for symptoms of illness. This is consistent with other studies that show an inverse relationship between mental health and general early childhood outcomes, with depressed mothers more likely to have children who are ill, malnourished, and have low birth weight [9–15]. Patel et al. found that depressed postpartum mothers spent about twice the number of days in the previous 30 days unable to complete their daily activities [38]. It is likely that postnatal mental health issues are associated with lower maternal health-seeking behaviors and practices, thus infants are more likely to experience symptoms of illness. Similarly, higher rates of postnatal mental health problems may be leading to an increase in infant doctor visits. These results confirm the inverse relationship between postnatal mental health and infant health outcomes.

Additionally, when examining the correlations between postnatal mental health and handwashing practices, we found significant overall negative associations between symptoms of mental health problems and handwashing practices. Specifically, mothers at risk of depression is significantly less likely to have a higher handwashing count, frequently wash their hands before feeding the infant or cleaning infant's bottom, or having cleaning agent at the place of handwashing; mother with anxiety or stress symptoms is less likely to have a higher handwashing account or frequently wash their hands after cleaning infant's bottom.

These findings are consistent with the few studies that exist on mental health and hygiene, which have similarly found that the two are negatively associated [16–18]. Given these findings, it is likely that mental health issues are associated with mothers paying less attention to their infant's hygiene—an association which is common with other child care practices, such as infant nutrition [39–41] and immunizations [9].

Our findings show that postnatal mental health in rural China has far reaching implications for both hygiene and infant illnesses, and thus requires more attention from policymakers and researchers. For instance, proactively including mental health care into perinatal care may mitigate the associations found between poor postnatal mental health and hygiene practices [16–18]. This type of mental health support is likely to result in positive behavioural outcomes such as increased engagement and greater attentiveness towards infant health [25,42–46]. Additional interventions which teach mothers about the importance of hygiene practices are another good step in preventing poor infant health outcomes. While depressed mothers displayed the lowest adherence to hygiene practices, general hygiene practices were low across the entire sample population, indicating that additional interventions focusing on health and hygiene education may be useful in preventing poor infant health outcomes. Emphasis on when and how to properly wash their hands (such as before feeding their infants or after cleaning the bottom of their infants) is likely to result in better hygiene practices across the community and lower rates of infant illness.

This study has many strengths. It is one of the first to examine the correlations between postnatal mental health, handwashing practices, and infant illness outcomes, and the first paper to do so in China. This study also fills a gap in the literature on postnatal mental health and infant care in rural China, by at women with infants aged 0-6 months, as opposed to previous studies which have rarely sampled women with young children.

We acknowledge that this study has several limitations. For one, since our analysis utilizes cross sectional data, we are not able to draw causal relationships between mental health and hygiene practices. Second, the hygiene measures could be more extensive as they only focused on handwashing and soap ownership. In addition, handwashing was measured based solely on recall which can be inaccurate. Future research should examine hygiene practices in detail and over time to understand the causal relationships between postnatal mental health, hygiene, and infant health in rural China.

Conclusion

This study found that postnatal mental health is significantly associated with hygiene practices and infant health outcomes. The results show a significantly negative association between symptoms of mental health problems and handwashing practices. Infants who have mothers with poor mental health are also more likely to have higher rates of illness. The study suggests that postnatal mental health interventions may be effective in mitigating poor infant health outcomes.

Abbreviations

LMICs: Low- and Middle-Income Countries

DASS-21: Depression, Anxiety, and Stress Scale (short form)

International Food Policy Research Institute: IFPRI

Declarations

Ethics approval and consent to participate

This study received ethical approval from the Stanford University Institutional Review Board (Protocol # 44312). All participants provided informed consent for participation in this study. All methods were performed in accordance with the relevant guidelines and regulations. Individuals found to have severe mental health problems were referred to the local hospital for diagnosis and treatment.

Consent for publication

Not applicable.

Availability of data and materials

Datasets used in the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

QJ, NC, MO, EZ, SZ, YG, SD and SR contributed to the conceptualization of the study. QJ, QW, EZ, YG, SD and SR contributed to the acquisition, analysis or interpretation of data. QJ,

NC, MO, EZ, SZ, YG drafted the manuscript, and QJ, JG, QW, HJ, SD, HZ, and SR made substantial revisions to the manuscript.

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