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IMPROVING CHINESE MOTHERS' HEALTH LITERACY: A WECHAT INTERVENTION

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**IMPROVING CHINESE MOTHERS' HEALTH LITERACY: A WECHAT
INTERVENTION**

A Dissertation Presented

by

QIONG CHEN

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 2019

School of Public Health and Health Sciences
Department of Nutrition

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DEDICATION

To my dearest family.

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It has been a real privilege for me to have the opportunity to work with my mentor Dr. Elena Carbone in the past six years. This dissertation and my entire journey in pursuit of this degree would not have been possible without Dr. Carbone's inspiration and empowerment. I want to extend my gratitude to my committee members Dr. Jessica Pearlman and Dr. Patricia Beffa-Negrini, for sharing their wisdom and offering invaluable feedback during this research process.

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ABSTRACT

IMPROVING CHINESE MOTHERS' HEALTH LITERACY: A WECHAT INTERVENTION

SEPTEMBER 2019

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The health literacy and eHealth literacy of women during the reproductive age is crucial, as it can affect their health and the health of their children. Promoting health literacy is essential to achieve mothers' empowerment by improving access to and capacity of using health information effectively. However, functional, interactive, and critical health literacy and eHealth literacy have never been assessed among Chinese women.

The first study during this dissertation assessed functional, interactive, and critical health literacy and eHealth literacy among 421 of Chinese mothers with children under 3 years old. The results revealed overall less than optimal level of health literacy. Maternal age, education, occupation, household income, residency, preference of Western versus Traditional Chinese Medicine, children's age, time different caregivers spent taking care of the children were identified to be related to health literacy levels.

The second study in this dissertation explored the role of health literacy and eHealth literacy in the use of health information among the same group of Chinese mothers. While high health literacy and eHealth literacy were related to more frequent and higher confidence in the use of health information, low health literacy was connected to the use of low-quality health information and may have negative impacts on personal, family, and community health.

In the third study in this dissertation, an intervention based on a smartphone app WeChat was developed and implemented among 240 Chinese mothers with young children. This

intervention significantly increased mothers' confidence in their ability to appraise health information from WeChat. Mothers demonstrated improved functional, interactive and critical health literacy skills in focus group discussions. Increased health literacy skills also empowered mothers to make better health-related decisions for their children. WeChat-based interventions have the potential to improve all categories of health literacy skills among women with young children. Promoting health literacy may improve personal and community health outcomes.

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CHAPTER 1

EXAMINING FUNCTIONAL, INTERACTIVE, AND CRITICAL HEALTH LITERACY, EHEALTH LITERACY AND EMPOWERMENT AMONG CHINESE WOMEN WITH YOUNG CHILDREN

1.1 Abstract

Background: The health literacy of women during the reproductive age is crucial, as it can affect their health and the health of their children. eHealth literacy is also vital for women to effectively use health information from electronic sources. Health literacy is essential to achieve empowerment. However, functional, interactive, and critical health literacy and eHealth literacy, as well as their relationships to empowerment have never been assessed among Chinese women.

Objectives: To assess functional, interactive, and critical health literacy, empowerment, and eHealth literacy among Chinese women with young children; to examine the relationships between personal characteristics and different categories of health literacy; to assess the relationship between health literacy and eHealth literacy.

Methods: We used a cross-sectional online survey to reach a sample of Chinese women with children under three years old. The All Aspect Health Literacy Scale (AAHLS) was used to assess functional, interactive, and critical health literacy. The eHealth Literacy Scale (eHLS) was used to assess functional, interactive, and critical eHealth literacy. Empowerment was measured using four items adapted from the World Bank's empowerment survey. One-way ANOVA, independent t-test, Pearson's and Spearman's correlations were used to examine relationships between personal factors and health literacy levels.

Results: Mean age of the women ($n = 421$) was 30.3 ± 3.9 years; 73.4% completed college or higher education. Mean functional, interactive, and critical health literacy scores were $2.19 \pm .48$, $2.79 \pm .33$, and $2.53 \pm .38$, respectively (range: 1 - 3, higher score indicates higher literacy). Mean functional, interactive, and critical eHealth literacy scores were $2.91 \pm .95$, $3.65 \pm .66$, and 3.96

$\pm .61$, respectively (range: 1 - 5, higher score indicates higher literacy). Women with a master's degree or higher education had the highest critical health literacy, functional eHealth literacy, and critical eHealth literacy as compared to women with less education. Women engaged in health-related jobs had the highest functional health literacy, empowerment, and functional eHealth literacy as compared to those who were unemployed or had other jobs. Household income level was positively associated with functional and critical eHealth literacy. Using Western medicine as a first choice of medical practice was related to higher functional eHealth literacy as compared to those who preferred traditional Chinese medicine as their first choice. Urban residency was related to higher functional and critical eHealth literacy. Critical health literacy was not correlated to functional health literacy, while all the other categories of health literacy and eHealth literacy were positively correlated with each other.

Conclusions: There is room for improvement in all three categories of health literacy and eHealth literacy in this highly educated population. Education, occupation, and household income appear to positively impact some, but not all types of health literacy and eHealth literacy. Tailored interventions are needed to improve different aspects of health literacy targeting women with different social demographic characteristics.

1.2 Introduction

The World Health Organization (WHO) defines health literacy as the “cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health” (Nutbeam, D., 1998).

Health literacy of women during their reproductive age is crucial, as it can affect their health and the health of their children. Higher health literacy levels are linked to better use of healthcare and educational services (Kohan et al., 2008; Zhang, L. et al., 2015), better pregnancy outcomes (Feng, 2013; Kohan et al., 2008), higher parenting self-efficacy (Lee, 2016), better

child feeding practices and nutrition status (Johri et al., 2016; Yin et al., 2014), and higher child vaccination coverage (Johri et al., 2015).

Chinese women at reproductive age have an overall low health literacy level according to multiple studies using different measures of health literacy (Feng, 2013; Zhang et al., 2015; Zhang, R. et al., 2011; Zou et al., 2013). Furthermore, these studies primarily measured only the basic reading, writing, and numeracy skills that are necessary to understand factual health information. However, health literacy skills are more than basic literacy skills.

Nutbeam (2000) defined a framework of three categories of health literacy, which captures a broader definition of health literacy: *Functional health literacy (FHL)* refers to basic reading, writing and numeracy skills that enable individuals to understand factual health information and to navigate the health system (e.g., correctly read or understand words). *Communicative/interactive health literacy (IHL)* refers to the ability “to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances” (e.g., correctly interpret complex information). *Critical health literacy (CHL)* refers to the ability “to critically analyze information, and to use this information to exert greater control over life events and situations” (e.g., evaluate quality of information). Interactive and critical health literacy skills enable women to extract information from various forms of communication and apply the information to gain more control over their lives (Nutbeam, 2000). To our knowledge, these skills have never been examined in Chinese women of reproductive age. This was the first study to assess the health literacy levels in this population to identify needs for improvement, and to generate effective intervention strategies to address needs.

The WHO defines empowerment as “a process through which people gain greater control over decisions and actions affecting their health” (Nutbeam, 1998). Nutbeam (1998) pointed out that by improving the access to and the capacity of effective use of health information, health literacy is critical to empowerment. CHL is linked to both individual and population benefits through individual and collective actions in the effort to address social, economic and

environmental determinants of health (Nutbeam, 2000). However, health literacy and empowerment were often not examined together in previous studies (Crondahl & Eklund Karlsson, 2016). Therefore, the relationships between categories of health literacy and empowerment are not clear.

Examining traditional print-based health communications is not enough. Indeed, with the development of the Internet and the popularity of accessing health information from electronic sources with mobile devices, a transition from traditional health information sources to online sources has been observed. Results of a cross-sectional survey with 1636 Chinese people (52.08% female, 67.79% between 18 – 40 years old) found that 71.79% of the study sample viewed the Internet as their primary means of obtaining health education (Zhang, X. et al., 2017). eHealth literacy is defined as the ability to seek, find, understand, and appraise health information from electronic sources and to apply knowledge gained to addressing or solving a health problem (Norman & Skinner, 2006). eHealth literacy skills are vital for women to navigate the eHealth world successfully. However, these skills have not been measured among Chinese women during reproductive age. Further, the relationship between health literacy and eHealth literacy has not been adequately evaluated (Diviani et al., 2016; Griffith & Monkman, 2017). As we shift from traditional health information sources to online sources, it is worth investigating if those with higher general health literacy skills are more likely to navigate the complex online health resource systems more successfully than those with lower health literacy skills.

Ever since it was launched in 2011 by Tencent, the all-in-one communication app known as WeChat has become the most popular social media platform in China. According to Tencent's quarterly report, WeChat had 1.11 billion monthly active users as of March 2019 (Tencent, 2019). Users can send instant messages, create group chats, make audio or video calls, post photos and videos to share with friends, make payments within the app, and obtain information generated by numerous official accounts. WeChat-based business is also expanding as both individuals and businesses can promote and market products through their social networks (Yang et al., 2016).

The popularity of the WeChat app and the powerful social networks it creates have made WeChat an ideal platform to administer online questionnaires (Zhang et al., 2017). Therefore, we used WeChat as the platform to conduct this study.

The objectives of this study were to: (1) assess the current status of health literacy and eHealth literacy levels; (2) explore personal and demographic factors related to health literacy and eHealth literacy; and to (3) examine the relationship between health literacy and eHealth literacy among women of reproductive age in China.

1.3 Methods

1.3.1 Participants

Chinese women older than 18 years, with at least one child between 0 and 3 years old at the time of recruitment, who currently live in mainland China were eligible to participate in this study. We used data from two sources: (1) questionnaire data from a small group of women who participated in an interview about health literacy, eHealth literacy, and behaviors related to the health information on WeChat; (2) baseline questionnaire data from a randomized controlled trial aiming to improve health literacy and eHealth literacy among Chinese women.

1.3.2 Data collection

Interview participants were recruited by contacting individuals through the first author's personal connections. Individuals were screened for eligibility prior to data collection. For intervention participants recruitment, advertisements were posted to the first author's WeChat Moments, 30 WeChat groups, and other online maternal communities. Viewers were invited to re-post the recruitment advertisement to their social networks and friends. To encourage participation, we offered to invite women who completed the baseline questionnaire to join a WeChat nutrition group and free nutrition advice was provided by two Registered Dietitians as incentives. Interested individuals were invited to friend the author on WeChat. An online screening form with three questions (age, gender, and if they had a child under 3 years old) was

sent once they added the author as a friend on WeChat prior to baseline questionnaire collection. Screening and data collection were completed using an online survey tool called Sojump. Sojump is the largest online survey platform used by research institutions in China (<https://www.wjx.cn/>). The questionnaire took 7 to 13 minutes to complete.

1.3.3 Measures

Health literacy

Health literacy was measured using the Chinese version of the AAHLS (Wu et al., 2017), which measures Nutbeam's three categories of health literacy and is validated in the Chinese population. This tool has three items on functional health literacy, three items on interactive health literacy, and four items on critical health literacy. Responses were measured on a 3-point Likert scale (rarely, sometimes, often).

Empowerment

The original AAHLS developed by Chinn and McCarthy (2013) included a 3-item construct of empowerment; however, these items did not perform well when tested among a sample of Chinese patients and therefore were dropped from the Chinese version (Wu et al., 2017). Different empowerment measures have been developed for different context and population (Cyril et al., 2015), however, we did not find any measure for Chinese women with young children. Chinese women often have to make health-related decisions for themselves and for their children in clinical settings and at home with other family members due to tense patient-provider relationships and dependence on childcare from their parents (Goh & Kuczynski, 2010; He, 2014). Therefore, four questions were modified from the World Bank's Draft National Survey Empowerment Module (Alsop & Heinsohn, 2005) to measure women's perceived control over decisions related to their health and their children's health when interacting with health care providers and family members. The questions included: (1) When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diagnostic tests, drugs, treatment plans, etc.); (2) When seeking help from

health care providers, to what degree do you feel you have control over decisions regarding your child/children's health?; (3) When at home, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diet, lifestyle, disease care, etc.); and (4) When at home, to what degree do you feel you have control over decisions regarding your child/children's personal health? (e.g. diet, lifestyle, disease care, etc.). Responses were measured on a 4-point Likert scale (4 = "to a very high degree" to 1 = "not at all"). These four questions were pilot tested among five Chinese mothers to ensure face validity.

eHealth literacy

eHealth literacy was measured using questions modified from the eHLS (Hsu et al., 2014). eHLS has three items measuring functional eHealth literacy, four items measuring interactive eHealth literacy, and five items measuring critical eHealth literacy. Possible responses to the items were measured on a 5-point Likert scale vary from "total disagreement" to "total agreement." eHLS was developed in traditional Chinese and validated in Taiwan. Due to the different language habits between Taiwan and mainland China, items were modified to suit the language habits of the targeted population in this study. The modified eHLS was pilot tested among five Chinese mothers to ensure face validity.

Personal and demographic factors

Participants' age, number of children, age of children, household income, education level, occupation (unemployed, health-related jobs, or other jobs), involvement in WeChat business, marital status, pregnancy status, registered residency (urban or rural), geographic location, preferred type of medicine (Traditional Chinese Medicine (TCM) or Western medicine), and time caregivers spent taking care of the children were measured in the questionnaire.

Statistical analysis

All responses to the Likert scales were coded as 1-3, 1-4, or 1-5 depending on the number of options. Items were coded so that a higher number represented a higher level of literacy skills or empowerment. Items measuring the same construct were averaged. Means and standard

deviations were used to summarize the distribution of continuous variables, frequencies and percentages were used to summarize categorical variables. One-way ANOVA and independent sample t-test were used to analyze the relationships between continuous and categorical variables. Person's correlation was used to examine the relationships among continuous variables. All statistical analyses were performed using the SPSS Version 25. The significance level was set at $p < 0.05$.

This study was approved by the University of Massachusetts Institutional Review Board. Informed consent was obtained from all participants.

1.4 Results

We collected 437 questionnaires between July 2018 and April 2019. A total of 421 valid questionnaires were included in our analysis; 16 questionnaires were excluded due to filling out the questionnaire twice ($n=9$), not having a child under 3 years old ($n=6$), and not living in mainland China ($n=1$).

1.4.1 Participants characteristics

Table 1.1 shows the characteristics of the participants. Participants were 18 to 44 years of age (mean = 30.3; SD = 3.89). A majority of the sample were married ($n=414$; 98.3%). More than half ($n=232$; 55.1%) had a bachelor's degree, and 77 (18.3%) had a master's or higher degree. Most of the participants ($n=327$, 77.7%) had only one child, while 94 (22.3%) had two or three children. The mean age of the youngest child was 16.3 months (SD = 9.35), and the cumulative age of all their children was 35.0 months (SD = 42.38). Most of the participants were not currently pregnant ($n=401$; 95.2%).

Seventy-four (17.6%) were in tier 1 cities (Beijing, Shanghai, Guangzhou, and Shenzhen), 147 (34.9%) were in tier 2 cities (provincial capital cities excluding tier 1 cities), and 200 (47.5%) were in other locations. Most participants were registered as urban residency ($n=296$; 70.3%) and 114 (27.1%) had rural residency.

Two-thirds of the participants had a non-health-related job (n=278; 66.0%), while 69 (16.4%) had a health-related job, and 74 (17.6%) were unemployed. Most of the women were not involved in a WeChat business (n=372, 88.4%), and 49 (11.6%) women were involved in WeChat business at some level. The most frequent household income category was 5,000-10,000 CNY per month (equivalent to 727 – 1,454 USD; n=117; 27.8%).

Most participants (n=406; 96.4%) reported taking care of their young child, among which the average time spent daily was 14.1 hours (SD=7.53). While 357 (84.8%) of the participants reported their partners participated in taking care of the child, the average time spent was 4.4 hours per day (SD=4.52). Paternal and maternal grandparents also played a role in providing childcare (58.7% and 53.9%, respectively), both for 5.8 hours daily on average. Only 16.2% of the families had nannies taking care of their children for an average of 1.9 hours (SD=5.35), 9.5% used daycares for one hour per day (SD=3.86), and 6.7% used other resources to take care of their child.

When seeking health care, 144 (34.2%) participants responded using Western medicine as their first choice, 63 (15%) chose Traditional Chinese Medicine as the first choice, and 194 (46.1%) chose “it depends.”

1.4.2 Health literacy

Table 1.2 presents the distribution of the individual health literacy items and empowerment items, as well as the three categories of health literacy, four situations of empowerment, and overall empowerment.

The average scores for functional, interactive, and critical health literacy were 2.19 (SD=0.476), 2.79 (SD=0.331), and 2.53 (SD=0.382), respectively. For the three functional health literacy items, 24.9-48.0% of the participants selected the options representing the highest level of health literacy. For the three interactive health literacy items, 72.0-86.0% of participants selected the response that represented the highest literacy level. For the four critical health literacy items,

19.5-76.2% of participants selected the response that represented the highest level of literacy possible.

The average score of empowerment regarding participants' own health, their children's health, when seeking help from health care providers, and when at home were 3.12 (SD=0.573), 3.15 (SD=0.585), 2.81 (0.735), and 3.45 (0.545), respectively. The percentage of participants who selected the highest empowerment option for the four items varied from 20.0% to 51.5%.

1.4.3 eHealth literacy

Table 1.3 presents the distribution of the individual eHealth literacy items, as well as the three categories of eHealth literacy. The average scores of functional, interactive, and critical eHealth literacy were 2.91 (SD=0.945), 3.65 (SD=0.655), and 3.96 (SD=0.612), respectively. For the functional, interactive, and critical eHealth literacy items, 6.9 to 8.8%, 10.0% to 14.5%, and 16.2 to 21.9% of the participants selected the highest literacy options, respectively.

1.4.4 Factors associated with health literacy and eHealth literacy

Table 1.4 and Table 1.5 present the factors that are related to health literacy and eHealth literacy categories.

CHL, eFHL, and eCHL were significantly different among women with different education levels ($p<0.001$, $p<0.001$, $p=0.038$, respectively). Women with master's degree or higher education level had the highest CHL, eFHL, and eCHL as compared to women with less education. Women engaged in health-related jobs had the highest FHL ($p<0.001$), empowerment ($p=0.040$), and eFHL ($p<0.001$) as compared to those who were unemployed or had other jobs. Household income level was positively associated with eFHL ($p=0.001$) and eCHL ($p=0.014$). Urban residency was related to higher eFHL ($p=0.030$) and eCHL ($p=0.014$). Using Western medicine as the first choice of medical practice was related to higher functional eHealth literacy as compared to those who chose traditional Chinese medicine (TCM) as their first choice ($p<0.001$). Women's geographic location was not related to any category of health literacy.

Children's age was positively correlated to empowerment ($r=0.012$, $p<0.05$). Women's age was positively correlated to eFHL ($r=0.123$, $p<0.05$). Time women spent on childcare was negatively correlated to eIHL ($r=-0.158$, $p<0.01$). Time the partner spent on childcare was positively correlated to women's eIHL ($r=0.127$, $p<0.01$). Time the paternal grandparents spent on childcare was negatively correlated with women's empowerment ($r=-0.105$, $p<0.05$). The time that maternal grandparents spent on childcare was positively correlated to women's eIHL ($r=0.100$, $p<0.05$). The time that a nanny spent on childcare was positively correlated to women's CHL ($r=0.099$, $p<0.05$), eIHL ($r=0.098$, $p<0.05$), and eCHL ($r=0.108$, $p<0.05$). Using daycare or other childcare were not correlated to women's health or eHealth literacy.

1.4.5 Relationships among health literacy and eHealth literacy categories

All categories of health literacy, eHealth literacy, and empowerment were positively correlated to each other, except for functional and critical health literacy. Most of the correlation coefficients fell below 0.3, and a few fell into 0.3 to 0.7 range: eFHL and FHL ($r=0.362$), CHL and IHL ($r=0.322$), EMP and CHL ($r=0.304$), eCHL and eIHL ($r=0.619$), all p values <0.001 (Table 1.5).

1.5 Discussion

We assessed functional, interactive, and critical health literacy and eHealth literacy among a group of Chinese mothers with young children. The results revealed that there is room for improvement in all categories of health literacy and eHealth literacy in this highly educated population. We identified factors related to some but not all types of health literacy and eHealth literacy, including age, education, occupation, household income, residency, preferred type of medicine, children's age, and time different caregivers spent taking care of the children. All health literacy and eHealth literacy categories were positively correlated to each other, except for functional health literacy and critical health literacy.

A cutoff of high versus low health literacy was not defined for AAHLS (Chinn & McCarthy, 2013) and eHLS (Hsu et al., 2014), therefore we were not able to quantify the percentage of our study sample with adequate health literacy and eHealth literacy. However, based on the number of respondents who selected the highest level of literacy possible, we see an overall less than optimal level of health literacy and eHealth literacy in all aspects. Our study sample had the highest scores in interactive health literacy subscale, followed by critical and functional subscales, indicating that participants were more confident in interacting with health care providers. Similar pattern has been observed in other studies using the original or modified AAHLS (Barsell et al., 2018; Chen et al., 2018; Chinn & McCarthy, 2013; Wu et al., 2017). We did not find other studies that have used eHLS and reported item-wise distribution of the responses. Therefore, we were not able to compare the eHealth literacy level of our sample to others.

Chen et al. (2018) used the modified AAHLS (responses measured in 5-point Likert scale) to assess health literacy among Chinese Americans in the U.S. when they used English and Chinese, respectively. They found that their sample were not likely to question the health care providers despite what languages the providers used. About 41.2-46.4% sometimes question their provider, 16.3-21.7% often or always question their providers (Chen et al., 2018). In our sample, 62.9% sometimes question the providers, and 19.5% often question the providers. Besides the difference in the samples and the measures, the distinction in health care system between the U.S. and China may also have contributed to this difference.

Our study sample had the lowest perceived control over health-related decisions when seeking help from health care providers. This result indicates that women rely on their health care providers to make health-related decisions such as diagnostic and treatment options. However, low empowerment might have a negative impact given that Evidence-Based Medicine (EBM) is not universal and excessive treatment is common in the Chinese health care system (Zhang, P. et al., 2010; He, 2014). A national wide cross-sectional survey investigated Chinese pediatricians'

EBM practice in 2009, the results showed that 10.3% of the 1,988 pediatricians never applied clinical evidences to their practices, 51.4% occasionally, and 38.3% often applied clinical evidences to their practices (Zhang, P. et al., 2010). Overprescription of unnecessary drugs or clinical tests was also common in China. A cross-sectional survey with 504 Chinese licensed physicians showed that 61.9% of the study sample reported “sometimes” and 18.7% reported “often” when asked the frequency of prescribing diagnostic tests or procedures that are clinically unnecessary (He, 2014). Patient empowerment may have the potential to increase their participation in decision making and reduce overprescription.

We found a positive correlation between empowerment and all categories of health literacy and eHealth literacy. Empowerment had the strongest relationship with CHL as compared to other categories of health literacy and eHealth literacy. Although the direction of the relationship between empowerment and health literacy cannot be identified from this study, our findings suggest that CHL is more closely related to empowerment as compared to other categories of health and eHealth literacy. Our empirical data supports Smith and Carbone’s view (2019) that CHL is the intersection between empowerment and health literacy. Improving CHL may have the strongest impact on empowerment.

We identified a number of personal and sociodemographic factors that are positively related to categories of health literacy and eHealth literacy, including higher education, having health-related jobs, higher household income, urban residency, and older maternal and child age. Our findings are consistent with prior research that has highlighted the relationships these sociodemographic factors and health literacy (Ji et al., 2017; Jing et al., 2016; Tang et al., 2017; Wang, 2017; Xu et al., 2016; Zhang et al., 2015; Zhang et al., 2011; Zou et al., 2013). However, these previous studies examined functional health literacy only. Chinn and McCarthy (2013) found that ethnicity, education level, and age were related to functional, interactive, and critical health literacy measured by AAHLS. We found that these factors were associated with some, but not all categories of health literacy, suggesting that the impact of the sociodemographic factors

have on health literacy might be complex. Difference combinations of personal and sociodemographic factors may have specific impact on different categories of health literacy.

One interesting finding of our study was that using Western medicine as first choice of medical practice was associated with higher functional eHealth literacy as compared to those who chose traditional TCM as their first choice. This finding reflects the unique social and cultural context of China. TCM was originated in China over 2,000 years ago, and it was developed based on empirical knowledge rather than clinical evidence (Fung & Linn, 2015). While the effectiveness and safety of TCM is debatable (Hu et al., 2011; Liu et al., 2015), the number of medical organizations providing TCM has increased by 12% from 2017 to 2018 (National Health Commission Department of Planning and Information, 2019). As of 2018, 15% of all hospitals in China are TCM hospitals and TCM services accounted for 13% of all medical services provided in 2018 (National Health Commission Department of Planning and Information, 2019). This complex health system is challenging for Chinese mothers to select the best care for their family. Our findings suggest that mothers with higher functional eHealth literacy are more likely to use evidence-based western medicine.

We found that the less time women spent on childcare, the more time their partners, parents, and nannies spent on childcare were related to higher women's health literacy in some categories. However, women felt having less control over health-related decisions when their in-laws were providing more childcare. An and Chou (2016) surveyed 366 first-time mothers in mainland China about their social support experiences with their mothers and mothers-in-law in child-rearing. They found that women who received higher levels of support from their mothers reported lower levels of perceived stress, as well as higher levels of online support activities such as using the Internet to read child care-oriented information, post comments, and communicate with other mothers (An & Chou, 2016). Women may need to compromise on health-related decisions when maintaining harmonious relationship with other childcare providers, especially their in-laws.

Positive correlations between health literacy and eHealth literacy categories found in our study indicate that women with higher general health literacy skills may be more successful in navigating the eHealth world. Similar findings were reported in a study with 3000 Japanese adults, where the authors found that eHealth literacy were positively correlated with communicative and critical health literacy scores (Mitsutake et al., 2011). In another study with 44 Italian-speaking adults, participants with low functional health literacy measured by the Newest Vital Sign had higher scores on the eHealth Literacy Scale ($p=0.007$), indicating that they perceived themselves more competent in online health information seeking and appraising (Diviani et al., 2016).

We found that FHL and CHL were not correlated to each other. This finding suggests that functional and critical health literacy might be independent to each other. Women may not need high functional health literacy to achieve high critical health literacy or vice versa.

1.6 Limitations

This study had a number of limitations. First, this was a cross-sectional study; no causal relationship can be determined. Second, we used a convenience sampling method generated from a personal WeChat account. The characteristics of the author's social network may have impacted the characteristics of the sample, such as education level and geographic location. We offered free nutrition advice as an incentive; therefore, participants who joined the study might be more health conscious. Our sample had relatively high education level and urban residency, thus the generalizability of our findings is limited. Third, self-reported data were collected online using subjective measures. This may have excluded mothers who do not own a smartphone or do not use WeChat. Participants with limited reading skills may not have been able to provide accurate answers. However, the fact that the questionnaires were collected online avoided the potential bias introduced by the presence of a researcher. Fourth, no cut-offs of adequate health literacy level were established for the health literacy and eHealth literacy measures used in this study,

therefore we were not able to quantify the percentage of our sample with adequate health literacy. Moreover, empowerment was operationalized from another survey and only focused on specific situations regarding health-related decisions for women and their children in clinical settings and at home. Other situations requiring empowerment such as shopping, communicating with friends, and activities as a community or society member online and offline were not captured. Despite all these limitations, our study evaluated the different aspects of health literacy and eHealth literacy of a unique sample of Chinese women with young children.

1.7 Conclusions

There is room for improvement in all categories of health literacy and eHealth literacy in this highly educated population. Education, occupation, household income, residency, preferred type of medicine, children's age, women's age, and time different caregivers spent taking care of the children appear to be associated with some, but not all types of health literacy and eHealth literacy. Our results provide a snapshot of the health literacy level of this population and provided direction for future research. Tailored interventions are needed to improve different aspects of health literacy to empower woman and to address the social determinants of health. We found that lower education, lower income level, unemployment, and rural residency were negatively associated with health literacy skills. Future research should consider reaching these population and assess their needs for intervention. Another important direction of future research is to explore how each category of health literacy impacts health and social outcomes.

Table 1.1 Characteristics of participants (n=421).

Variables	n (%)	Variables	n (%)
Household monthly income (CNY (USD))		Education	
< ¥5,000 (<\$727)	46 (10.9)	Less than high school degree	10 (2.4)
¥5,000 – 10,000 (\$727 – 1,454)	117 (27.8)	High school degree	24 (5.7)
¥10,001 – 15,000 (\$1,455 – 2,181)	89 (21.1)	Some college or vocational school	78 (18.5)
¥15,001 – 20,000 (\$2,182 – 2,908)	65 (15.4)	Bachelor's degree	232 (55.1)
¥20,001 – 30,000 (\$2,908 – 4,362)	51 (12.1)	Master's degree or higher	77 (18.3)
≥ ¥30,001 (≥ \$4,363)	53 (12.6)	Residency status	
Occupation		Urban	296 (70.3)
Unemployed	74 (17.6)	Rural	114 (27.1)
Health-related jobs	69 (16.4)	Not sure	11 (2.6)
Other jobs	278 (66.0)	Location¹	
WeChat business involvement		Tier 1 cities	74 (17.6)
Full-time	2 (0.5)	Tier 2 cities	147 (34.9)
Part-time with another job	28 (6.7)	Other	200 (47.5)
Part-time without other jobs	19 (4.5)	Preferred type of medicine	
Not involved	372 (88.4)	TCM ² as first choice	63 (15.0)
Marital status		Western medicine as first choice	144 (34.2)
Never married	2 (0.5)	Depends	194 (46.1)
Married	414 (98.3)	Number of children	
Living in a marriage-like relationship	1 (0.2)	1	327 (77.7)
Divorced/separated	3 (0.7)	2	92 (21.9)
Widowed	1 (0.2)	3	2 (0.5)
Current pregnancy status			Mean ± SD (Range)
Pregnant	14 (3.3)	Mothers' age (years)	30.3 ± 3.9 (18 - 44)
Not pregnant	401 (95.2)	Children's age total (months)	35.0 ± 42.4 (0 - 239)
Not sure	6 (1.4)	Youngest child's age (months)	16.3 ± 9.4 (0 - 43)
If they take care of the children (Yes)		Time spent taking care of the children (hours/day)	Mean ± SD
Mother	406 (96.4)	Mother	14.1 (7.5)
Father	357 (84.8)	Father	4.4 (4.5)
Paternal grandparents	247 (58.7)	Paternal grandparents	5.8 (6.7)
Maternal grandparents	227 (53.9)	Maternal grandparents	5.8 (7.1)
Nanny	68 (16.2)	Nanny	1.9 (5.4)
Daycare	40 (9.5)	Daycare	1.0 (3.9)
Other	28 (6.7)	Other	0.5 (2.5)

¹ Tier 1 cities: Beijing, Shanghai, Guangzhou, Shenzhen; Tier 2 cities: Provincial capital cities excluding tier 1 cities.

² TCM: Traditional Chinese Medicine

Table 1.2 Health literacy level (n=421).

	Responses ¹ n (%)			Mean (SD)
	Often	Sometimes	Rarely	
1. How often do you need someone to help you when you are given information to read by your doctor, nurse or pharmacist?	55 (13.1)	244 (58.0)	122 (29.0)	2.16 (0.629)
2. When you need help, can you easily get hold of someone to assist you?	202 (48.0)	179 (42.5)	40 (9.5)	2.38 (0.654)
3. How often do you need help to fill in official documents?	95 (22.6)	221 (52.5)	105 (24.9)	2.02 (0.690)
Functional health literacy (Average of items 1-3)				2.19 (0.476)
4. When you talk to a doctor or nurse, do you give them all the information they need to help you?	358 (85.0)	57 (13.5)	6 (1.4)	2.84 (0.407)
5. When you talk to a doctor or nurse, do you ask all the questions you want or need to ask?	362 (86.0)	54 (12.8)	5 (1.2)	2.85 (0.391)
6. When you talk to a doctor or nurse, do you make sure they explain anything that you do not understand?	303 (72.0)	108 (25.7)	10 (2.4)	2.70 (0.510)
Interactive health literacy (Average of items 4-6)				2.79 (0.331)
7. Are you someone who likes to find out lots of different information about your health?	309 (73.4)	104 (24.7)	8 (1.9)	2.71 (0.492)
8. How often do you think carefully about whether the health information you see makes sense in your particular situation?	321 (76.2)	89 (21.1)	11 (2.6)	2.74 (0.497)
9. How often do you think about whether the information about your health can be trusted?	291 (69.1)	119 (28.3)	11 (2.6)	2.67 (0.525)
10. Are you the sort of person who might question your doctor or nurse's advice based on your own research?	82 (19.5)	265 (62.9)	74 (17.6)	2.02 (0.609)
Critical health literacy (Average of items 7-10)				2.53 (0.382)
	Responses ² n (%)			
	Not at all	To a small degree	To a fairly high degree	To a very high degree
11. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	12 (2.9)	155 (36.8)	170 (40.4)	84 (20.0)
12. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	10 (2.4)	132 (31.4)	188 (44.7)	91 (21.6)
13. When at home, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diet, lifestyle, disease care, etc.)	0 (0.0)	24 (5.7)	180 (42.8)	217 (51.5)
14. When at home, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diet, lifestyle, disease care, etc.)	1 (0.2)	17 (4.0)	193 (45.8)	209 (49.6)
Empowerment regarding their own health (Average of items 11 and 13)				3.12 (0.573)
Empowerment regarding their children's health (Average of items 12 and 14)				3.15 (0.585)
Empowerment seeking help from health care providers (Average of items 11 and 12)				2.81 (0.735)
Empowerment at home (Average of items 13 and 14)				3.45 (0.545)
Empowerment (Average of items 11-14)				3.13 (0.530)

¹ Range of responses 1-3; higher score indicates higher health literacy level.

² Range of responses 1-4; higher score indicates higher empowerment.

Table 1.3 eHealth literacy level (n=421).

	Responses ¹ n (%)					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean (SD)
1. I don't understand the meaning of symbols (e.g. BMI, pH, OGTT, etc.) used in health information on the Internet.	32 (7.6)	94 (22.3)	66 (15.7)	157 (37.3)	72 (17.1)	2.66 (1.213)
2. I find health information on the Internet hard to understand.	29 (6.9)	139 (33.0)	126 (29.9)	104 (24.7)	23 (5.5)	3.11 (1.030)
3. I find the use of math formulas (e.g., formula of calculating BMI, fetal movements, energy expenditure, etc.) to explain health information on the Internet is difficult to understand.	37 (8.8)	121 (28.7)	92 (21.9)	133 (31.6)	38 (9.0)	2.97 (1.148)
Functional eHealth literacy (Average of items 1-3)						2.91 (0.945)
4. I can use search engines to effectively find health information on the Internet.	11 (2.6)	82 (19.5)	95 (22.6)	172 (40.9)	61 (14.5)	3.45 (1.042)
5. I try to find new health information on the Internet.	4 (1.0)	49 (11.6)	102 (24.2)	208 (49.4)	58 (13.8)	3.63 (0.894)
6. From the health information on the Internet, I can select what I need.	2 (0.5)	28 (6.7)	80 (19.0)	254 (60.3)	57 (13.5)	3.80 (0.771)
7. I can understand the health information I find on the Internet.	2 (0.5)	31 (7.4)	96 (22.8)	250 (59.4)	42 (10.0)	3.71 (0.763)
Interactive eHealth literacy (Average of items 4-7)						3.65 (0.655)
8. I think over if the health information on the Internet applies to my situation.	2 (0.5)	10 (2.4)	50 (11.9)	281 (66.7)	78 (18.5)	4.00 (0.665)
9. I try to use multiple sources to verify if the health information on the Internet is correct.	3 (0.7)	18 (4.3)	65 (15.4)	256 (60.8)	79 (18.8)	3.93 (0.757)
10. I check the validity and reliability of health information on the Internet.	4 (1.0)	26 (6.2)	70 (16.6)	253 (60.1)	68 (16.2)	3.84 (0.798)
11. I review many people's opinions and discussions so that I can make decisions or take actions that are good for my health.	2 (0.5)	14 (3.3)	51 (12.1)	268 (63.7)	86 (20.4)	4.00 (0.709)
12. When I question the health information on the Internet, I use other channels to verify it.	2 (0.5)	14 (3.3)	51 (12.1)	262 (62.2)	92 (21.9)	4.02 (0.719)
Critical eHealth literacy (Average of items 8-12)						3.96 (0.612)

¹ Range of responses 1-5; higher score indicates higher eHealth literacy level.

Table 1.4 Health literacy, eHealth literacy and their relationship to factors of interest (n=421).

Factor of Interest	n (%)	Health Literacy				eHealth Literacy		
		Functional	Interactive	Critical	Empowerment	Functional	Interactive	Critical
Education								
Less than high school	10 (2.4)	1.93 (0.439)	2.83 (0.236)	2.18 (0.553) ^a	3.00 (0.540)	2.17 (0.758) ^a	3.70 (0.771)	3.74 (0.737) ^{ab}
High school degree	24 (5.7)	2.17 (0.368)	2.74 (0.354)	2.33 (0.446) ^a	3.15 (0.621)	2.65 (0.825) ^a	3.43 (0.686)	3.68 (0.791) ^a
Some college or vocational school	78 (18.5)	2.15 (0.418)	2.74 (0.402)	2.54 (0.370) ^{ab}	3.20 (0.565)	2.69 (0.877) ^a	3.64 (0.600)	3.97 (0.612) ^{ab}
Bachelor's degree	232 (55.1)	2.22 (0.487)	2.79 (0.316)	2.53 (0.361) ^{ab}	3.13 (0.500)	2.92 (0.894) ^a	3.63 (0.642)	3.95 (0.591) ^{ab}
Master's degree or higher	77 (18.3)	2.19 (0.525)	2.87 (0.287)	2.66 (0.360) ^b	3.07 (0.553)	3.29 (1.075) ^b	3.77 (0.711)	4.09 (0.569) ^b
p-value		0.381	0.174	< 0.001	0.598	< 0.001	0.245	0.038
Occupation								
Unemployed	74 (17.6)	2.09 (0.436) ^a	2.77 (0.339)	2.48 (0.399)	3.11 (0.504) ^{ab}	2.51 (0.790) ^a	3.71 (0.630)	3.97 (0.561)
Health-related jobs	69 (16.4)	2.56 (0.463) ^b	2.79 (0.348)	2.58 (0.347)	3.28 (0.480) ^a	3.73 (0.862) ^b	3.77 (0.613)	4.01 (0.535)
Other jobs	278 (66.0)	2.12 (0.446) ^a	2.80 (0.325)	2.54 (0.386)	3.10 (0.543) ^b	2.82 (0.887) ^c	3.60 (0.668)	3.94 (0.643)
p-value		< 0.001	0.694	0.288	0.040	< 0.001	0.115	0.718
Household monthly income (CNY)								
< 5,000	46 (10.9)	2.14 (0.453)	2.77 (0.329)	2.43 (0.446)	3.05 (0.539)	2.64 (0.933)	3.54 (0.716)	3.81 (0.682)
5,000 – 10,000	117 (27.8)	2.11 (0.429)	2.75 (0.364)	2.52 (0.396)	3.12 (0.525)	2.70 (0.886)	3.62 (0.581)	3.83 (0.575)
10,001 – 15,000	89 (21.1)	2.24 (0.485)	2.75 (0.361)	2.53 (0.324)	3.13 (0.540)	2.91 (0.833)	3.75 (0.605)	4.02 (0.572)
15,001 – 20,000	65 (15.4)	2.18 (0.497)	2.82 (0.328)	2.57 (0.422)	3.05 (0.575)	3.12 (1.010)	3.65 (0.618)	4.03 (0.479)
20,001 – 30,000	51 (12.1)	2.30 (0.504)	2.84 (0.225)	2.57 (0.371)	3.24 (0.394)	3.07 (0.998)	3.53 (0.702)	4.00 (0.639)
≥ 30,001	53 (12.6)	2.22 (0.510)	2.89 (0.268)	2.59 (0.333)	3.05 (0.539)	3.22 (0.985)	3.73 (0.808)	4.14 (0.745)
p-value		0.184	0.079	0.321	0.313	0.001	0.330	0.014
Residency								
Urban	296 (70.3)	2.20 (0.510)	2.80 (0.335)	2.55 (0.376)	3.14 (0.528)	2.99 (0.977) ^a	3.68 (0.636)	4.01 (0.577) ^a
Rural	114 (27.1)	2.16 (0.382)	2.79 (0.314)	2.49 (0.387)	3.11 (0.525)	2.71 (0.816) ^b	3.57 (0.699)	3.82 (0.676) ^b
Not sure	11 (2.6)	2.24 (0.397)	2.82 (0.405)	2.39 (0.466)	2.98 (0.627)	2.94 (1.083) ^{ab}	3.70 (0.660)	3.93 (0.671) ^{ab}
p-value		0.683	0.943	0.149	0.541	0.030	0.286	0.014
Location								
Tier 1 cities	74 (17.6)	2.11 (0.530)	2.77 (0.393)	2.51 (0.447)	3.04 (0.552)	2.91 (0.975)	3.63 (0.718)	4.06 (0.641)
Tier 2 cities	147 (34.9)	2.19 (0.467)	2.82 (0.295)	2.56 (0.350)	3.12 (0.493)	3.03 (0.963)	3.64 (0.726)	3.96 (0.702)
Other	200 (47.5)	2.22 (0.460)	2.78 (0.330)	2.52 (0.380)	3.17 (0.545)	2.83 (0.915)	3.66 (0.572)	3.92 (0.522)
p-value		0.235	0.425	0.509	0.168	0.151	0.891	0.259
WeChat business								
Involved in WeChat business	49 (11.6)	2.14 (0.446)	2.74 (0.355)	2.55 (0.356)	3.20 (0.545)	2.71 (0.865)	3.68 (0.637)	3.97 (0.579)
Not in WeChat business	372 (88.4)	2.20 (0.480)	2.80 (0.327)	2.53 (0.386)	3.12 (0.528)	2.94 (0.952)	3.64 (0.658)	3.96 (0.617)
p-value		0.406	0.243	0.814	0.346	0.105	0.689	0.877
Choice of medical practice								
TCM ¹ as first choice	63 (15.0)	2.07 (0.453)	2.77 (0.348)	2.50 (0.427)	3.15 (0.584)	2.64 (0.968) ^a	3.69 (0.596)	3.81 (0.662)
Western medicine as first choice	144 (34.2)	2.22 (0.505)	2.83 (0.308)	2.58 (0.332)	3.07 (0.516)	3.18 (0.944) ^b	3.66 (0.682)	4.02 (0.601)
Depends	194 (46.1)	2.19 (0.456)	2.77 (0.345)	2.52 (0.404)	3.17 (0.525)	2.85 (0.907) ^a	3.64 (0.670)	3.97 (0.606)
p-value		0.090	0.305	0.216	0.205	< 0.001	0.867	0.066

^{abc} Groups with same superscripts were not significantly different from Bonferroni post hoc comparison. ¹ TCM: Traditional Chinese Medicine

Table 1.5 Factors correlated to health literacy and eHealth literacy (n=421).

	FHL	IHL	CHL	EMP	eFHL	eIHL	eCHL
Children's age total (month)	0.077	-0.085	-0.037	0.112*	0.009	-0.014	-0.012
Mother's age (year)	0.094	-0.026	0.039	0.030	0.123*	0.050	0.018
Time taking care of the child (hours/day)							
Mother	-0.044	0.041	-0.090	0.015	-0.015	-0.158**	-0.020
Partner	0.065	-0.063	-0.056	0.000	0.031	0.127**	-0.030
Paternal grandparents	0.052	-0.036	-0.015	-.105*	0.041	0.044	-0.063
Maternal grandparents	0.003	-0.046	0.047	0.008	-0.016	0.100*	0.045
Nanny	0.034	0.081	0.099*	0.024	0.075	0.098*	0.108*
Daycare	-0.023	0.030	0.037	0.003	-0.006	0.016	0.008
Other	-0.042	-0.002	-0.007	0.070	0.021	-0.052	-0.020
Functional health literacy (FHL)	-	-	-	-	-	-	-
Interactive health literacy (IHL)	0.103*	-	-	-	-	-	-
Critical health literacy (CHL)	0.019	0.322**	-	-	-	-	-
Empowerment (EMP)	0.198**	0.196**	0.304**	-	-	-	-
Functional eHealth literacy (eFHL)	0.362**	0.134**	0.229**	0.208**	-	-	-
Interactive eHealth literacy (eIHL)	0.237**	0.203**	0.277**	0.211**	0.257**	-	-
Critical eHealth literacy (eCHL)	0.131**	0.177**	0.249**	0.177**	0.150**	0.619**	-

Correlation coefficients and *p*-values derived from Pearson's correlation; **p* values < 0.05; ** *p* values < 0.001

1.8 References

- Alsop, R., & Heinsohn, N. (2005). *Measuring empowerment in practice: structuring analysis and framing indicators*. Washington, DC: World Bank.
- An, Z., & Chou, C. (2016). Social support for first-time Chinese mothers in contexts of provider-recipient relationships. *Health Communication, 31*(4), 504-512. doi:10.1080/10410236.2014.973556
- Barsell, D. J., Everhart, R. S., Miadich, S. A., & Trujillo, M. A. (2018). Examining health behaviors, health literacy, and self-efficacy in college students with chronic conditions. *American Journal of Health Education, 49*(5), 305-311. doi:10.1080/19325037.2018.1486758
- Carbone, E., & Smith, S. (2019). Empowerment & health literacy: Reintegrating critical health literacy. *Health literacy in clinical practice and public health: New initiatives and lessons learned at the intersection with other disciplines*. (Unpublished book chapter)
- Chen, X., Goodson, P., Acosta, S., Barry, A. E., & McKyer, L. E. (2018). Assessing health literacy among Chinese speakers in the U.S. with limited English proficiency. *Health Literacy Research and Practice, 2*(2), 94-106. doi:10.3928/24748307-20180405-01
- Chinn, D., & McCarthy, C. (2013). All Aspects of Health Literacy Scale (AAHLS): developing a tool to measure functional, communicative and critical health literacy in primary healthcare settings. *Patient Education and Counseling, 90*(2), 247-253.
- Crondahl, K., & Eklund Karlsson, L. (2016). The Nexus Between Health Literacy and Empowerment: A Scoping Review. *SAGE Open, 6*(2), 1-7. doi:10.1177/2158244016646410
- Cyril, S., Smith, B. J., & Renzaho, A. M. (2015). Systematic review of empowerment measures in health promotion. *Health Promotion International, 31*(4), 809-826.
- Diviani, N., Van den Putte, B., Meppelink, C. S., & van Weert, J. C. (2016). Exploring the role of health literacy in the evaluation of online health information: insights from a mixed-methods study. *Patient Education and Counseling, 99*(6), 1017-1025.
- Feng, A. (2013). 孕产妇母婴健康素养现况调查及其妊娠结局相关研究 [Research on health literacy and pregnancy outcomes among pregnant women] Available from China Masters' Theses Full-text Database. Retrieved from <http://cdmd.cnki.com.cn/Article/CDMD-10422-1014123124.htm>
- Fung, F. Y., & Linn, Y. C. (2015). Developing traditional Chinese medicine in the era of evidence-based medicine: current evidences and challenges. *Evidence-Based Complementary and Alternative Medicine, 2015*, 1-9.
- Goh, E. C., & Kuczynski, L. (2010). 'Only children' and their coalition of parents: Considering grandparents and parents as joint caregivers in urban Xiamen, China. *Asian Journal of Social Psychology, 13*(4), 221-231.

- Griffith, J., & Monkman, H. (2017). Usability and eHealth Literacy Evaluation of a Mobile Health Application Prototype to Track Diagnostic Imaging Examinations. *Studies in Health Technology and Informatics*, 234, 150-155. doi:10.3233/978-1-61499-742-9-150
- He, A. J. (2014). The doctor–patient relationship, defensive medicine and overprescription in Chinese public hospitals: Evidence from a cross-sectional survey in Shenzhen city. *Social Science & Medicine*, 123, 64-71.
- Hsu, W., Chiang, C., & Yang, S. (2014). The effect of individual factors on health behaviors among college students: the mediating effects of eHealth literacy. *Journal of Medical Internet Research*, 16(12), e287. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/25499086>
- Hu, J., Zhang, J., Zhao, W., Zhang, Y., Zhang, L., & Shang, H. (2011). Cochrane systematic reviews of Chinese herbal medicines: an overview. *PLoS One*, 6(12), 1-6.
- Ji, G., Hu, X., Zou, W., Wu, Z., & Chu, C. (2017). 安徽省相关人群母婴健康素养调查报告 [Investigation report on Maternal and child health literacy in Anhui Province]. *Chinese Journal of Health Education*, 33(3), 203-207. Retrieved from <http://www.cqvip.com/qk/80686x/201703/671863456.html>
- Jing, X., Pan, C., Zhou, Y., Wu, Y., Yang, Q., An, Y., . . . Gao, W. (2016). 重庆市北碚区母婴健康素养现状分析 [Investigation on maternal and infant health literacy in Beibei District of Chongqing]. *Chinese Journal of Health Education*, 32(1), 45-48. Retrieved from <http://lib.cqvip.com/qk/80686X/201601/668069430.html>
- Johri, M., Subramanian, S. V., Koné, G. K., Dudeja, S., Chandra, D., Minoyan, N., . . . Pahwa, S. (2016). Maternal health literacy is associated with early childhood nutritional status in India. *The Journal of Nutrition*, 146(7), 1402-1410. doi:10.3945/jn.115.226290
- Johri, M., Subramanian, S. V., Sylvestre, M., Dudeja, S., Chandra, D., Koné, G. K., . . . Pahwa, S. (2015). Association between maternal health literacy and child vaccination in India: a cross-sectional study. *Journal of Epidemiology and Community Health*, 69(9), 849-857. doi:10.1136/jech-2014-205436
- Kohan, S., Ghasemi, S., & Dodangeh, M. (2008). Associations between maternal health literacy and prenatal care and pregnancy outcome. *Iranian Journal of Nursing and Midwifery Research*, 12(4), 146-152.
- Lee, J. Y. (2016). *Maternal health literacy among low-income mothers with infants* (Doctoral dissertation) Available from UT Electronic Theses and Dissertations. Retrieved from <https://repositories.lib.utexas.edu/handle/2152/40335>
- Liu, S., Chuang, W., Lam, W., Jiang, Z., & Cheng, Y. (2015). Safety surveillance of traditional Chinese medicine: current and future. *Drug Safety*, 38(2), 117-128.

- Mitsutake, S., Shibata, A., Ishii, K., Okazaki, K., & Oka, K. (2011). Developing Japanese version of the eHealth Literacy Scale (eHEALS). *Japanese Journal of Public Health*, 58(5), 361-371.
- National Health Commission Department of Planning and Information. (2019). 2018 年我国卫生健康事业发展统计公报 [2018 China's health care development statistics bulletin]. Retrieved from <http://www.nhc.gov.cn/guihuaxxs/s10748/201905/9b8d52727cf346049de8acce25ffcbd0.shtml>
- Nutbeam, D. (1998). Health promotion glossary. *Health Promotion International*, 13(4), 349-364. doi:10.1093/heapro/13.4.349
- Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15(3), 259-267.
- Tang, X., Lu, Y., & Li, M. (2017). 苏州市孕产妇母婴健康素养调查 [Research on maternal and infant health literacy in Suzhou]. *Jiangsu Prev Med*, 28(5), 598-599.
- Tencent. (2019). 腾讯公布 2019 年第一季度及中期业绩 [Tencent releases its first quarter and interim performance in 2019]. Retrieved from <http://www.tencent.com/zh-cn/articles/15000771557911821.pdf>
- Wang, B. (2017). 北京市昌平区孕妇母婴健康素养现况调查分析 [Investigation and analysis of current maternal health literacy in Changping District Beijing]. *China Health Care & Nutrition*, 27(4), 307-308. doi:10.3969/j.issn.1004-7484.2017.04.444
- Wu, Q., Ye, X., Wu, Y., Zhao, L., & Wu, J. (2017). 全面健康素养测量量表的汉化及信效度分析 [The Chinesization of All Aspects of Health Literacy Scale and Its Reliability and Validity]. *Chinese General Practice*, 20(10), 1229-1233.
- Xu, H., Yao, M., Wang, X., Pang, S., & Zhao, F. (2016). 唐山市孕产妇母婴健康素养现状调查分析 [Investigation and analysis of current maternal health literacy in Tangshan]. *Chinese Journal of Health Education*, 32(8), 746-749.
- Yang, S., Chen, S., & Li, B. (2016). The role of business and friendships on WeChat business: An emerging business model in China. *Journal of Global Marketing*, 29(4), 174-187.
- Yin, H. S., Sanders, L. M., Rothman, R. L., Shustak, R., Eden, S. K., Shintani, A., . . . Perrin, E. M. (2014). Parent health literacy and "obesogenic" feeding and physical activity-related infant care behaviors. *The Journal of Pediatrics*, 164(3), 83.e1. doi:10.1016/j.jpeds.2013.11.014

- Zhang, L., Liao, P., Li, Y., & Guan, H. (2015). 孕产妇母婴健康素养现况及影响因素分析 [Current situation of maternal and infantile health literacy and influencing factors]. *Maternal and Child Health Care of China*, 30(36), 6553-6556. Retrieved from <http://www.cqvip.com/qk/90631x/201536/666990207.html>
- Zhang, P., Ding, J., Chen, Z., & Zhang, C. (2010). 2009 年 2 045 名中国儿科医生循证医学知晓度横断面调查 [A cross-sectional survey on awareness of evidence-based medicine in 2,045 Chinese pediatricians in 2009]. *Chin J Evid Based Pediatr*, 5(3), 172-179.
- Zhang, R., Chen, Y., & Luo, X. (2011). 北京市朝阳区孕产妇母婴健康知识认知情况调查 [Survey on knowledge of maternal and child health in Chaoyang district, Beijing]. *Chinese Journal of Child Health Care*, 19(11), 1058-1061.
- Zhang, X., Wen, D., Liang, J., & Lei, J. (2017). How the public uses social media WeChat to obtain health information in china: a survey study. *BMC Medical Informatics and Decision Making*, 17(Suppl 2), 71-79. doi:10.1186/s12911-017-0470-0
- Zou, X., Shi, Y., & Zhou, Y. (2013). 北京市海淀区母婴健康素养现状的调查分析 [Investigation on maternal and infant health literacy in Haidian District, Beijing]. *Chinese Journal of Health Education*, 29(4), 331-334. Retrieved from <http://www.cqvip.com/qk/80686x/201304/45988107.html>

CHAPTER 2

ROLE OF HEALTH LITERACY AND EHEALTH LITERACY IN THE USE OF HEALTH INFORMATION AMONG CHINESE YOUNG MOTHERS: A MIXED METHODS STUDY

2.1 Abstract

Background: Online sources have been increasingly used to obtain health information in recent years. The role of functional, interactive, and critical health literacy and eHealth literacy in relation to the interaction with health information has not been explored in Chinese women with young children.

Objectives: To explore the relationships between health literacy, eHealth literacy skills and the obtaining, appraising, applying, and sharing of health information among Chinese women with young children.

Methods: We used a mixed methods approach to explore the relationships between health literacy skills and interaction with health information. We used a cross-sectional questionnaire with a convenience sample of 421 women with young children under three years old to examine the relationships between health literacy and frequency in obtaining and sharing and confidence in appraising and applying health information from WeChat, the most popular social network app in China. We also interviewed a subgroup of 20 women to explore their functional, interactive, and critical health literacy skills and their pattern of using health information.

Results: Quantitative results revealed that women with higher critical health literacy, functional eHealth literacy, and critical eHealth literacy obtained health information from WeChat more frequently compared to those with lower health literacy skills; empowerment and interactive eHealth literacy were positively related to more frequent sharing of health information on WeChat; women with higher interactive eHealth literacy and critical eHealth literacy were more confident in applying health information they obtained from WeChat; women with higher

functional, interactive, and critical eHealth literacy felt more confident appraising health information from WeChat. Qualitative results showed that women's primary sources of health information were online such as WeChat official accounts, WeChat mothers' groups, Moments and search engines. Most women in this study did not have adequate health literacy skills to obtain, appraise, and apply health information to promote their health or the health of their child. The complexity of the health environment also placed high demands on the women, which may have hindered the positive impact of health literacy.

Conclusions: Health and eHealth literacy skills play a vital role in the effective use of health information both online and offline; however, this group of Chinese mothers with young children did not have high health literacy skills. Interventions are needed to improve functional, interactive, and critical health and eHealth literacy among women with young children to empower them in making good health-related decisions for themselves and their families.

2.2 Introduction

Rapid development of the Internet has made it the most popular source of health information for the public (China Internet Network Information Center, 2018; Prestin et al., 2015). As of 2017, the number of Internet users in China had reached 772 million with 753 million mobile Internet users (China Internet Network Information Center, 2018). Pew Research Center's data indicate that 94% of Chinese people between 18 to 34 years old owned a smartphone in 2016 (Poushter, 2016). Among all Internet users, 195 million (26.6%) used the Internet for health-related purposes, including information seeking, medical appointments, medical consultations, purchasing medical and healthcare products, and fitness purposes (such as workout guidance and fitness tracking apps) (China Internet Network Information Center, 2017). Results of a recent cross-sectional survey with 1636 Chinese people (52.08% female, 67.79% between 18 – 40 years old) indicated that 71.79% of the study sample viewed the Internet as their primary means of obtaining health education (Zhang, X. et al., 2017). Gao et al. (2013) surveyed

335 Chinese pregnant women who attended an antenatal clinic in Guangzhou and found that 91.9% had access to the Internet. Most of them (88.7%) used the Internet to obtain health information on such topics as fetal development and nutrition in pregnancy.

WeChat, an all-in-one communication app, has become the most popular social media platform in China. According to the Tencent's quarterly report, WeChat had 1.11 billion monthly active users as of March 2019, an increase of 6.9% as compared to the previous year (Tencent, 2019). Based on a 2016 survey with 3000 social app users in China, 92.6% used WeChat. The WeChat app is highly versatile. It is compatible with various models of mobile phones and can be installed on desktops, laptops, and tablets. There are three main channels where users can obtain and generate information within WeChat: (1) one-on-one chatting and group chatting; (2) official accounts, where third-party individuals and organizations can create and disseminate information; and (3) Moments, where new feeds can be posted privately by users and their friends. WeChat allows users to obtain, comment on, share, and produce information and share their personal experiences. Due to its popularity, WeChat has become a new channel for the public to obtain health information. A cross-sectional survey of 1636 educated WeChat users (52.08% female, 67.79% between 18 – 40 years old, 92.79% had a Bachelor's degree or higher) showed that 30.02% of them frequently received and read health information through WeChat; however, only 14.43% believed that WeChat health information could improve their health (Zhang et al., 2017).

Health literacy and eHealth literacy may play an important role in effective access and utilization of online health information. Health literacy is defined as the “cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health” (Nutbeam, D., 1998). eHealth literacy has a specific focus on electronic sources and is defined as “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem” (Norman & Skinner, 2006). Nutbeam (Nutbeam, Don, 2000) further characterized the concept of health literacy into three categories:

Functional health literacy (FHL) refers to “basic skills in reading and writing” that enable individuals to understand factual health information and navigate the health system (e.g., correctly read and understand words). *Communicative/interactive health literacy (IHL)* refers to the ability “to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances” (e.g., correctly interpret complex information). *Critical health literacy (CHL)* refers to the ability “to critically analyze information, and to use this information to exert greater control over life events and situations” (e.g., evaluate quality of information and apply it in various contexts).

In the new era of eHealth, the role of health and eHealth literacy in Chinese women’s utilization of online health information has not been examined. Therefore, the objective of this study was to explore the relationship between health literacy and eHealth literacy level and the use of health information among Chinese women with young children.

2.3 Methods

2.3.1 Study design

We used a mixed methods approach to explore the role of functional, interactive, and critical health literacy skills in the use of health information. A cross-sectional questionnaire was used to examine the quantitative relationships between health literacy skills and frequency and confidence of using health information from WeChat in a convenience sample of Chinese mothers with young children. In-person qualitative interviews were conducted with a subgroup of mothers to explore patterns of health information use and health literacy skills.

This study was approved by the University of Massachusetts Amherst Institutional Review Board.

2.3.2 Participant recruitment

Eligible participants had to meet the following criteria: 1) Chinese women older than 18 years, 2) at least one child between 0 and 3 years old at the time of recruitment, 3) currently

living in mainland China. For interview participants, one additional inclusion criterion was the ability to meet the first author in person to conduct the interview.

A convenience sampling method was used to recruit interview subjects. The researcher approached individuals through personal connections (e.g. contact friends with young children). Snowball sampling was also used to recruit participants by asking them if they knew any friends who were eligible. The first author screened participants for their eligibility prior to the study. After participants completed the quantitative questionnaire, the first author met with each individual to conduct the interviews at a location that was determined mutually by the participant and the first author. All interviews were carried out in Shaoxing, a small city in Eastern China.

Quantitative questionnaire findings served as baseline data for the randomized controlled trial to improve health literacy and eHealth literacy among Chinese women. For intervention participant recruitment, advertisements were posted to the first author's WeChat Moments, 30 WeChat groups, and other online maternal communities. Viewers were invited to re-post the recruitment advertisement to their social networks and friends. To encourage participation, we offered to invite women who completed the baseline questionnaire to join a WeChat nutrition group and receive free nutrition advice provided by two Registered Dietitians as incentives. Interested individuals were invited to friend the author on WeChat. An online screening form with three questions (age, gender, and if they had a child under 3 years old) was sent once they added the author as a friend on WeChat and prior to baseline questionnaire collection. Screening and data collection were completed using an online survey tool called Sojump. Sojump is the largest online survey platform used by research institutions in China (<https://www.wjx.cn/>). The questionnaire took 7 to 13 minutes to complete.

2.3.3 Quantitative questionnaire

Health literacy

Health literacy was measured using the Chinese version of the All Aspect Health Literacy Scale (AAHLS) (Wu et al., 2017). AAHLS measures Nutbeam's three categories of health

literacy and has been validated in the Chinese population. This tool includes three items on functional health literacy, three items on interactive health literacy, and four items on critical health literacy. Responses were measured on a 3-point Likert scale (rarely, sometimes, often).

Empowerment

Four questions, modified from the World Bank's Draft National Survey on Empowerment Module (Alsop & Heinsohn, 2005), were used to measure women's perceived control over decisions related to their health and their children's health when interacting with health care providers and family members. These four questions were pilot tested among five Chinese mothers who were not participants of the study to ensure face validity. Responses were measured on a 4-point Likert scale (1=not at all, 2 to a small degree, 3=to a fairly high degree, and 4=to a very high degree).

eHealth literacy

eHealth literacy was measured using questions modified from the eHealth Literacy Scale (eHLS) (Hsu et al., 2014). eHLS contains three items measuring functional eHealth literacy, four items measuring interactive eHealth literacy, and five items measuring critical eHealth literacy. Possible response options were measured on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree). eHLS was developed in traditional Chinese language and validated in Taiwanese. Due to the different language characteristics between Taiwan and mainland China (traditional vs. simplified Chinese), items were modified by the first author to suit the language of the targeted population in this study. The modified eHLS was pilot tested among five Chinese mothers who were not included as study participants to ensure face validity.

Use of health information

Questions related to the use of health information on WeChat were developed by the authors based on functionality of the WeChat app, and the characteristics of health information on WeChat. Four items were developed to measure frequency of obtaining and sharing health

information, and confidence in appraising and applying health information from WeChat (Gan & Li, 2018; Tang et al., 2014; Zhang et al., 2017) . A 5-point Likert scale was used to measure the response to each item (1=never to 5=always or 1=strongly disagree to 5=strongly agree). Each of these items was pilot tested with five Chinese mothers who were not part of the study to ensure face validity.

Personal and demographic factors

Participants' age, number of children, age of children, household income, education level, occupation (unemployed, health-related jobs, or other jobs), involvement in WeChat business, marital status, pregnancy status, registered residency (urban or rural), geographic location, preferred type of medicine (Traditional Chinese Medicine (TCM) or Western medicine), and time caregivers spent taking care of the children were measured in the questionnaire.

Statistical analysis

All responses to Likert scale items were coded as 1-3, 1-4, or 1-5 depending on the number of response options. Items were coded so that a higher number represented a higher level of literacy skills, empowerment, frequency, or confidence. Items measuring the same construct were averaged. Means and standard deviations were used to summarize the distribution of continuous variables; frequencies and percentages were used to summarize categorical variables. Ordinal logistic regression was used to examine relationships between categories of health literacy skills and the use of health information on WeChat. Predicted probabilities were calculated to help interpret the ordinal logistic regression results. Data management and statistical analyses were performed using the SPSS Version 25 and Stata Version 15. The significance level was set at $p < 0.05$.

2.3.4 Qualitative interviews

After completing the online questionnaire, the first author met with individuals in person and asked them questions about their experiences with health information using a semi-structured interview guide (Figure 2.1). The interview questions were adapted from previous studies (Chen,

Qimei, 2017; Fredriksen et al., 2016; Lupton, 2017; Prescott & Mackie, 2017). The interviews were conducted in Chinese. The length of the interviews was less than 50 minutes. All interviews were audio recorded and transcribed verbatim. The first author analyzed the interview transcripts in Chinese using thematic analysis (Braun et al., 2018). Themes and quotes were translated from Chinese to English.

2.4 Results

2.4.1 Quantitative results

Participants' demographic characteristics are presented in Table 2.1. Their age ranged from 18 to 44 years old (mean=30.3), 232 (55.1%) had a bachelor's degree, and 77 (18.3%) had a master's or higher degree. Details of the health literacy and eHealth literacy of this population were described elsewhere (Chen, Q. et al., 2019).

Among the participants, 184 (43.7%) often and 147 (34.9%) sometimes found health-related information through WeChat; 173 (41.1%) sometimes and 123 (29.2%) rarely shared health-related information with other WeChat users (Table 2.2). Nearly half (n=187,44.4%) sometimes and over one-quarter (n=113, 26.8%) very often felt confident using health-related information from WeChat to make health decisions. Half the participants (n=214,50.8%) reported that they very often could distinguish high quality from low quality health information on WeChat and 121 (28.7%) indicated they could "sometimes" tell (Table 2.2).

Ordinal logistic regression analysis results (Table 2.3) show that CHL ($B=0.785$, $p<0.05$), eFHL ($B=0.334$, $p<0.05$) and eCHL ($B=1.016$, $p<0.001$) were positively associated with higher frequency of obtaining health information on WeChat. Additional analysis in predicted probabilities indicate that as CHL increased from 1 (low) to 3 (high), the probability of being in the "very often or always obtain information from WeChat" category increased from 28 to 59%. Further, as eFHL increased from 1 (low) to 5 (high), this probability increased from 38 to 65%, and as eCHL increased from 1 to 5, it increased from 6 to 72% (Figure 2.2).

EMP ($B=0.624$, $p<0.05$) and eIHL ($B=0.440$, $p<0.05$) were positively associated with more often sharing of health information on WeChat (Table 2.3). As empowerment increased from 1 (low) to 4 (high), the predicted probability of being in the “very often or always share information on WeChat” increased from 8 to 35% and as eIHL increased from 1 to 4, this probability increased from 10 to 36% (Figure 2.3).

eIHL ($B=0.715$, $p<0.001$) and eCHL ($B=0.526$, $p<0.06$) were positively associated with higher confidence in applying health information obtained from WeChat (Table 2.3). As eIHL increased from 1 (low) to 4 (high), the predicted probability of being most confident in applying health information on WeChat increased from 6 to 49%; as eCHL increased from 1 to 4, this probability increased from 8 to 39% (Figure 2.4).

eFHL ($B=0.361$, $p<0.05$), eIHL ($B=0.867$, $p<0.001$), and eCHL ($B=0.814$, $p<0.001$) were positively associated with higher confidence in appraising health information on WeChat (Table 2.3). As eFHL increased from 1 to 4, the predicted probability of being in the most confident in appraising health information on WeChat category increased from 46 to 74%. Finally, as eIHL increased from 1 to 4, this probability increased from 17 to 81%; and as eCHL increased from 1 to 4, it increased from 16 to 76% (Figure 2.5).

2.4.2 Qualitative results

A total of 20 mothers were interviewed in July 2018. Among these interviewees, 11 had a bachelor’s degree, 2 had a health-related job, 12 had one child, and 8 had 2 children. Their characteristics are summarized in Table 2.4.

Obtaining health information

Online information sources such as search engines, smartphone apps, websites, online chatting groups, have largely replaced traditional sources of health information such as books, magazines, and television. WeChat is especially popular among young mothers who want to obtain health information quickly and easily through official accounts, Moments, and other functions.

I read my subscribed WeChat official account pretty much every day or every other day. ... It's faster to get the information you need if you use a smart phone. If you watch TV, you have to be there at a certain time to get the information. If you read a book, the book may not necessarily have the information you want. However, if you search a keyword on WeChat or on a website, you will quickly get results. (P2, 2 children)

When I was pregnant with my first child, I subscribed [to] the magazine "Mommy Baby" which focused on child development from 0-3 years old. ... Now that the Internet is more developed, I have been using WeChat, Moments, and I also browse websites... Now that everyone has a smartphone, any information is from the Internet... (P11, 2 children)

Social networks had a profound influence on preferred sources of health information. Instead of objective evaluation of these sources, mothers tended to go to people they know, such as colleagues, friends, and experienced mothers for information. The quality of health information recommended by their social network varied. Women's social networks had a strong impact on what information they received; without high CHL skills these women were unable to assess the quality and validity of this information.

I have subscribed to various WeChat official accounts and joined a WeChat mothers' group. These are mostly recommended by my friends. Sometimes I saw my friends sharing articles from official accounts on WeChat Moments, sometimes I search on Baidu [a search engine], sometimes I post questions on Moments or in the WeChat mothers' group. I have a friend who has a couple of kids, so I would also consult her too. (P6, 1 child)

I mostly get my health information online. Search online using Baidu or ask other moms on WeChat. My WeChat official accounts were recommended by others. I usually listen to experienced mothers. (P9, 2 children)

I downloaded an app which tells me how the baby was developing at each stage. It was recommended by a friend. My friend also used this app when she was pregnant, she thought it was pretty good, so she recommended it to me. ...I like the old-fashioned way [of raising a child]. I trust my parents because they have the experiences. (P18, 2 children)

I have a neighbor who is a nurse. I usually ask her to read my lab reports from the hospital. She would ask doctors she knows and give me unbiased advice. (P17, 1 child)

Online information sources and social networks were often used in addition to information offered by healthcare providers when it came to medical treatment. Mothers would seek information from other sources before and after going to the hospital to understand the disease condition and to validate the information they had received. However, the ultimate decisions they made were largely dependent upon their health literacy level.

I don't really know which online source is credible to be honest, so I just look around. I don't pay attention to the platform or organization where the information is from. I sometimes have this confusion of what can I believe when looking at information online. For example, when my child had rashes, I searched online to find out what was the matter. Then I went see a doctor. Sometimes the doctor's words are vague, so I would search online again. I would ask other mothers on the app Babytree to see if they have experienced similar situations and how they handled it, then compare their situation to mine. I would pay attention to my particular situation and also listen to the doctor a little. (P3, 1 child)

When my son is coughing, I usually give him Mucosolvan [not approved by FDA]. My colleague recommended this medication to me. I trust my colleague, so I gave this medication to my son when he had a cold. He got better after a few days, so I thought this medication was pretty good. I asked the doctor about this medication. The doctor

said it's made in Germany and he didn't know the ingredients, so he insisted to use medication that's made in China. (P7, 1 child, health-related job)

Other mothers compared information from several sources before making a decision.

I think what's online can only be used as a reference, because the parents online may not describe their children's symptoms correctly, and the doctors online have not seen the child in person. Doctors in the hospitals are more reliable because they are professional and they have seen your child, so they can use their experiences to make their judgment. (P15, 1 child, unemployed)

I use online search engines to look for information. My baby didn't start teething until 14 months old. At the beginning I was worried that he may have malnutrition, maybe the diet was not right. I searched online first, some people said it's because of calcium deficiency, others said pre-term babies may have this symptom. Then we went to the hospital and checked the micronutrient status. The doctors said it was all normal, it may be because of genetics, every child is different. Then I felt relieved. Two months later he started teething. (P20, 1 child, unemployed)

Appraising health information

Only one mother indicated that she actively appraised the information she sees on WeChat.

I check the author's credibility, the content [of the WeChat official account Dingxiang Doctor] was written by doctors. I think because they are doctors from big hospitals in big cities, they are more reliable. The content of the articles is also logical, not like a lot of the other official accounts who use sensational content to attract attention. For example, you will [have this consequence] if you don't do something. I think it's unreliable when I saw those type of titles. I would trust the information more if the language was simple and unemotional. (P2, 2 children)

Most participants did not evaluate the credibility of the health information they heard or saw online. They did not have the skills or awareness to check an author's credibility, the source of the information, or evidence supporting the information to critically appraise its validity.

I don't really know how to tell if the information is correct [laugh]. If I think it's correct, then it should be correct. ...I have not paid attention to who were the authors of the WeChat official account content. (P6, 1 child)

I've seen a lot of articles on WeChat that were wrong. When I first saw them, I believe in them. Later on, there would be other articles clarifying those rumors. Then I believe in those articles more. I am not sure why. But when I read the article and think it flows well, I would think this is correct. I did not evaluate it at the Moment. Once there is a clarification article, I would rather trust the clarification. I just skimmed through the articles and would not think about it deeply. (P8, 2 children)

Almost all participants chose to believe certain health information based on their existing knowledge and prior experiences. They tended to trust the opinions of their friends, people with experience, and information that appeared to be useful or practical without validating the credibility of the information.

[Researcher: Have you paid attention to the authors of the information on the app Babytree?] Interviewee: Not really. Maybe I just agree more with their content. I just check if their opinion is similar to mine. If it's the same, then I think it's right. (P4, 1 child, health-related job)

I have not paid attention to the characteristics of the articles or the credibility of the information. If I think it makes sense to me, I would keep reading.... I check if the content attracts me, if I can apply the information in my life. For example, how to cool down the baby's fever physically without taking medication [practices no longer recommended by AAP]. (P19, 1 child)

What other moms described in the WeChat group were their real experiences. I know them so I trust what they said.... The common diseases among young kids are all similar. Most moms in the group would share what they have done when their kids were sick. They would explain in great detail. (P13, 2 children, unemployed)

Some mothers talked about comparing information from multiple online and offline sources or checking if advertisements had been used. These skills can help mothers filter out some low-quality information; however, such skills do not guarantee a conclusion, let alone the correct conclusion.

[Researcher: Why do you think some of the articles on WeChat are not credible?] Interviewee: Because I think there are too many advertisements in the articles....Sometimes the purpose of the articles is to sell products. [Researcher: You mentioned Niangao Mom earlier to be a good source, don't they also sell products?]
Interviewee: Yes, but those products are what I need... (P4, 1 child, health-related job)

When I Baidu, I rarely pay attention to the information source or who wrote the article. I would check multiple pages of the search results, look at what different websites are saying. I am also WeChat friends with a couple of other mothers. We would share the health information we found online with each other. I would also ask my friends, including a pediatrician. I would ask multiple people if I should do it or if it is right and consider all their responses. It's hard to tell if certain characteristics would make an online article untrustworthy. (P1, 1 child)

I would go to the doctors and also check information on WeChat official accounts. However, it's hard to decide sometimes because the doctors would say you can use this medication, but some WeChat official account may say you cannot use it. It's hard for us to tell if this medication is good or bad for the baby. (P12, 2 children)

Applying health information

Mothers tended to apply the health information they believed in most to make decisions. We did not observe them engaging in a critical appraisal process before applying the information in most cases. We saw both right and wrong health information being applied by the mothers. Some were able to apply the correct health information they obtained in making their decisions; others were not able to do so.

When I had my older child, we added salt as soon as she started to eat complementary food. I didn't know much back then. My in-laws said the baby needed salt for energy. So I followed their advice. She is a picky eater now and only likes food with strong flavors. For my second child, I have learned something from the WeChat official accounts and apps, so we did not add any salt before he was one year old. The second baby is a good eater and likes everything. (P12, 2 children)

Some would apply the information if they thought the information or methods were practical or worked for others.

[Researcher: How do you know if the information is credible?] Interviewee: I think these WeChat official accounts and apps are all credible. I followed their instruction in feeding my baby. For example, what they can and cannot eat. (P5, 1 child)

When I first started breastfeeding, I didn't have too much milk. I searched on the app Babytree for methods of increasing milk production. One mother told me that I could eat pangolin scale powder [a TCM made from the scales of the animal pangolin] to increase milk. I also asked a high school friend of mine, she said she had tried this, and it worked for her. So, I took their advice and ate pangolin scale powder. My milk production had increased. (P17, 1 child)

Some mothers would evaluate the health information before making health-related decisions such as choice of medication, diet, and supplements. However, without the ability to critically appraise the information, the wrong information may be applied and it may not only have no health benefit, but it could result in health problems or unnecessary cost.

One night my baby had a fever. I searched online and found that you can wet a paper towel with raw egg white and put the paper towel on baby's forehead to lower the temperature. Because the Internet said so, I didn't think about if it would work or not. I thought it was just egg white and would not do harm to the baby. I also remembered my friend, a nurse, who also reposted this method on her WeChat Moments. Since she's a nurse so I just tried it. (P8, 2 children)

...I have also bought supplements from other countries for my baby to obtain more nutrients. A fish liver oil supplement from Australia and a calcium supplement from the U.S. Considering calcium is hard to get and hard to absorb, I took calcium supplements when I was pregnant. I have always been giving my baby calcium supplement too. Fish liver oil was recommended by the doctor, all babies should take it... I always had the plan [of taking calcium supplement] based on my own knowledge. Before I got pregnant, my nutritionist friend also recommended calcium supplements. He works for Amway [a multi-level marketing company who also sells supplements], but he didn't say that I have to use their products, so I think I can take his advice. (P10, 1 child)

Sharing health information

Just like a lot of the mothers who seek health information or sources of health information from their friends, some mothers also like to share their knowledge with others. A few participants were active and liked to share information with their social networks, or even to larger communities with the good intention to share knowledge and advocate for themselves and their community. However, the information shared was often based on mothers' perceived usefulness of it, not necessarily on its credibility.

If I think the information [I learned from WeChat or other places] is useful, I would share it with my friends. I would also share it to a WeChat mothers' group since I am the owner of a group. The members in my WeChat group would also discuss the information I shared. (P6, 1 child)

I would repost in my WeChat Moments to let others know. Although I know you, but I don't know all your friends and you don't know all my friends. If I post something, and you repost it, some of your friends who also need the information may see it. I remember one time when I was still pregnant, I reposted an article explaining umbilical cord around the neck. I saw about 12 of my friends reposted the article. When the doctor tells you that your baby has the cord around the neck, mothers are always worried that the baby may be choked. [This article explained that] usually you don't need to worry about it. However, you should also consider the doctor's advice. (P15, 1 child, unemployed)

Sharing health information within the family, especially from mothers to grandparents, was very common among our interviewees. Sometimes mothers just wanted to pass information on; other times they used evidence from other sources to convince the older generation who had different opinions.

If I think the information I saw was scientific, I would always send the links of the articles to my mother-in-law. She always read these articles. She would change her way of doing things if I told her it's wrong. (P6, 1 child)

I would communicate with my family in terms of health information. For example, I would tell my mother-in-law what the baby cannot eat because she takes care of the baby during the day. For example, herpangina [mouth blisters caused by viruses] is spreading in the area recently, I would tell her that do not let others to kiss the baby when she takes the baby out. (P19, 1 child)

Mothers with high health literacy skills were able to extract and apply the correct health information, and they were empowered to disseminate the correct information to their family and virtual community to promote better health of others. However, misinformation can just as easily be passed to others if the mother did not have the ability to critically appraise the information with a potentially negative impact.

One time my son had tonsillitis. The doctor at the nearby clinic prescribed him antipyretics [medications that reduce fever]. It turned out that that antipyretics could not be used in children under 12 years old. ... I always read the package inserts of drugs. If clinics prescribe drugs in small quantities without providing package inserts, I would always look it up online. I found online that the antipyretics prescribed should not be used in children under 12, however, my son has already taken two packages. So I went to the clinic to argue with them. They did not admit being wrong. For drugs like these, I would follow the instructions. It takes a lot of experiments [to test the drugs]. What population can use it and what side effects [the drug had are all on the package inserts]. The government has strict regulations on this, so the package inserts are highly credible, and we should follow it when using medication. I posted [my experience] on the local online forum, telling others not to go to this irresponsible clinic. If anyone is giving this drug to their children who were under 12, they should stop it and change to other medications. I would share my options with others. My parents told me not to make a scene, “you just stop using that drug on your son”. But I think everyone should know this, it could be bad for children after all. ... This post has become a highlighted post, everyone in the online community was discussing it. Others commented what other clinics were using this same drug inappropriately. (P11, 2 children)

Since I had the baby first, my relatives would ask me for advice. The nurse told me not to switch formula between brands in the first six months. “If you switch brands, the nutrient content also changes and may cause diarrhea”. So I gave my baby the same formula in the first six month. I told my relatives to pick a really good brand of formula at the beginning and stick to it in the first six months. (P8, 2 children)

High demands of the health environment

The current health environment in China is extremely complex and requires a lot of skill to successfully navigate the system and make the best health decisions.

The mothers talked about the fact that they may not always get satisfactory responses from their providers due to the high workload of the doctors. The health information from the providers may not be always correct or evidence-based. Over prescribing of medication was also mentioned as a common practice. Mothers with high health literacy skills were able to tell if information from the providers was trustworthy. However, those with low health literacy skills were disadvantaged and had an extremely difficult time making informed decisions.

For example, specialist clinics. Everyone is going there for the experts, so they are very busy. Usually the specialist won't tell you too many details. Sometimes when you ask follow-up questions or want to clarify something, the specialists do not like to communicate with you because they are too busy. Sometimes when I was explaining my baby's symptoms, they wouldn't necessarily listen carefully. (P10, 1 child)

When my son had a fever, we went to the hospital. The doctor recommended intravenous injection (IV). I did not listen to the doctor. Because a lot of the other mothers said fever is very common and does not require IV. [The other mother said my son] should first take oral medication and try to lower the temperature physically. The other mothers had the experience, so I listened to them. It is very common nowadays that the doctor overprescribes to make a profit. (P17, 1 child)

Every time when I took my younger child for physical check-ups, the provider would ask us to take such and such supplements. I've read that only vitamin D supplement is necessary. It was written on the discharge paperwork when I had the baby. Every time the primary-care provider asks us if [my child is] taking calcium supplements and fish liver oil. I said no, she said you should take those supplements. If you don't, the baby's teeth won't come out. I told her that my older child didn't take calcium supplement and she was fine. The provider said you have to take it, now the baby is growing very fast, he won't meet his nutritional needs without the supplements. ... Well, I cannot argue with her, so I just keep it to myself. (P14, 2 children)

I trust the doctors more. For example, my child' tongue sometimes looked white and sometime looked yellow. I tried to search online but failed to find a conclusion. So I went to the doctor for an answer. The doctor told us that it was because of dyspepsia. I trust the doctor. (P18, 2 children)

The eHealth environment is also complex and full of contradictory information or even consistently wrong information. In this context, it is even more challenging for mothers with low health literacy levels to know what is reliable health information.

My mother-in-law thinks we can start adding complementary foods after four or five months. I searched online to find out when to add complementary foods. All results said after six months because we were exclusively breastfeeding. I had some argument with my mother-in-law. ... I think five months is too early to add complementary foods. (P1, 1 child)

[Researcher: How did you know that certain foods reduce milk production?]

Interviewee: Foods like Chinese chives, fennel, barley tea, these will reduce milk in anyone. If you Baidu "foods reduce milk", it'll show the results from Baidu Encyclopedia, PCBaby, BabyKnows, 39Health, Mama, links to apps [all commercial sites]. These are all experiences from other moms or doctors. I think most of these are reliable. There's no reason for them to make irresponsible remarks. See the first result said barley tea, haw, bitter melon, maltose, Chinese chives, fennel, peppercorn. The second result also said barley tea, haw, etc. They are mostly consistent. (P14, 2 children)

Dealing with grandparents who were taking care of the children was also a challenge. Knowing what is credible health information was often not enough to change the older generation's outdated beliefs and behaviors.

My father-in-law has some old beliefs. For example, he thinks salt is essential for energy; babies can eat anything at any time; and when we are trying to let the baby exercise by crawling, he would say it's too much exercise and would pick him up

immediately. When it comes to salt, I strictly limit added salt in my baby's food; but when it comes to exercising, I just let him pick up the baby because there's not much difference if the baby exercises a few minutes less. I would let the baby exercise more when my father-in-law is not around. I would talk to him and try to convince him with new ideas; however, it never worked. What he thinks right is right. (P6, 1 child)

I would try my best to compromise with my mother because she is helping me to take care of the child. For example, feeding complementary food. My mother is worried that my 3-year-old daughter is not getting enough food, so she always tries to feed her as much food as she can, to a point my daughter vomits. I have talked to her about this. I told her that the doctors said we should not feed the baby too much food. However, my mother still thinks the baby is not full enough and continues to feed her. I stopped criticizing her method because I am afraid that she may get upset. (P8, 2 children)

We used to feed my son pureed food. Then I read that soft foods can be offered around nine months. At that time, my mother was taking care of my son. I suggested to feed him soft finger foods, but my mother didn't agree. She said she would wait until my son is one year old. Since I have to work and my mother was the one who's taking care of the baby, I let my mother continue to feed him pureed food. Now we both regret because my son's chewing ability is lower than other babies at the same age. (P4, 1 child, health-related job)

2.5 Discussion

We quantitatively and qualitatively explored the role of health literacy and eHealth literacy in use of health information among Chinese mothers with young children. Questionnaire data showed that health literacy and eHealth literacy skills were positively associated with frequency of obtaining and sharing health information on WeChat, and eHealth literacy skills were positively associated with participants' confidence in apprising and applying health

information from WeChat. Interview data indicated that the complexity of the health environment in China imposed high demands on the mothers; however, most mothers did not have the health literacy skills to effectively use credible health information.

While online health information sources were widely used by all mothers we interviewed, only a few were able to extract the correct information from evidence-based sources and use the information to make informed health-related decisions. Most of the mothers did not have adequate health literacy skills to find reliable information sources and they were unable to critically appraise the information before adopting it. They relied primarily on subjective opinions of others (friends, family, other members of online chat groups) when making health decisions. We found that health literacy and eHealth literacy skills were positively related to frequency of obtaining health information and confidence in appraising health information from WeChat. However, mothers could be overly confident, and the information obtained might not be entirely credible. We found that misconceptions about health were common in almost all of our interview participants. These findings were consistent with previous research. Chen and colleagues (Chen, Juan et al., 2016) tested a mixture of true and false health information that was widely spread on WeChat using a survey among a group of 362 Chinese WeChat users. Slightly more than half (59.9%) of the participants were female, 92.53% were between 18 and 35 years old, and 72.73% had a bachelor's degree or higher. Only 21.55% of the 362 users were able to accurately identify the authenticity of the health information (Chen et al., 2016). Gao et al. (Gao et al., 2013) studied 335 pregnant Chinese women and found the most important criteria for judging the trustworthiness of web-based information was to check the consistency of information from multiple sources (67% selected this option), check if references were provided (42% selected this option), and check if the facts had been reviewed by experts within the field (34% selected this option). However, these percentages may be artificially high because options were provided for the respondents to choose. In our interviews, no participants mentioned strategies such as checking references, reviewers, timeliness, or the authority of sponsored organizations. Our

interview participants also compared information from multiple sources; however, if the information sources they used for comparison were all not credible, they may not reach the right conclusion.

Most of the participants in our study used information from commercial websites, apps, or WeChat official accounts. However, the quality of the information on these sites is questionable. Some mothers found consistently incorrect information from multiple websites. Liu (Liu, 2016) analyzed 246 of the most popular health-related WeChat official accounts (based on WeChat Communication Index, which is calculated with number of views and likes) in March 2016, and found that two were run by the government, two were run by hospitals, and one run by a university (Liu, 2016). Li (2016) analyzed 327 WeChat official accounts that contained “health” or “health maintenance” in their titles in December 2014 and found that 90.6% of them were created and managed by businesses, 6.4% came from media organizations, and only 3% came from hospitals and government public health departments (Li, 2016). Government and public hospital run official accounts focus more on policy interpretation and governmental or organizational affairs; their health information always has a formal tone; they usually do not have a designated team to manage the accounts, and they lack high-quality original articles on health education (Jiang, 2016). Business-run official accounts generally do not provide author information or the source of the health information they deliver; however, advertisements are almost always inserted. Delivering health information, sometimes with exaggerated titles and misleading content, is a marketing technique for businesses to attract WeChat users to their advertisements and products (Li, W., 2017; Li, 2016). In our interviews, nobody mentioned using health information sources from governmental or professional organizations. Indeed, there is no information source that is equivalent to MedlinePlus® from the U.S. National Library of Medicine or HealthyChildren.org from the American Academy of Pediatrics in China. Such comprehensive evidence-based information sources need to be developed in China.

We found in our interviews that some mothers were applying incorrect feeding practices, giving unnecessary supplements, or not giving prescribed medication. Some also shared unreliable health information with their friends and family and recommended low-quality information sources to others. These actions can potentially have a negative impact on both their health and the health of their family and friends. The spreading of misinformation is not a unique problem in China; wide-spread antivaccination information on social media in the U.S. may also have a negative impact on public health. We agree with Chou et al. (Chou et al., 2018) that more research is needed to understand the effect of health misinformation and design interventions to mitigate their negative impact. Having high health literacy is needed to assess the quality of information, make informed health decisions, and promote engagement in actions that extend from personal decisions to social actions (Nutbeam, 2000).

Healthcare providers should be the most reliable information source in countries where evidence-based medicine is the mainstream practice. However, in China, this is often not the case. From our interviews, we found that doctors were limited to short encounters with the patients (often as short as six minutes (Xu & Zhang, 2014)); therefore, offering health education during the medical consultation is unrealistic. Information that was incorrect or not evidence-based was sometimes given to the participants by their providers. While some mothers trust the doctors, some complained about overprescription. A national cross-sectional survey investigated Chinese pediatricians' Evidence-Based Medicine practice in 2009. The results showed that 10.3% of the 1,988 pediatricians "never" applied, 51.4% "occasionally" applied, and 38.3% "often" applied clinical evidences to their practices (Zhang, P. et al., 2010). A cross-sectional survey with 504 Chinese licensed physicians 61.9% of the study sample reported "sometimes" and 18.7% reported "often" when asked the frequency of prescribing diagnostic tests or procedures that were clinically unnecessary (He, 2014). Some of our participants used online sources to complement inadequate information they received from their providers. Although some tried to discuss the information with their providers, they did not receive satisfactory response. Some researchers

have highlighted the importance of providers being aware of patients' use of online information (Sayakhot & Carolan-Olah, 2016) and have encouraged healthcare providers to discuss the information with their patients and guided them to high-quality information sources (Gao et al., 2013).

Some interviewees mentioned the challenges of taking care of their child together with parents or in-laws. Even if these parents were aware of best practices; they were often not able to apply the information as they were at work while the parents or in-laws were in charge of childcare, they did not want to upset their parents, or they were not able to convince the parents, despite a desire to use interpersonal communication strategies. Similar findings have been reported by other researchers. Goh and Kuczynski (Goh & Kuczynski, 2010) surveyed 1627 families with young children, 45.4% received grandparents' help in childcare, among these, more than half (54.4%) reported difficulties in caring for the child jointly due to differences in child-rearing methods between the parents and grandparents (Goh & Kuczynski, 2010). The shortage of childcare is another problem in China. For children under three years old, two major types of childcare services are available: nurseries and early learning and development centers. While the nurseries mainly provide custodial care, early learning and development centers focus on stimulating children's motor, language, and interaction skills (Qi & Melhuish, 2017). Access to these services is largely affected by a family's income level. According to the National Health and Family Planning Commission of China's 2015 statistics, 80% of infants in China were taken care of by their grandparents (National Health and Family Planning Commission, 2017). Potential strategies to improve this situation are to provide more daycare services, tailor interventions to improve communication skills among women, and to design interventions for the older generation to improve their health literacy.

The Healthy China Action (2019-2030) published in July 2019 (National Health Commission, 2019) has set several goals that are promising in addressing some of the issues raised in our study. The Action proposed to establish national and provincial health science expert

database and health information database by 2022-2030. While this is promising, we would like to restate the importance of these databases to be evidence-based, literacy appropriate, and up-to-date based on the challenges women are facing in our study sample. The Action also proposed incorporating health education in hospitals and by healthcare providers as performance evaluation indicators. This action may add more workload to the healthcare providers. We think that promoting the practice of evidence-based medicine among healthcare providers, restoring provider-patient trust, and reforming the healthcare system to reduce the workload of the doctors would be more strategic and have a higher potential for success. The Action also listed improved individual health literacy as an expected outcome. Our study suggested that interventions are needed to improve women's transferrable skills, which enable them to make good decisions in complex situations. Due to the popularity of the smartphone app WeChat, and the potential influence social networks have on individuals and vice versa, interventions delivered using WeChat may be promising in improving health literacy skills in communities.

2.6 Limitations

This study had a number of limitations. This cross-sectional study used convenience sample of participants who were self-selected; therefore, the findings may not be generalized to other populations. We only measured use of health information on WeChat in the questionnaire. Other information sources such as search engine and other maternal and infant apps were not included. However, WeChat is one of the most popular online platforms for the mothers to obtain health information, and the qualitative interviews provided insight into the use of other information sources. Women's health literacy, eHealth literacy, empowerment, and use of health information on WeChat were all measured using subjective measures. All interview participants were from a small city in Eastern China. The healthcare system in this area may differ from that of bigger cities and rural areas. Therefore, our findings may not be reflective of those who are living in other geographic locations.

2.7 Conclusions

Chinese women with young children frequently use online health information sources. Health and eHealth literacy skills have a crucial role in effective use of health information both online and in person. Low health literacy levels and misuse of health information were common in our study sample. Interventions are needed to improve the functional, interactive, and critical health and eHealth literacy among women with young children to empower them to make more informed health-related decisions for themselves and their family. As the most frequently used social network app, WeChat has the potential to deliver such interventions.

Table 2.1 Characteristics of all participants (n=421).

Variables	n (%)	Variables	n (%)
Household monthly income (CNY (USD))		Education	
< ¥5,000 (<\$727)	46 (10.9)	Less than high school degree	10 (2.4)
¥5,000 – 10,000 (\$727 – 1,454)	117 (27.8)	High school degree	24 (5.7)
¥10,001 – 15,000 (\$1,455 – 2,181)	89 (21.1)	Some college or vocational school	78 (18.5)
¥15,001 – 20,000 (\$2,182 – 2,908)	65 (15.4)	Bachelor's degree	232 (55.1)
¥20,001 – 30,000 (\$2,908 – 4,362)	51 (12.1)	Master's degree or higher	77 (18.3)
≥ ¥30,001 (≥ \$4,363)	53 (12.6)	Residency status	
Occupation		Urban	296 (70.3)
Unemployed	74 (17.6)	Rural	114 (27.1)
Health-related jobs	69 (16.4)	Not sure	11 (2.6)
Other jobs	278 (66.0)	Location¹	
WeChat business involvement		Tier 1 cities	74 (17.6)
Full-time	2 (0.5)	Tier 2 cities	147 (34.9)
Part-time with another job	28 (6.7)	Other	200 (47.5)
Part-time without other jobs	19 (4.5)	Preferred type of medicine	
Not involved	372 (88.4)	TCM ² as first choice	63 (15.0)
Marital status		Western medicine as first choice	144 (34.2)
Never married	2 (0.5)	Depends	194 (46.1)
Married	414 (98.3)	Number of children	
Living in a marriage-like relationship	1 (0.2)	1	327 (77.7)
Divorced/separated	3 (0.7)	2	92 (21.9)
Widowed	1 (0.2)	3	2 (0.5)
Current pregnancy status			Mean ± SD (Range)
Pregnant	14 (3.3)	Mother's age (years)	30.3 ± 3.89 (18 - 44)
Not pregnant	401 (95.2)	Children's age total (months)	35.0 ± 42.38 (0 - 239)
Not sure	6 (1.4)	Youngest child's age (months)	16.3 ± 9.35 (0 - 43)
If they take care of the children (Yes)		Time spent taking care of the children (hours/day)	Mean (SD)
Mother	406 (96.4)	Mother	14.1 (7.53)
Father	357 (84.8)	Father	4.4 (4.52)
Paternal grandparents	247 (58.7)	Paternal grandparents	5.8 (6.70)
Maternal grandparents	227 (53.9)	Maternal grandparents	5.8 (7.14)
Nanny	68 (16.2)	Nanny	1.9 (5.35)
Daycare	40 (9.5)	Daycare	1.0 (3.86)
Other	28 (6.7)	Other	0.5 (2.49)

¹ Tier 1 cities: Beijing, Shanghai, Guangzhou, Shenzhen; Tier 2 cities: Provincial capital cities excluding tier 1 cities.

² TCM: Traditional Chinese Medicine

Table 2.2 Interaction with health information on WeChat (n=421).

	Responses ¹ n (%)					Mean (SD)
	Never	Rarely	Sometimes	Very often	Always	
1. How often do you find health-related information through WeChat? (Obtain)	5 (1.2)	52 (12.4)	147 (34.9)	184 (43.7)	33 (7.8)	3.45 (0.851)
2. How often do you share health-related articles with others on WeChat? (Share)	20 (4.8)	123 (29.2)	173 (41.1)	93 (22.1)	12 (2.9)	2.89 (0.898)
3. I feel confident using health-related information from WeChat to make health decisions. (Apply)	11 (2.6)	99 (23.5)	187 (44.4)	113 (26.8)	11 (2.6)	3.03 (0.844)
4. I can tell high quality health information from low quality health information on WeChat. (Appraise)	7 (1.7)	42 (10.0)	121 (28.7)	214 (50.8)	37 (8.8)	3.55 (0.851)

¹Options are coded as 1=never, 2=rarely, 3=sometimes, 4=always, 5=always.

Table 2.3 Relationships between health literacy and the use of health information on WeChat (n=421).

	Obtain	Share	Apply	Appraise
	B(SE)	B(SE)	B(SE)	B(SE)
Education				
High school degree or less	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Some college or vocational school	-0.420(0.450)	0.005(0.425)	-0.306(0.428)	0.037(0.452)
Bachelor's degree	0.156(0.439)	-0.077(0.412)	-0.598(0.414)	-0.189(0.439)
Master's degree or higher	0.178(0.514)	0.324(0.480)	-0.476(0.481)	0.034(0.523)
Occupation				
Unemployed	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Other jobs	-0.518(0.297)	-0.534(0.273)	-0.035(0.275)	0.172(0.298)
Health-related jobs	-0.314(0.410)	0.310(0.375)	0.129(0.379)	-0.032(0.418)
Household monthly income (CNY (USD))				
< ¥5,000 (<\$727)	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
¥5,000 – 10,000 (\$727 – 1,454)	0.423(0.365)	0.064(0.341)	0.096(0.346)	0.229(0.360)
¥10,001 – 15,000 (\$1,455 – 2,181)	0.101(0.388)	-0.497(0.368)	-0.598(0.370)	0.320(0.388)
¥15,001 – 20,000 (\$2,182 – 2,908)	0.138(0.418)	-0.212(0.392)	-0.802(0.398) *	0.283(0.418)
¥20,001 – 30,000 (\$2,908 – 4,362)	-0.268(0.440)	-0.571(0.417)	-0.687(0.422)	1.354(0.483) *
≥ ¥30,001 (≥ \$4,363)	0.053(0.457)	-0.802(0.425)	-0.958(0.429) *	1.059(0.491) *
Residency				
Rural	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Not sure	-1.113(0.659)	-1.587(0.696) *	-0.722(0.616)	-0.050(0.685)
Urban	-0.624(0.262) *	-0.012(0.240)	0.141(0.242)	-0.140(0.263)
Mother's age	0.104(0.034) *	0.062(0.031) *	0.037(0.031)	0.031(0.035)
Child's age	-0.010(0.003) *	-0.005(0.003)	-0.001(0.003)	0.000(0.003)
Functional health literacy (FHL)	-0.178(0.247)	-0.138(0.226)	0.060(0.229)	-0.085(0.259)
Interactive health literacy (IHL)	0.184(0.324)	-0.254(0.311)	-0.552(0.316)	-0.186(0.336)
Critical health literacy (CHL)	0.785(0.300) *	0.251(0.286)	-0.172(0.288)	-0.241(0.312)
Empowerment (EMP)	0.213(0.213)	0.624(0.199) *	0.312(0.199)	0.183(0.221)
Functional eHealth literacy (eFHL)	0.334(0.133) *	-0.057(0.120)	0.052(0.122)	0.361(0.141) *
Interactive eHealth literacy (eIHL)	0.336(0.212)	0.440(0.198) *	0.715(0.203) **	0.867(0.222) **
Critical eHealth literacy (eCHL)	1.016(0.223) **	0.160(0.205)	0.526(0.209) *	0.814(0.225) **

Regression coefficients and standard errors were generated from ordinal logistic regression.

Obtain and share were re-coded as 1=never or rarely, 2=sometime, and 3=very often or always. Apply and appraise were re-coded as 1=strongly disagree or disagree, 2=neutral, and 3=agree or strongly agree.

*p<0.05, **p<0.001

Table 2.4 Characteristics of interview participants (n=20).

Variables	Mean ± SD (Range)
Mother's age (years)	31.80 ± 4.10 (27-39)
Children's age total (months)	54.1 ± 55.80 (6-201)
Youngest child's age (months)	17.4 ± 9.80 (1-33)
	n
Education	
High school degree or less	2
Some college or vocational school	7
Bachelor's degree	11
Occupation	
Unemployed	4
Health-related jobs	2
Other jobs	14
Household monthly income (CNY (USD))	
< ¥5,000 (<\$727)	2
¥5,000 – 10,000 (\$727 – 1,454)	7
¥10,001 – 15,000 (\$1,455 – 2,181)	4
¥15,001 – 20,000 (\$2,182 – 2,908)	3
¥20,001 – 30,000 (\$2,908 – 4,362)	4
Marital status	
Married	20
Current pregnancy status	
Not pregnant	20
Residency	
Urban	12
Rural	8
WeChat business involvement	
Involved at some level	5
Not involved	15
Number of children	
1 child	12
2 children	8

1. Where and how do you usually obtain maternal and infant related health information?
2. How do you know if the health information is trustworthy?
3. What would you do when you see false health information on WeChat?
4. How do you use the health information you get from WeChat?
5. Do you share health information related to your child in your family? To who? When? How often?
About what? Does your spouse also do the same thing?
6. How do you choose from the similar or conflicting information both from WeChat and from social relations (e.g. friends/parents/peers/spouse, etc.)?
7. How do you communicate with healthcare providers?

Figure 2.1 Interview guide.

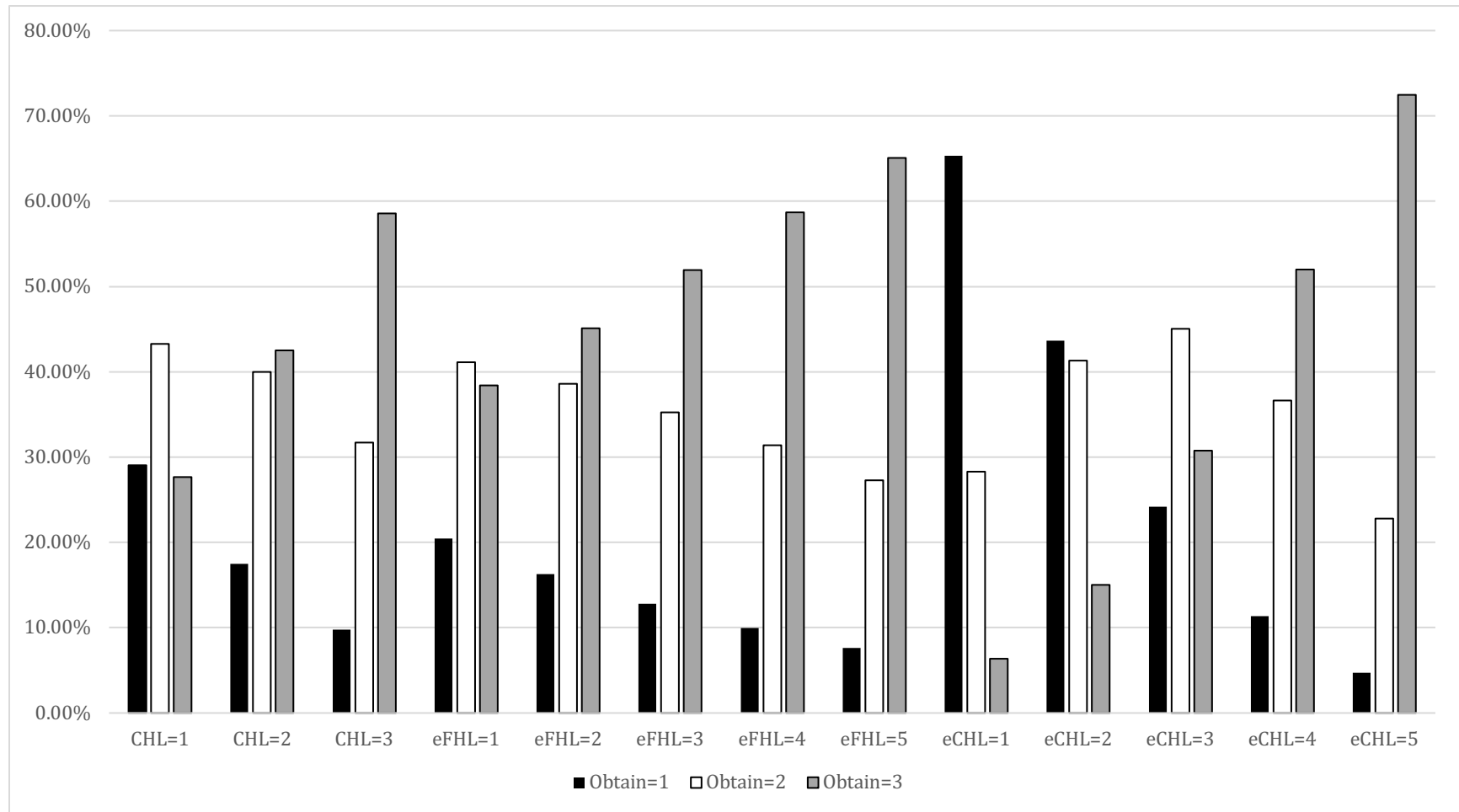


Figure 2.2 Predicted probabilities of frequency in obtaining health information on WeChat.

Frequency of obtaining health information on WeChat is coded as 1=never or rarely, 2=sometimes, 3=very often or always.

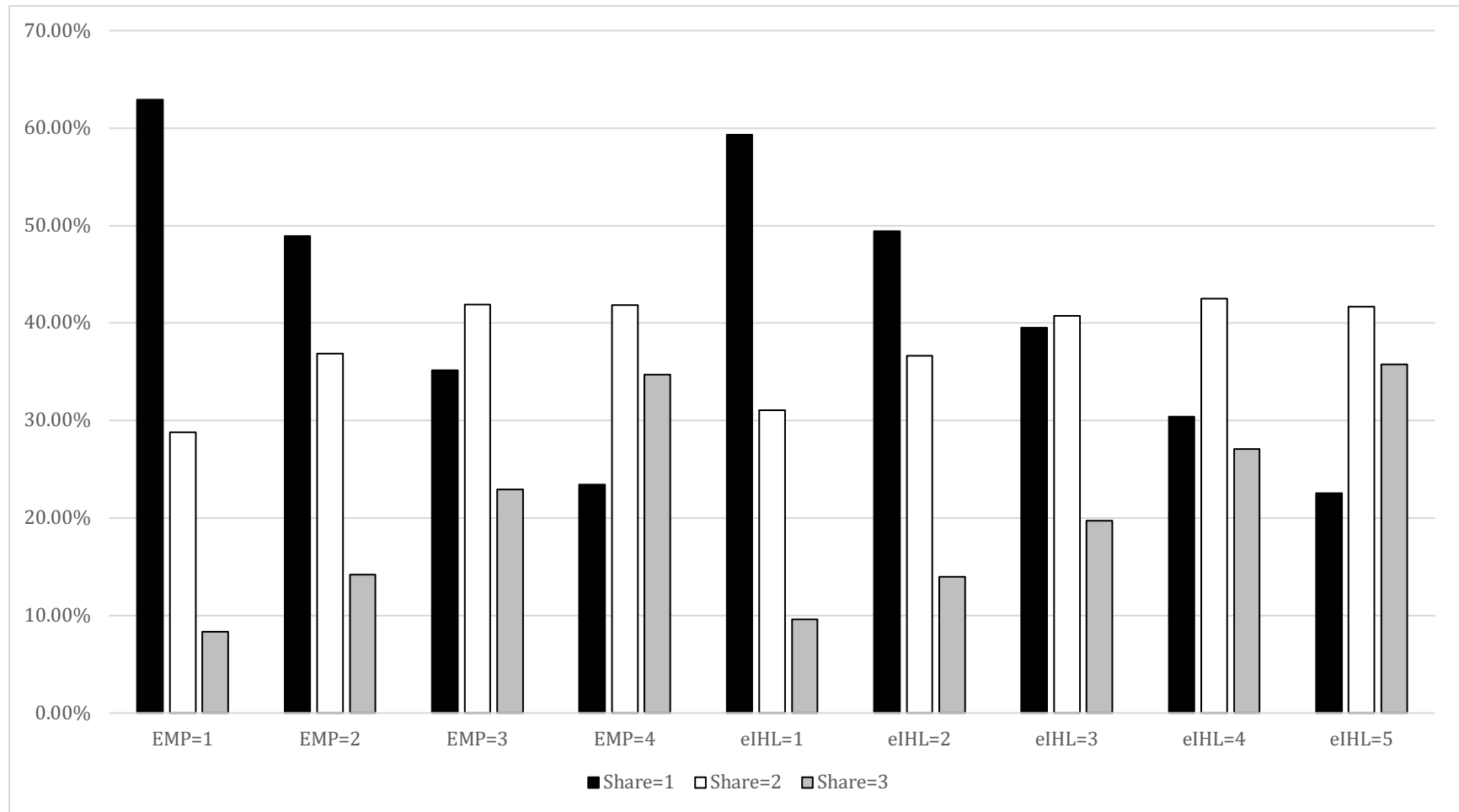


Figure 2.3 Predicted probabilities of frequency in sharing health information on WeChat

Frequency of sharing health information on WeChat is coded as 1=never or rarely, 2=sometimes, 3=very often or always.

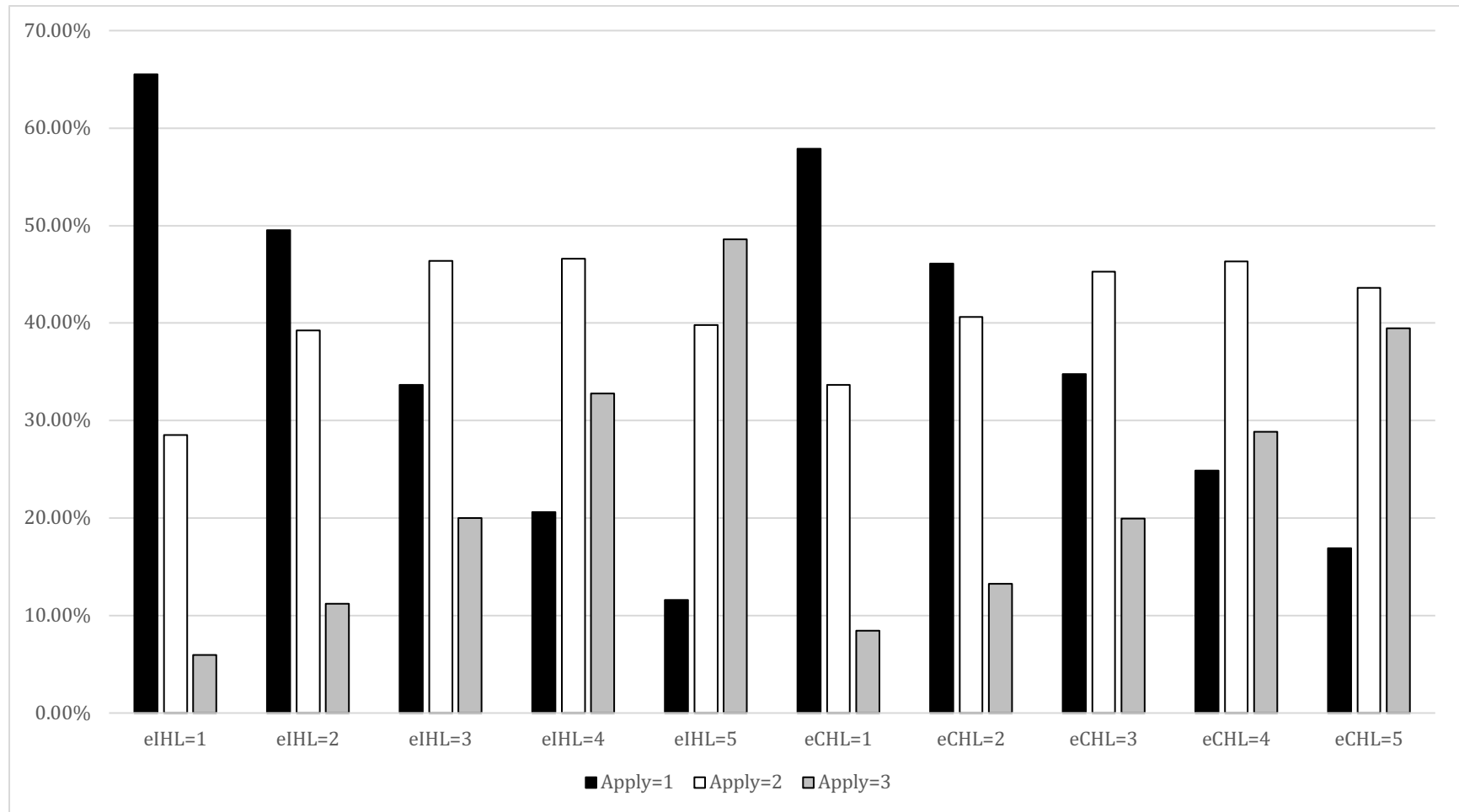


Figure 2.4 Predicted probabilities of confidence in applying health information on WeChat.

Confidence of applying health information on WeChat and appraise were re-coded as 1=strongly disagree or disagree, 2=neutral, and 3=agree or strongly agree.

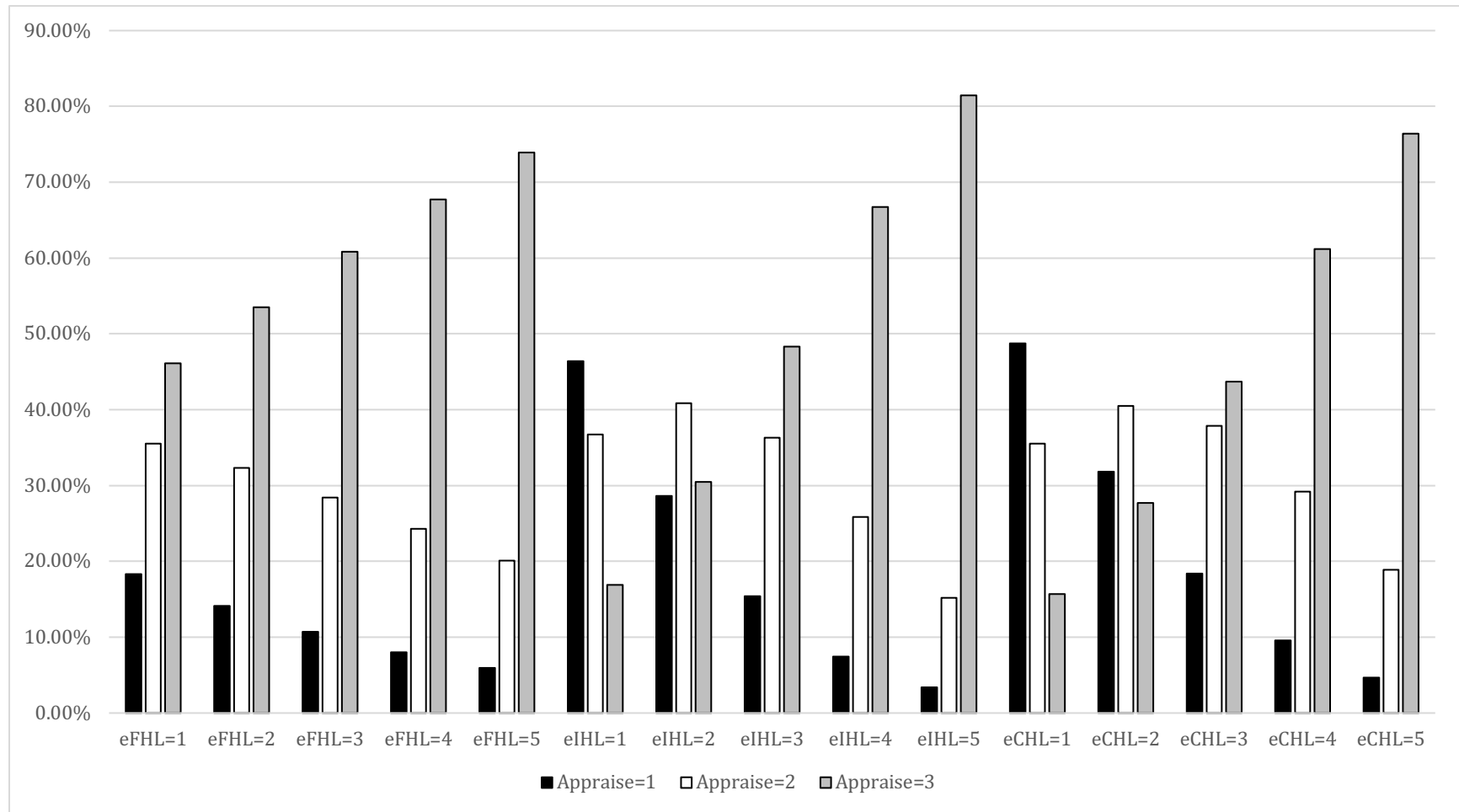


Figure 2.5 Predicted probabilities of confidence in appraising health information on WeChat.

Confidence of appraising health information on WeChat and appraise were re-coded as 1=strongly disagree or disagree, 2=neutral, and 3=agree or strongly agree.

2.8 References

- Alsop, R., & Heinsohn, N. (2005). *Measuring empowerment in practice: structuring analysis and framing indicators*. Washington, DC: World Bank.
- Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2018). *Thematic Analysis*. In: Liamputtong P. (eds) *Handbook of Research Methods in Health Social Sciences*. Singapore: Springer.
- Chen, J., Hou, X., Zhao, W., & Fu, Y. (2016). Users' perception and utility of health information based on WeChat. *Management Science and Engineering*, 10(3), 18-23.
doi://dx.doi.org/10.3968/n
- Chen, Q. (2017). *Reading the information in applications is like eating fast food": Motherhood and social media* (Master's Thesis) Available from Lund University Libraries. Retrieved from
<http://lup.lub.lu.se/luur/download?func=downloadFile&recordId=8906812&fileId=8916755>
- China Internet Network Information Center. (2017). *2016 年中国社交应用用户行为研究报告 [2016 China social app user behavior research report]*. Beijing: China Internet Network Information Center. Retrieved from
<https://cnnic.cn/hlwfzyj/hlwxbzg/sqbg/201712/P020171227483413972757.pdf>
- China Internet Network Information Center. (2018). *第 41 次中国互联网发展状况统计报告 [The 41st China statistical report on Internet development]*. Beijing: China Internet Network Information Center. Retrieved from
<http://www.cnnic.net.cn/hlwfzyj/hlwxbzg/hlwjtbg/201801/P020180131509544165973.pdf>
- Chou, W. S., Oh, A., & Klein, W. M. (2018). Addressing health-related misinformation on social media. *Jama*, 320(23), 2417-2418.
- Fredriksen, E. H., Harris, J., & Moland, K. M. (2016). Web-based discussion forums on pregnancy complaints and maternal health literacy in Norway: A qualitative study. *Journal of Medical Internet Research*, 18(5), e113. doi:10.2196/jmir.5270
- Gan, C., & Li, H. (2018). Understanding the effects of gratifications on the continuance intention to use WeChat in China: A perspective on uses and gratifications. *Computers in Human Behavior*, 78, 306-315.
- Gao, L., Larsson, M., & Luo, S. (2013). Internet use by Chinese women seeking pregnancy-related information. *Midwifery*, 29(7), 730-735.
- Goh, E. C., & Kuczynski, L. (2010). 'Only children' and their coalition of parents: Considering grandparents and parents as joint caregivers in urban Xiamen, China. *Asian Journal of Social Psychology*, 13(4), 221-231.

- He, A. J. (2014). The doctor–patient relationship, defensive medicine and overprescription in Chinese public hospitals: Evidence from a cross-sectional survey in Shenzhen city. *Social Science & Medicine*, 123, 64-71.
- Hsu, W., Chiang, C., & Yang, S. (2014). The effect of individual factors on health behaviors among college students: the mediating effects of eHealth literacy. *Journal of Medical Internet Research*, 16(12), e287. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/25499086>
- Jiang, T. (2016). 影响卫生政务微信平台健康传播效果因素探究 [What factors influence the impact of health communication by WeChat public health official accounts]. *Guangzhou 10th Health Education Academic Symposium*, Guangzhou. 157-159.
- Li, W. (2017). 健康谣言在微信平台传播的成因探析 [Exploring the cause of widespread health rumors on WeChat platform]. *Journal of Western Radio and Television*, (15), 12-13.
- Li, X. (2016). 微屏时代谁在传播健康? ——对微信平台健康养生信息兴起的传播学分析 [Who is spreading health information at the age of micro screen? -- An analysis of the communication of health information on WeChat platform]. *Modern Communication: Journal of Communication University of China*, (4), 21-26.
- Liu, Y. (2016). 健康类微信公众号主体分析 [Analysis on Health WeChat Official Accounts]. *Shanxi Science and Technology*, 31(5), 120-122.
- Lupton, D. (2017). ‘It just gives me a bit of peace of mind’: Australian women’s use of digital media for pregnancy and early motherhood. *Societies*, 7(3), 25.
- National Health and Family Planning Commission. (2017). 2017 年 1 月全面两孩政策工作进展专题新闻发布会文字实录 [January 2017 Progress of Full-scale two-child policy press conference transcript]. Retrieved from <http://www.nhfpc.gov.cn/zhuz/xwfb/201701/7ea4318bf0f7450aaf91d184e02e5dcf.shtml>
- National Health Commission. (2019). 健康中国行动 (2019—2030 年)[The Healthy China Action (2019-2030)]. Retrieved from <http://www.nhc.gov.cn/guihuaxxs/s3585u/201907/e9275fb95d5b4295be8308415d4cd1b2.shtml>
- Norman, C. D., & Skinner, H. A. (2006). eHealth literacy: essential skills for consumer health in a networked world. *Journal of Medical Internet Research*, 8(2), 1-11. doi:10.2196/jmir.8.2.e9
- Nutbeam, D. (1998). Health promotion glossary. *Health Promotion International*, 13(4), 349-364. doi:10.1093/heapro/13.4.349

- Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15(3), 259-267.
- Poushter, J. (2016). *Smartphone ownership and Internet usage continues to climb in emerging economies*. Retrieved from <http://sl.pulso.cl/wp-content/uploads/2016/02/2258581.pdf>
- Prescott, J., & Mackie, L. (2017). "You sort of go down a rabbit hole...You're just going to keep on searching": A qualitative study of searching online for pregnancy-related information during pregnancy. *Journal of Medical Internet Research*, 19(6), e194. doi:10.2196/jmir.6302
- Qi, X., & Melhuish, E. C. (2017). Early childhood education and care in China: History, current trends and challenges. *Early Years*, 37(3), 268-284.
- Sayakhot, P., & Carolan-Olah, M. (2016). Internet use by pregnant women seeking pregnancy-related information: a systematic review. *BMC Pregnancy and Childbirth*, 16(1), 65.
- Tang, Z., Wang, F., & Fu, H. (2014). 高校学生电子媒介健康素养量表的编制及评价 [Development and assessment on the eHealth Literacy Scale for college students]. *Chinese Journal of Health Education*, 30(1), 35-38.
- Tencent. (2019). 腾讯公布 2019 年第一季度及中期业绩 [Tencent releases its first quarter and interim performance in 2019]. Retrieved from <http://www.tencent.com/zh-cn/articles/15000771557911821.pdf>
- Wu, Q., Ye, X., Wu, Y., Zhao, L., & Wu, J. (2017). 全面健康素养测量量表的汉化及信效度分析 [The Chinesization of All Aspects of Health Literacy Scale and Its Reliability and Validity]. *Chinese General Practice*, 20(10), 1229-1233.
- Zhang, P., Ding, J., Chen, Z., & Zhang, C. (2010). 2009 年 2 045 名中国儿科医生循证医学知晓度横断面调查 [A cross-sectional survey on awareness of evidence-based medicine in 2,045 Chinese pediatricians in 2009]. *Chin J Evid Based Pediatr*, 5(3), 172-179.
- Zhang, X., Wen, D., Liang, J., & Lei, J. (2017). How the public uses social media WeChat to obtain health information in china: a survey study. *BMC Medical Informatics and Decision Making*, 17(Suppl 2), 71-79. doi:10.1186/s12911-017-0470-0

CHAPTER 3

IMPACT OF A WECHAT DELIVERED INTERVENTION ON CHINESE MOTHERS' HEALTH LITERACY AND EHEALTH LITERACY: A MIXED METHODS STUDY

3.1 Abstract

Background: Chinese women who are at reproductive age, overall, have a less than optimal health literacy levels. Efforts has been made to improve health literacy in this population, however, the focus of these interventions was primarily on functional health literacy. WeChat is a promising social networking app that may be used as a tool to deliver interventions and improve interactive and critical health literacy in this population.

Objectives: To evaluate the impact of a WeChat delivered intervention designed to improve Chinese mothers' health literacy, eHealth literacy, and use of health information on WeChat.

Methods: Using a mixed methods approach, we conducted a randomized controlled trial among 389 women to evaluate the impact of the intervention using pre- and post- questionnaires. Two online focus groups were held with 16 women who completed the intervention to further explore how it impacted their health literacy and use of health information.

Results: Quantitative results indicated that the intervention significantly improved mothers' confidence of appraising health information they found on WeChat. Qualitative results suggested improved functional, interactive and critical health literacy. Improved health literacy skills empowered mothers to make decisions that lead to desired health outcomes in their children. Empowered individuals had positive influences on the people around them by sharing quality information.

Conclusions: WeChat-based interventions have the potential to improve functional, interactive, and critical health literacy skills among women with young children. Promoting all categories of health literacy may improve personal and community health outcomes.

3.2 Introduction

Health literacy is the “cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health” (Nutbeam, D., 1998) (p 357). With the increasing popularity of obtaining health information from online sources, the concept of eHealth literacy has been developed to describe health literacy skills that are relevant to electronic sources specifically. Norman and Skinner defined eHealth literacy as “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem” (Norman & Skinner, 2006).

The three-category model of health literacy was developed by Nutbeam (2000). *Functional health literacy (FHL)* refers to basic reading, writing and numeracy skills that enable individuals to understand factual health information and navigate the health system (e.g., correctly read or understand words). *Communicative/interactive health literacy (IHL)* refers to the ability “to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances” (e.g., correctly interpret complex information). *Critical health literacy (CHL)* refers to the ability “to critically analyze information, and to use this information to exert greater control over life events and situations” (e.g., evaluate quality of information) (Nutbeam, 2000). (p 263-264). A few measurement tools have been developed to assess the three categories of health literacy and eHealth literacy (Chinn & McCarthy, 2013; Hsu et al., 2014; Ishikawa et al., 2008).

Empowerment is a concept that is closely connected to health literacy but was rarely addressed together with health literacy (Crondahl & Eklund Karlsson, 2016). Empowerment was defined by the World Bank as “a person’s or group’s capacity to make choices and transform those choices into desired actions and outcomes” (Alsop & Heinsohn, 2005) (p 5) and by the World Health Organization as “a process through which people gain greater control over decisions and actions affecting their health” (Nutbeam, 1998) (p 354). These definitions indicate

that health-promoting decisions and actions are the keys of empowerment. Health literacy is critical to empowerment by improving people's access to and effective use of health information (Nutbeam, 2000). Smith & Carbone (2019) pointed out that critical health literacy is the intersection between health literacy and empowerment: while FHL is not sufficient in developing empowerment, CHL and empowerment enables actions on information for personal and community benefits. IHL has an important role in the process of becoming empowered because it involves participation or action, which is the key of empowerment (Carbone & Smith, 2019).

Women's health status and understanding of health information directly impact their health and that of their children before conception, during pregnancy, and during the formative years (Ferguson, 2008). With the goal of improving the health of mothers and children, in 2012 the Chinese government started to promote maternal and infant health literacy among Chinese mothers. However, both the educational materials and evaluation tools developed only focused on clinically-oriented maternal and infant health-related knowledge and concepts (National Health and Family Planning Commission, 2012; Zhang, R. et al., 2011). Using these tools, an overall low to adequate health literacy level (from 1.52% to 31%) and low accuracy in answering questions on different aspects of maternal and infant knowledge (from 39.0% to 73.15%) were observed in multiple studies (Feng, 2013; Zhang, L. et al., 2015; Zhang et al., 2011; Zou et al., 2013).

However, functional, interactive, and critical health literacy and eHealth literacy skills have not been systematically assessed in Chinese women. Our assessment of the three categories of health and eHealth literacy indicated overall less than optimal status in Chinese women with young children (Chen, Q., et al., 2019).

Efforts have been made to promote health literacy and eHealth literacy in different populations. For instance, Ohnishi (2005) and Lv (2012) focused on improving health literacy among 124 pregnant women in Paraguay and 3,500 pregnant women in China, respectively. However, these two studies employed a one-arm intervention design; therefore, the improvements

in health literacy from pre- to post-intervention cannot be solely attributed to the health education. Huang (2014) used a stronger RCT study design and found that group-based interactive prenatal classes were more effective in improving health literacy as compared to lecturing among 90 pregnant Chinese women. However, tools used to measure health literacy in all three studies focused only on women's knowledge, and only functional health literacy skills were examined. Xie (2011) explored the strategies of improving eHealth literacy. Although older adults were the targeted population in their research, some of the intervention modules such as using a reliable website with high-quality health information, and skill-building related to online health information appraisal appeared to be effective in improving eHealth literacy.

In 2016, it was estimated that 94% of the Chinese people between 18 to 34 years old owned a smartphone (Poushter, 2016). Cellphone-based interventions have also been developed to improve health literacy. Zhuang (2016) compared the effectiveness of health education delivered by short message service (SMS) and by traditional channels such as bulletin boards, posters, and lectures among 6,413 Chinese urban citizens. Their results showed significant improvement in health literacy among those who received SMS but not in those who received traditional health education. Smartphone apps were also used to deliver interventions. WeChat is the most popular social networking app in China. According to the company who developed the app, WeChat had 1.11 billion monthly active users as of March 2019 (Tencent, 2019). Users can send instant messages, create group chats, make audio or video calls, post photos and videos to share with friends, make payments, and obtain information generated by numerous official accounts. Compared to SMS, which can deliver only relatively short messages in the format of text, WeChat also allows multimedia messages and group communications. Zhang (2017) conducted an RCT among 463 Chinese college students and showed that intervention messages delivered by the WeChat app significantly improved students' health literacy. However, only functional health literacy was measured in these two studies. Whether cellphone-based interventions can improve interactive and critical health literacy has not been studied.

Intervention studies using WeChat to improve health literacy among women of reproductive age were not found, however, various interventions have been carried out using WeChat as a platform among this population and showed promising results in improving clinical outcomes such as increasing breastfeeding rates, decreasing depression, and decreasing anxiety levels (Hong et al., 2017; Xia, 2017; Yi et al., 2017).

We developed and implemented a WeChat-based health literacy intervention for Chinese mothers with young children to improve functional, interactive, and critical health and eHealth literacy. The purpose of this study was to evaluate the impact of a WeChat-based intervention on Chinese mothers' health literacy, eHealth literacy, and use of health information from WeChat.

3.3 Methods

3.3.1 Development of the intervention

We first established six intervention topics based on the definition of health literacy, eHealth literacy, and the expected challenges faced by Chinese mothers with young children. Emphasis was placed on interaction and critical health literacy skills. We presented the six topics to 20 Chinese mothers with young children and interviewed them regarding content, format, and delivery of the intervention. All six topics were retained based on feedback expressed by the interviewees. No new topics relevant to health literacy were suggested during the interviews. The interviewees did not want to read very long articles; therefore, we developed 12 lessons to cover the six topics and limited the time needed to complete each lesson to under 10 minutes. Note: Based on feedback from the pilot tests, each topic was referred to as a "lesson;" therefore, this term will be used throughout this article. The content of each lesson was adapted from credible sources such as the American Academy of Pediatrics and the National Institutes of Health and were approved by all authors. Up to five activities were developed based on the content of each lesson to foster learning. The first author translated the intervention lessons from English to Chinese. The Chinese version of the lessons was reviewed by two Registered Dietitians (RD)

(first language Chinese) and three Chinese mothers with young children. Modifications to the wording and flow of the lessons were made based on their feedback. We decided to deliver the 12 lessons on every Wednesday and Sunday evening over six weeks based on the preferred frequency and time of delivery suggested by the interviewees. The contents of the intervention lessons are shown in Table 3.1.

3.3.2 Study design

We used a mixed methods approach in this study. A randomized controlled trial was used to evaluate the impact of the intervention on health literacy, eHealth literacy, and use of health information on WeChat as measured by pre- and post- questionnaires. We also conducted online focus group discussions with a subgroup of participants who completed the intervention to further explore how the intervention impacted them. An overview of the study is presented in Figure 3.1.

The intervention and all relevant materials were approved by the University of Massachusetts Amherst Institutional Review Board.

3.3.3 Participants and recruitment

Inclusion criteria for participation in the intervention were: 1) female, 2) currently living in mainland China, 2) older than 18 years, and 3) having at least one child between 0 and 3 years old at the time of recruitment. Online advertisements were posted to the first author's WeChat Moments, 30 WeChat groups, and other online maternal communities. Viewers were invited to repost the recruitment ad to their social networks and friends. To encourage participation, we offered to invite women who completed the pre-questionnaire to join a WeChat nutrition group and receive free nutrition advice by two RDs and the first author as incentives. Interested individuals were invited to friend the author on WeChat. An online screening form with three questions (age, gender, and if they have a child under 3 years old) was sent once an interested participant added the author as a friend on WeChat. All eligible participants who completed the pre-questionnaire were invited to join a WeChat nutrition group. However, they have the option to decline the invitation, but still be a part of the study. We aimed to reach a baseline sample of

300 to ensure adequate power in statistical analysis. During the enrollment period, participants were allowed to ask nutrition related questions in the WeChat group and the RDs answered questions daily. The RDs were instructed to only give fact-based answers related to nutrition and not to discuss information that would be covered in the intervention lessons.

3.3.4 Randomization

Once an ideal sample size was reached, stratified randomization was used to create intervention and control groups. The WeChat nutrition group members were randomized into either the intervention or control WeChat nutrition groups. Participants who filled out the pre-questionnaire but did not accept the invitation to join the WeChat nutrition group were also randomized into control or intervention groups. Since new participants continued to contact us to join the study, we kept the enrollment open until the last intervention lesson was delivered. A pre-generated randomization list was used to assign participants who joined after the initial randomization into either control or intervention group. Invitations to join either the control WeChat nutrition group or intervention WeChat nutrition group were also sent to all new participants.

3.3.5 Intervention delivery

The 12 intervention lessons were sent individually from the first author to intervention participants in WeChat every Wednesday and Sunday around 8:00 pm from February 17 to March 27, 2019. Participants were encouraged to ask the first author any questions. If they were members of the WeChat intervention group, they were also encouraged to discuss the lessons in the group with other participants and the RDs. To avoid potential contamination, the intervention group was instructed not to share the lessons outside of the WeChat intervention group except for their family members during the study period. Meanwhile, intervention participants could still ask the RDs and the first author nutrition-related questions in the intervention WeChat group or individually. Completion of the exercises was tracked throughout the intervention, and reminders were sent to those who had not completed the exercises. To encourage participation, incentives

were provided half way through (5 CNY or 0.74 USD upon completion of the first six lessons) and (5 CNY or 0.74 USD) at the end of the intervention when all 12 lessons were completed. Zhang et al. (2017) also used the WeChat social network to collect online surveys and they successfully collected over 1,500 surveys by offering an average monetary incentive of 1 CNY (0.15 USD) per person. The amount of incentives of our study was decided based on their successful experiences, the expected time commitment of the participants, and the available funding.

The control group did not receive any intervention lessons during the intervention period. They were able to ask the RDs in the WeChat group or the first author any nutrition-related questions throughout the study period. Answers were limited to nutrition facts only. Upon completion of the post-questionnaire from all participants, the control group received the intervention lessons from the first author. At that point, both intervention and control group participants were encouraged to share the intervention lessons with their friends and family.

3.3.6 Quantitative measures

Quantitative data collection was completed using an online survey tool called Sojump. Sojump is the largest online survey platform that has been widely used by research institutions in China (<https://www.wjx.cn/>). Pre- and post-intervention questionnaires were collected for all participants. Both questionnaires included questions that assessed health literacy, eHealth literacy, and the use of health information on WeChat. Personal and demographic data were only collected in the prequestionnaires. Additional questions measuring intervention participation were added to the post-questionnaire for the intervention group. Both control and intervention participants were provided 5CNY (or 0.74 USD) for completing the post-questionnaire.

Health literacy

Health literacy was measured using the Chinese version of the All Aspects of Health Literacy Scale (AAHLS) (Wu et al., 2017). AAHLS measures Nutbeam's three categories of health literacy and has been validated in the Chinese population. This tool includes three items on

functional health literacy, three items on interactive health literacy, and four items on critical health literacy. Responses were measured on a 3-point Likert scale (rarely, sometimes, often).

Empowerment

Four questions were modified from the World Bank's Draft National Survey on Empowerment Module (Alsop & Heinsohn, 2005) and were used to measure women's perceived control over decisions related to their health and their children's health when interacting with health care providers and family members. These four questions were pilot tested among five Chinese mothers who were not participants of the study to ensure face validity. Responses were measured on a 4-point Likert scale (1= "not at all", 2= "to a small degree", 3= "to a fairly high degree, and 4 = "to a very high degree").

eHealth literacy

eHealth literacy was measured using questions modified from the eHealth Literacy Scale (eHLS) (Hsu et al., 2014). eHLS has three items measuring functional eHealth literacy (eFHL), four items measuring interactive eHealth literacy (eIHL), and five items measuring critical eHealth literacy (eCHL). Possible response options were measured on a 5-point Likert scale ("strongly disagree", "disagree", "neutral", "agree", and "strongly agree"). eHLS was developed in traditional Chinese and validated in Taiwanese. Due to the different language habits between Taiwan and mainland China, items were modified by the first author to suit the language of the targeted population in this study. The modified eHLS was pilot tested among five Chinese mothers who were separate from the study participants to ensure face validity.

Use of health information online

Questions related to the use of health information on WeChat were developed by the authors based on the functionality of the WeChat app, and the characteristics of health information on WeChat. Four items were developed to measure frequency of obtaining and sharing health information, and confidence in appraising and applying health information from WeChat (Gan & Li, 2018; Tang et al., 2014; Zhang et al., 2017): (1) How often do you find

health-related information through WeChat? (2) How often do you share health-related articles with others on WeChat? (3) I feel confident using health-related information from WeChat to make health decisions. (4) I can tell high quality health resources from low quality health resources on WeChat. A 5-point Likert scale was used to measure the response to each item (1=never to 5=always, or 1=strongly disagree to 5=strongly agree). Each of these items was pilot tested among 5 Chinese mothers who were not part of the study and face validity was ensured. These four items were referred to as “obtain”, “share”, “apply”, and “appraise”.

Personal and demographic factors

Participants’ ages, number of children, ages of children, household income, education level, occupation (unemployed, health-related jobs, or other jobs), involvement in WeChat business, marital status, pregnancy status, registered residency (urban or rural), geographic location, preferred type of medicine (Traditional Chinese Medicine (TCM) or Western medicine), and time caregivers spent taking care of the children were measured by the questionnaire.

Intervention participation

For intervention participants, the following questions were added to the post-questionnaire to obtain additional information regarding their participation: *Have you read this lesson (lesson 1-12)?* Response options included “yes,” “no,” or “don’t remember.” The following open-ended question was also included: *For the lessons you have read, what comments do you have?*

Statistical analysis

All responses to Likert scale items were coded as 1-3, 1-4, or 1-5 depending on the number of response options. Items were coded so that a higher number represented a higher level of literacy skills or empowerment. Items measuring the same construct were averaged. For example, the mean was computed from the four questions measuring empowerment (item 11-14 in Table 3.4). Means and standard deviations were used to summarize the distribution of continuous variables; frequencies and percentages were used to summarize categorical variables.

Multiple linear regression was used to examine the impact of the intervention on different categories of health literacy and eHealth literacy post intervention after controlling for health literacy pre-intervention and selected covariates. Longitudinal ordinal logistic regression was used to examine the impact of the intervention on the use of health information on WeChat. Predicted probabilities were calculated to help interpret the longitudinal ordinal logistic regression results. Data management and statistical analyses were performed using the SPSS Version 25 and Stata Version 15. The significance level was set at $p < 0.05$. Additional analysis was performed to compare the characteristics of those who completed the intervention and those who were lost to follow-up. Subgroup analysis was conducted to explore the impact of the intervention on those who had lower health literacy at baseline.

3.3.7 Online focus groups

Online focus groups have been increasingly used in social science and health science research and they have the unique capabilities such as remote access, asynchronous setting, and text-based nature (Reisner et al., 2018; Stewart & Williams, 2005). To find out the experiences of the intervention participants and to accommodate the different geographic locations of the participants, we adopted online focus groups in our study. Invitations were sent to active intervention participants (who left a comment in the follow-up questionnaire or completed most intervention lesson exercises within one day after receiving them). We offered a 30 CNY (\$4.40 USD) incentive for participation. Those who agreed to participate were randomly assigned to one of the two focus groups. Both focus groups were moderated by the first author and one RD, and conducted in Chinese. The focus groups were held virtually in WeChat groups in an asynchronous manner to accommodate difference geographic locations and time availabilities of the participants and the researchers. The length of the focus group was planned to last up to two weeks, and the active participation time was expected to be less than one hour. A semi-structured focus group guide was developed (Figure 3.2) and used by the moderators to guide the discussion. Every day in the first five days of the online focus group discussion, two to three

questions were posted in the group. Participants were encouraged to answer the questions whenever they had time. The moderators sent responses to each answer to acknowledge participation, and asked follow-up questions for more details or clarification. Reminders were sent to participants who had not answered the questions in the previous days by tagging them in the group (they would receive a special notification if someone in the group sent a message with @their name). After no more comments or responses were sent in five consecutive days, focus groups were ended by the moderators.

All focus group discussion data were in the form of text saved in the WeChat app as group chat history. All discussion history was transferred to a computer and managed in NVivo 12. Data were analyzed in Chinese using thematic analysis (Braun et al., 2018). Nutbeam's definition of the three categories of health literacy was used as a guide to code the data and identify themes (Nutbeam, 2000). Themes and representative quotes were translated into English by the first author.

3.4 Results

3.4.1 Quantitative results

Participant characteristics

A total of 401 eligible mothers filled out the pre-questionnaire between August 2018 and March 2019. At randomization, 12 participants deleted or blocked the first author and therefore could not be included in the intervention. At baseline, a total of 190 participants were randomly assigned to the intervention group, and 199 were randomly assigned in the control group. A total of 240 mothers completed pre- and post-questionnaires, including 117 from the intervention group and 123 from the control group that were collected between April 8 and 15, 2019 (Figure 3.1). Only participants with complete pre- and post-data were included in the analysis.

Control and intervention participants' characteristics are presented in Table 3.2. Most of the participants were married (>98%), not pregnant (>93%), and not involved in WeChat business

(>86%), had only one child (>78%), had a bachelor's or higher degree (>75%), and urban residency (>68%). Their household monthly income was mostly between 5,000 and 20,000 CNY (equivalent to 727 – 2,908 USD). Their average age for the mothers and the children were 30-31 years old, and 31-41 months old. The participants received considerable amount of help from their parents in childcare (5.5-6.7 hours/day). The control and intervention groups were not significantly different at baseline except for their preferred type of medicine ($p=0.047$).

Intervention and control participants' health literacy, empowerment, eHealth literacy, and use of health information from WeChat pre- and post-intervention are presented in Tables 3.3 to 3.6.

Impact on health literacy, empowerment, and eHealth literacy

Results from multiple linear regression analysis are shown in Tables 3.7 and 3.8.

Having health-related jobs, higher household income, and higher pre-intervention FHL were significant predictors of higher post-intervention FHL; however, the intervention did not impact the post-intervention FHL after controlling for the pre-intervention FHL, age, children's age, education, occupation, household income, and residency. (Table 3.7)

Pre-intervention IHL, CHL, and empowerment were the only significant predictors of post-intervention IHL, CHL, and EMP, respectively. The intervention did not change the post scores of these outcomes after controlling for the pre-scores, age, children's age, education, occupation, household income, and residency (Table 3.7).

All categories of post-intervention eHealth literacy were strongly related to pre-intervention eHealth literacy. A child's age negatively predicted post-intervention eFHL, eIHL, and eCHL. Having a master's degree positively predicted eFHL and eCHL. Having a health-related job positively predicted eFHL and eIHL. Household income was only positively related to post-intervention eCHL. And being unsure about residency status was positively related to post-intervention eIHL. However, the intervention did not have a significant impact on any categories of eHealth literacy post-intervention (Table 3.8).

Impact on the use of health information on WeChat

Due to the small number of participants in the lowest and the highest categories of the responses to the four questions measuring the use of health information on WeChat (Table 3.6), the response categories were collapsed from 1-5 to 1-3, where the lowest two categories and the highest two categories were combined. The three-level coding of these four variables was used in the longitudinal ordinal logistic regression models.

The intervention did not have a significant impact on the frequency of obtaining, sharing, or in the confidence in applying health information on WeChat (Table 3.9). However, the interaction term of intervention and time (pre-, post-intervention) significantly increased women's confidence in appraising health information from WeChat ($B_{\text{Intervention} \times \text{Time}} = 0.766$, $p < 0.05$) (Table 3.7).

Figure 3.3 shows how the probabilities of being in each level of appraising health information (1-3) on WeChat changed as we varied the intervention condition and time pre- and post-intervention and held the other variable at their means. The predicted probability of being in the lowest category of appraisal was 13% for the control group at baseline and 17% post-intervention. For the intervention group, the predicted probability of being in the lowest category of appraisal was 15% pre-intervention and 11% post-intervention. For the highest category of appraisal, the predicted probabilities were 60% at pre- and 53% post-intervention for the control group, and 56% at pre- and 64% post-intervention for the intervention group.

3.4.2 Qualitative results

We sent invitations to 66 women who were active intervention participants. A total of 20 women agreed to participate within three days of receiving the invitation and 16 women actually participated in the focus group discussion. Participants' characteristics are presented in Table 3.11. Five participants were doctors or had other health-related jobs (FG1P4, FG1P5, FG1P6, FG1P8, FG2P5). All of the focus group participants joined the intervention WeChat nutrition group.

Impact on FHL and eFHL

Some participants improved their ability to read and understand food labels.

...especially food product ingredients. Given any product, [my] first reaction is to read the ingredients list. I have also shared this [method of reading food labels] to my friends, especially pregnant women. (FG1P5, health-related job)

The most obvious improvement was that I learned how to read the ingredients list and I am not obsessed with big brands any more. (FG2P8)

[I have learned] to read the ingredients list of a food product before making purchases. (FG2P3)

Impact on IHL

Several participants did not improve their communication skills with family members and doctors because they did not think they had any communication issues to begin with.

My occupation is related to public health, so I don't have much problem evaluating the credibility of health information or communicating with doctors and families. Therefore, I did not benefit much from the relevant lessons. (FG1P6, health-related job)

[I] did not have any apparent change in skills of communication. My family does not have communication problems. (FG1P3)

Some participants gained communication skills so that they were able to prioritize their issues and better extract and convey health information in their interactions with healthcare providers.

My favorite was "Lesson #7 How do I make the most out of a clinical appointment with my child's doctor?" The examples provided in the lesson made me realize how inadequate my communication skills were when talking to my child's doctor. The section of "how to ask doctors questions" helped me sort out the questions I always

wanted to ask, but was too scared to ask, or didn't know how to ask. This article is very helpful! I read it over and over again, made notes, and shared it with my partner. Two-hour waiting time and only five minutes with the doctor. This guideline significantly improved the efficiency of the precious five minutes of time. (FG2P7)

Going to the hospital has always been hectic. The doctors' offices are always crowded in China, there is no privacy. [I used to] give a simple answer whenever the doctor asked me questions and would remember questions I forgot to ask after I left the office. I was very anxious. Now I would think through my priorities, wrote down the questions I want to ask in my phone in case I forget. I feel much relaxed when communicating with doctors now, and I always know what to do next after the visit. (FG2P6)

Some participants indicated that they were communicating more effectively with family members when discussing health-related issues. As result, family relationships were in greater harmony, and the participants said they felt less stressed.

Communicating health-related issues with family members are not as difficult as before. [I] am now much more patient. (FG2P4)

...whenever my husband brought up any ideas about child-rearing that were different than mine, my first reaction was to prove him wrong and convince him to accept my idea. Because I am the doctor and he is not. With this mindset, it was very easy to cause argument. I am starting to face this issue of mine and trying to make a change. After learning of the lessons, I am able to not get into a dead end and to provide the latest credible evidence for our whole family to learn together. (FG1P8, health-related job)

I have made great efforts in learning how to raise a child. Therefore, I used to send good articles to my husband or parents as I was the authority. However, they wouldn't necessary read [the articles I sent]. There are still conflicts between us and the older generation in concepts of child-rearing. Now I am trying to show my weaknesses

and divide the tasks [with the older generation]. I have changed the way of expressing myself and it has been working well! My parents feel that they are respected, my husband can also participate in childcare free of pressure. I also feel lots of weight off my shoulder! For example, I used to tell my husband “Don’t eat any more meat!” because he is fat and I didn’t want him to eat too much meat. Now I would be gentler and say “Eating too much meat is not good for your health. You are the backbone of the family and we need you to be healthy. Eat more vegetables and set a good example for our baby” ... (FG2P6)

However, for some participants, communication with family members was still a challenge and the strategies provided in the intervention lessons were not well suited for their situations.

[I] feel lesson 9 [How do I communicate with other family members about my child’s health?] was not very helpful. In China, most mothers are raising their children as if they are single mothers [even if they are not]. There is almost no need to communicate. The dad is usually not involved at all while the paternal grandma steps in. Grandma uses her outdated methods that are sometimes unscientific. It’s easy to cause a lot of family conflicts. A lot of mothers quit their jobs and take care of their child full-time just to avoid the conflicts...Raising a child is the business of the whole family’s. It is not easy to change the current situation. (FG1P1)

I personally did not like lesson 9 that much. It was not so useful to me. I usually have the final say about decisions related to the baby. I have my own way of communication when other family members have different opinions. I did not learn anything that’s particularly effective. I think each family has their own ways of communication. Your lesson may be helpful to some families. However, I think most of the older generations are too stubborn and would not accept these ways of communication. 😊 (FG1P3)

Impact on CHL

Most focus group participants increased their information appraisal skills by learning how to apply the evaluation methods that were introduced in the intervention lessons.

How to evaluate the credibility of health information from online encyclopedia and WeChat official accounts was very helpful to me. I used to search online for answers whenever I had a question, however, it never came to my mind that the information online could have been edited by anyone or could be unreliable. I also like to obtain information from WeChat official accounts and used to believe whatever I read. After learning the lessons, I fell into the habit of paying attention to the source of information, whether the information has been approved by authorities, and if there is any marketing intentions....I am no expert, but I am confident that I can tell high from low quality [health information] now. (FG1P7, unemployed)

I now have stronger ability to evaluate the health information online. I used to rely on my remaining medical knowledge [learned from school] to make judgement. Now my first reaction is to look for author information and sources, if that's not reliable, I would ignore the content directly. Your lessons were successful! 🍊 (FG1P6, health-related job)

Some participants starting using higher quality information sources as suggested by the intervention lessons; other participants stated that they were using more caution before adopting information from various sources.

Before the learning process, I tend to prefer Baidu and some WeChat official accounts for health information. Now I prefer to use Dingxiang Doctor and Yihe Health [Relatively Credible WeChat official accounts specialized in health education introduced in intervention]. I would also consult in WeChat groups organized by doctors by asking the doctor directly. When there is an emergency, I would go to hospital... I used to be

skeptical about the credibility of health information, I would check if it was exaggerating. Now I pay more attention to the source of an article, the background of the author, author's intention, and timeliness of the information. [I] am more confident in differentiating high from low quality information. (FG2P6)

There are so many accounts online, which requires mothers to carefully evaluate the information. Sometimes it's confusing, people are just repeating what others said. I used to ask questions in WeChat mothers' groups, and apply solutions based on what's worked for others. However, these solutions were mostly empirical, and may not be necessarily appropriate. (FG2P3)

I still use Baidu when I have questions. But now I am also likely to use Merck's Manual [introduced in the intervention] to search for results. For Baidu search results, I would critically evaluate them before accepting. (FG1P3)

Understanding the concept of evidence-based medicine and the quality of evidence, as well as finding out which doctor was practicing evidence-based medicine was a challenge for some participants.

The content [of lesson 10] was not very easy to understand, maybe I need to go over it again to better grasp the ideas. We should trust doctors who practice evidence-based medicine. However, when we visit doctors, we do not know how to tell if this doctor follows evidence-based principles. (FG2P4)

...how do you know which doctor is practicing evidence-based medicine, which is not? [I think] most mothers are not able to tell (FG1P3)

...I was able to understand [the information in lesson 10] because I studied a similar major [biology], but according to my experience, 80% of the mothers won't be able to understand the content. (FG2P7)

As mentioned by another mom, lesson 10 is challenging. In reality, I feel that I would act like a lot of other mothers, tend to prefer doctors who happen to have the same opinions as mine. (FG2P6)

Impact on empowerment

Some participants were already highly empowered in making health-related decisions for their children.

I have always been the one who makes decisions at home. When at a hospital, I will take doctors' advice, but I am still the one who makes the final decision. (FG1P5, health-related job)

[My empowerment] has not changed, I have always had great control. (FG1P2)

Some decisions at home were driven by careful evaluation of the consequences, which required mothers to have high level of IHL and CHL skills.

When making health-related decisions for my child at home, I would be softer and more willing to listen to what the older generation have to say. I would search my knowledge [to match their opinions] to my perceptions and try to make an agreement. The consequence of a decision is the major factor [for me to make the decision]. For example, when feeding my baby shrimp, I think offering whole shrimp would improve their chewing ability. After I told [my rationale] to my mother-in-law, she still wanted to feed them chopped shrimp. In this case I just let her feed them chopped shrimp. However, for [actions that may have] severe consequences, for example my mother wants to [put on more layers] on the baby to make them sweat when they have a fever, I would definitely stop her. (FG2P7)

Increased CHL lead to greater empowerment in health decision-making when seeking help from the healthcare providers.

...when my child had jaundice, the doctor said it might be due to breastmilk and suggested me to feed formula instead of breastfeeding. I ignored the doctor's advice and continued breastfeeding. One one-hand, I think it was not pathological and [continuing breastfeeding] would not have severe consequence; on the other hand, I also have evidence from books, e.g. American Academy of Pediatrics' Caring for your baby and young child. I trust the information on it. (FG2P7)

I used to mainly rely on doctor's examinations. Now I would raise different opinions to the doctors. For example, [objection of] universal screening of micronutrients deficiency (still required at the local hospital child growth clinic). I would also give more thoughts on medications, make sure [it is appropriate] before given to my child. (FG2P6)

I am more empowered. I think excessive treatment is common in China. For example, if the baby had a cold, I used to trust the doctors and gave him whatever medication prescribed. Now I would look up the medication [before giving it to my child]. I know that it needs his immune system to fight the virus. If he is comfortable, no medication is needed. (FG2P8)

Mothers' increased knowledge, FHL and CHL lead them to more informed decisions regarding food and supplement choices.

I think there is a change [in applying health information]. Not only from the intervention lessons, but also from the discussion in the WeChat nutrition group. For example, when I went to maternal and infant product stores and received recommendations of supplements, I thought whether it works or not, everyone else is taking it, I should not be saving money on this. Now I will not follow the others blindly. (FG1P3)

Before, when I read that for example fish is good for the baby, I would buy it for her immediately. Now I will consider the quality of what I read, if they are trying to sell

products (for example, I saw the account “Baby is hungry” is attacking handmade food products today, but their true purpose is to promote their own products. Dingxiang Doctor has a lot of articles like this). Now I would do my research on different types of fish (e.g. oilfish vs. cod), consider the place of origin, and nutrient benefits to my baby before making purchase. (FG2P6)

Promote healthier family and community

By sharing high quality health information and sharing strategies to improve health literacy, participants with high CHL started empowering people in their social networks to promote healthier families and communities.

My parents used to repost articles that were not so trustworthy. I used to tell them not to believe in those articles, however, I was not able to defend my suggestions. Now I know how to convince them. Those articles were not based on strong evidence and were low in quality. I am more knowledgeable and experienced in screening health articles now. (FG2P1)

My own ability [of communicating health information] has not changed too much. However, I have shared the lessons to my family members. It worked better than me trying to convince them. My parents and in-laws used to believe in products recommended by drug stores, business, relatives, and friends. They have been buying a lot of products. After learning the lessons, they are able to think critically! When I told them before, they were not convinced.[titter emoji] (FG1P4, health-related job)

When communicating with my friends, I used to share my own experiences. In addition to that, now I would search for articles from professional WeChat official accounts and share with them. I think this is more straightforward. I would also tell her how to evaluate the quality of the article at the same time. (FG2P6)

Some participants who might have been spreading low-quality health information to their social networks reported that they had begun disseminating high-quality health information and felt they may be having a positive impact on others' health.

I didn't know how to evaluate health information before. I thought that anything out there should be reviewed and would repost to my friends without thinking as long as I think it's right. Now I am much more cautious. (FG2P4)

I used to repost any health articles, including those with exaggerating titles, to my WeChat Moments so that more other mothers like me could also see them. Now after studying the lessons, I would first evaluate the quality of the article before reposting. I have formed this good habit. (FG2P3)

Several participants who were healthcare providers said they felt they might have a more positive impact on others, including their family, friends, and patients, after participating in the intervention.

I like to repost medical popular science articles written by my classmates to WeChat Moments. They are all qualified [doctors]. They are using their precious time to write articles not for fame or money. What I can do is to repost and make [the health information] available to more people who are in need. After learning the lessons, I became very cautious in evaluating health information. As a healthcare provider, I need to be the information screener for my family, friends, and patients. In addition, I hope your team can widely promote these lessons 🌹🌹🌹 ... (FG1P8, health-related job)

Impact of WeChat group

In addition to gaining skills regarding how to read and understand food labels, participation in the intervention WeChat nutrition group also increased participants' knowledge about nutrition and child feeding.

I think this group has been very helpful to me. [I have learned] to read the ingredients list before buying food products for baby, what [nutrients or ingredients] content should be low, what [foods] babies should and should not be eating. As an unexperienced new mom, I have learned a lot of knowledge about infant nutrition.

(FG1P3)

I have gained a lot of knowledge and have more options in child feeding now. [I have realized that] a lot of the things can be done differently, [for example,] babies can feed themselves after one. [I have also learned] type, amount, and frequency of food they can eat, etc. (FG2P8)

3.5 Discussion

We developed and implemented a WeChat delivered intervention among 240 Chinese women with children under 3 years old. Quantitative analysis showed that the intervention significantly increased mothers' confidence in their ability to appraise health information from WeChat. Qualitative analysis indicated improvements in FHL, IHL, and CHL in different participants. Increased health literacy skills also empowered mothers to make better health-related decisions for their children.

An increase in health knowledge and functional health literacy skills, specifically the ability to understand food labels, was observed in some of the focus group participants. The intervention lessons did not have specific content covering these topics; therefore, participants might have gained their skills from being a member of the WeChat nutrition group. Questions related to breastfeeding, complementary feeding, and choice of foods for young children were most frequently asked by the WeChat nutrition groups. Both intervention and control groups were invited to join the nutrition groups; however, we did not see an increase in FHL or eFHL for either group from pre- to post-intervention (Table 3.3 and 3.5). Since some participants in the focus groups indicated high FHL skills before intervention, we conducted subgroup analysis

including those with lower pre-intervention health literacy skills only (below the 50th percentile). Results showed that both intervention and control group participants with lower FHL or eFHL had improvements after the intervention (Table 3.12). Our findings suggest that participation in online discussion with peers moderated by healthcare professions may have a positive impact on mothers' health knowledge and functional health literacy skills and eHealth literacy skills, especially for mothers with lower FHL or eFHL. These findings are in keeping with Fredriksen et al. (2016) who reported that women using web-based discussion forums increased their health-related knowledge and competencies. Other interventions utilizing the WeChat platform to deliver prenatal health education among pregnant women in China were also successful in improving maternal knowledge (Hong et al., 2017; Li, Y. & Liu, 2015; Xia, 2017; Yi et al., 2017).

While some participants reported having no problems communicating with healthcare providers; others reported improving their communication skills with healthcare providers as a result of participating in the focus group discussion. Patients in large hospitals in China have reported being dissatisfied with the long wait times, bad attitudes of health workers, and high cost of treatment (Li, J. et al., 2016). In pediatric wards, the average encounter between a doctor and a patient is estimated to be six minutes (Xu & Zhang, 2014). After the intervention, some participants were able to prioritize their questions and use the very limited time with their providers to address their concerns. This finding suggests that improved patient IHL may also lead to higher patient's satisfaction and reduce patient-doctor conflicts.

Better communication with family members was reported by some focus group participants, including several participants who were doctors. Living with parents and taking care of a child together with the parents or in-laws may cause stress to the young mothers due to different beliefs. In our study sample, 69% of the mothers were receiving an average of 5.5 hours/day of help in childcare from their in-laws, and 67% were receiving an average of 6.7 hours/day of help from their parents (Table 3.2). Goh and Kuczynski (2010) surveyed 1627

families with young children, 45.4% received grandparents' help with child care, among these, more than half (54.4%) reported difficulties caring for the child jointly due to differences in child-rearing methods between parents and grandparents (Goh & Kuczynski, 2010). Our findings suggest that improved communication with family members can improve family dynamics, decrease stress, and promote health. However, a variety of intervention approaches needs to be tested to improve communication strategies that work for different families.

We did not observe a significant impact of the intervention on IHL and eIHL from our quantitative analysis. However, subgroup analysis revealed that participants who scored at below the 50th percentile of eIHL in the control group had a significant increase in eIHL post intervention. However, this result may be attributed to the lower pre-eIHL of this group (Table 3.13).

Although we found no statistically significant impact of the intervention on CHL and eCHL from our quantitative analysis, most of the focus group participants reported increased information appraisal skills. This finding was consistent with our results showing that the intervention significantly increased participants' confidence in evaluating health information from WeChat. Further, participants gained transferable CHL skills such as using credible information sources and critically evaluating the quality of health information, both online and offline.

Our findings suggest that increased health literacy skills can lead to empowerment. Using the nutrition knowledge and label reading skills they learned through interactions with the RDs and other mothers in the WeChat group, women in our study were able to make healthier food choices for their children. When family members with different opinions are involved, CHL enables the mothers to foresee the consequences of different options, and IHL enables them to communicate health information with family members. These higher-level health literacy skills are required for them to make the best health-related decisions.

By increasing health literacy skills, mothers have more control over clinical decisions related to desired health outcomes. Mothers with high-level CHL skills are able to evaluate doctors' prescriptions to avoid excessive treatment. This is particularly relevant because overprescription of unnecessary drugs or clinical tests are common in China. A cross-sectional survey with 504 Chinese licensed physicians showed that 61.9% of the study sample reported "sometimes" and 18.7% reported "often" when asked the frequency of prescribing diagnostic tests or procedures that are clinically unnecessary (He, 2014). In the situation of overprescription, clinical adherence might not be the ideal outcome. CHL skills are essential for mothers to make the best decisions to get necessary treatment and avoid overuse of treatments, medications, and supplements.

Participants learned that doctors who practice evidence-based medicine are more reliable. However, understanding what evidence-based medicine is and identifying doctors who practice evidence-based medicine remained a challenge. In a nationwide cross-sectional survey that investigated Chinese pediatricians' evidence-based medicine practice in 2009, 10.3% of the 1,988 pediatricians reported they never applied clinical evidence to their practice, 51.4% said they occasionally did, and 38.3% often did (Zhang, P. et al., 2010). Given the current complex health-care system in China, improving patients' health literacy is an important first step to improve clinical outcomes. However, it will likely not be enough. Policy-level efforts are also needed to promote evidence-based medicine in China.

Willingness to share information and offering help to others does not necessarily translate into healthier outcomes; and sometimes can be dangerous. For example, sharing false health information to friends or online communities, and offering advice based on personal experiences that may not apply to others may have a negative impact to the community. However, high health literacy skills combined with willingness to share information can help promote health. Ishikawa et al. (2018) reported that participants who gained health literacy skills from a community based

in-person intervention tended to apply what they learned to support others; thus expanding individual gains to community or population gains.

3.6 Limitations

A convenience sampling method was used to recruit participants from the first author's personal WeChat account. The characteristics of the author's social network may have impacted the characteristics of the sample, such as education level and geographic location. We offered free nutrition advice as an incentive; therefore, participants who joined the study might be more health conscious. We randomized the sample to minimize the potential impact of the confounders. Our sample had relatively high education level and urban residency, and only complete cases were included in the analysis; thus the generalizability of our findings is limited.

We had about a 60% retention rate for both the intervention and control groups. It was challenging to encourage participation and to collect post-intervention questionnaires. Despite pilot testing the lessons, mothers in our study may not have been interested in all topics selected. Another possible reason for loss to follow-up is lack of time. Additional analysis showed the mothers who were lost to follow-up reported receiving 4.7 (SD=6.19) hours/day of help from their parents, while mothers who completed the study reported receiving 6.1 (SD=7.56) hours/day of help from their parents at baseline. We performed supplemental analysis to summarize the variables of interest at baseline for intervention and control participants who did and did not complete the post-questionnaire. No difference among the four groups was observed except for empowerment. Intervention participants who were lost to follow-up had higher empowerment at baseline as compared to those who completed the post-questionnaire.

We used online focus group discussion to collect qualitative data in asynchronous style; therefore, we were not able to see participants' non-verbal signals such as facial expressions and body language as we would with traditional face-to-face focus groups (Reisner et al., 2018). However, some participants used emojis in their responses reflecting their emotions. We did not

see a lot of interaction among the participants even after encouraging them to comment on other participants' responses. This is probably because they were active at different times. Our group of young mothers was located in different cities in China with different personal schedules; therefore the flexibility of the online focus groups proved to be a useful research strategy.

We saw some improvement in all categories of health literacy skills from focus group participants. However, our quantitative analysis did not show any significant impact of the intervention on health and eHealth literacy skills as measured by AAHLS and eHLS. A pre- to post-analysis with the focus group participants only did not show any improvement in health literacy, eHealth literacy, or use of health information from WeChat (Table 3.12). This inconsistency between qualitative and quantitative results may due to: 1) more participants already had a high literacy level; therefore limiting room for improvement (Table 3.13); 2) not enough participants made improvements or not enough improvement were made; 3) the measures used were not sensitive enough to capture the improvements that were made. Indeed, authors of the AAHLS Chinn and McCarty (2013) have pointed out that using only questionnaires to measure concepts may oversimplify the competencies and suggested that researchers employ qualitative methods to gain a better understanding of the problem. In another study using AAHLS among Chinese-speaking patients in the U.S., the authors found that the 3-point AAHLS scale did not provide sufficient options for patients; therefore, they modified the responses to a 5-point scale (Chen et al., 2018). Our findings suggest that efforts are needed to develop, refine, and validate health literacy assessment tools for communities and populations to make evaluations and comparisons possible.

Our results showed that some components of the intervention might have worked for some participants but not others, and not every participant may need intervention on all aspects of health literacy skills. However, we delivered all 12 lessons to all participants. This one-intervention-for-all strategy may not be the best to meet our participants' different needs. With the development of smartphone apps and artificial intelligence, one potential strategy for future

research is to individualize the intervention material based on a baseline assessment and continuous feedback from the participants.

3.7 Conclusions

We developed a 12-lesson intervention to improve health literacy and eHealth literacy among Chinese mothers with young children. This WeChat-based intervention has the potential to improve functional, interactive, and critical health literacy skills among women with young children. Future research should focus on developing more tailored intervention strategies for individuals with different needs. Better measurement tools of health literacy are also needed to accurately evaluate the impact of community-based health literacy interventions.

Table 3.1 Content of the intervention lessons.

Table of Content of the Intervention Lessons		
Initial Topics		
Topic	Description	
1.Where can I find reliable health and child-raring information?	The Internet and social media have become an important channel for us to obtain health and parenting information. Governmental websites, professional organizations, media, academic journals, which one is reliable? We'll give you the answer in this course.	
2.How to distinguish real from fake health information?	There is a lot of health information on the Internet. In this course, we will summarize the characteristics of high quality and low-quality information.	
3.How to interpret the latest health research in the news?	We see new health discoveries, breakthroughs, and innovations in the news all the time. What do different types of research mean to us? We will give you the answer in this course.	
4.What can you do when you see false health information?	There is a lot of health information on the Internet including health rumors. What can we do when we see false health information? We will give you some tips in this course.	
5.How do I make the most out of a clinical appointment with a doctor?	Hospitals are always crowded. Doctors see a patient for only a few minutes on average. How can we communicate with doctors most effectively? Here are some tips for you.	
6.What should I do when I have a different opinion on child care with my family members?	If you are taking care of your child together with your family members, you might have different opinions sometimes. In this course, we will discuss how to communicate with family members.	
Final Intervention		
Lessons	Learning objectives <i>By the end of this lesson, participants will be able to...</i>	Exercises
1. How can I tell if the health information I'm reading is reliable? (Part 1)	Evaluate health information by asking: <ul style="list-style-type: none">Who runs the platform? Why does it exist?	Judge if some characteristics increase or decrease the reliability of the health information.
2. How can I tell if the health information I'm reading is reliable? (Part 2)	Evaluate health information by asking: <ul style="list-style-type: none">How is the information produced? Is it up-to-date?Where does the information come from? What's the evidence?Is it too good/bad to be true?	Judge if some characteristics increase or decrease the reliability of the health information.
3. Is an online encyclopedia a reliable information source?	<ul style="list-style-type: none">Recognize that anyone can edit online encyclopedia (Baidu Baike);Evaluate reliability of commercial sites.Find reliable information on disease description.	Compare two articles using the questions from lesson 1 and evaluate which article is more reliable.
4. Are online forums or chat groups reliable information sources?	<ul style="list-style-type: none">Recognize that anyone can post on online discussion forums/groups.Recognize that personal experiences can be biased and may not apply to your situation.Identify undercover advertisers.	What would you tell your friend when she got conflicting suggestions from a WeChat group?
5. How can I tell if a WeChat official account is reliable?	<ul style="list-style-type: none">Evaluate the reliability of WeChat official accounts.	Compare two WeChat official accounts, which one is a better source of health information?
6. What can I do when I suspect that what I'm reading is not true?	<ul style="list-style-type: none">Identify tools to check the information credibility (WeChat rumor refute assistant)Report false information on Social network sites (SNSs).	What would you do when you see a friend posting false health information on WeChat?
7. How do I make the most out of a clinical appointment with my child's doctor?	<ul style="list-style-type: none">Explain symptoms clearly and bring all important information that's relevant. Write down questions.	Choose which one is a better description of child's symptoms during an appointment.

	<ul style="list-style-type: none"> • Ask questions: Address key issues early in the visit. Ask for clarifications if something is not understandable. • Follow-up: Don't leave until you understand what the provider tells you and what you need to do next and follow the instructions. 	
8. Are online medical consultation sites reliable?	<ul style="list-style-type: none"> • Recognize when online medical consultation can be useful. • Look up a practitioner's information on National Health Commission (NHC) website. 	Situations when you can use online consultation sites.
9. How do I communicate with other family members about my child's health?	<p>Communicate clearly with your partner, by:</p> <ul style="list-style-type: none"> • Welcome your partner's participation and acknowledge their good intentions. • Explore the reasons behind the behaviors with curiosity. • Discuss differences with your partner on the basis of the shared goal to best care for your child. • Form a united front. <p>In addition, tips you can use when communicating with your parents or in-laws:</p> <ul style="list-style-type: none"> • Weigh the pros and cons and have an agreement with your partner • Communicate with your own parents • Establish boundaries and divide the work • Show your weakness • Reduce their pressure • Encourage learning 	What advice would you give your friend if she has problems communicating with her partner?
10. Who should I listen to when different doctors have different opinions?	<ul style="list-style-type: none"> • Recognizing that not all scientific studies are equal. RCT is the gold standard of evaluating a treatment. • Realizing that experiences and opinions are not good evidence. • Recognizing that the latest guidelines are usually based on the best scientific evidence. • Realizing that good health care doesn't rely only on personal views and experiences, but is also based on the best scientific evidence. 	Decide if the examples are based on good evidence.
11. How do I interpret the latest health research in the news?	<p>Critically read health news by answering the following questions:</p> <ul style="list-style-type: none"> • Does the article support its claims with scientific research? • Was the study conducted with animals or people? Does the study include people like you? • How big was the study? • Was it a randomized controlled clinical trial? • If the study assessed what's in the headline? • Who paid for the research? 	Provide two example of health news, and ask them if they should believe it.
12. Summary and FAQs	<ul style="list-style-type: none"> • Summarize and review the previous lessons. • Address questions asked by the moms during the intervention. 	Provide follow-up questionnaire link.

Table 3.2 Baseline characteristics of intervention participants (n=240).

	Control (n=123)	Intervention (n=117)				Control (n=123)	Intervention (n=117)	
Variables	n (%)	n (%)	p ¹		Variables	n (%)	n (%)	p ¹
Household monthly income (CNY (USD))					Education			
< ¥5,000 (<\$727)	9 (7.3)	14 (12.0)	0.570		High school degree or less	10 (8.1)	5 (4.3)	0.092
¥5,000 – 10,000 (\$727 – 1,454)	35 (28.5)	30 (25.6)			Some college or vocational school	13 (10.6)	24 (20.5)	
¥10,001 – 15,000 (\$1,455 – 2,181)	27 (22.0)	29 (24.8)			Bachelor's degree	70 (56.9)	67 (57.3)	
¥15,001 – 20,000 (\$2,182 – 2,908)	20 (16.3)	20 (17.1)			Master's degree or higher	30 (24.4)	21 (17.9)	
¥20,001 – 30,000 (\$2,908 – 4,362)	17 (13.8)	9 (7.7)			Residency status			
≥ ¥30,001 (≥ \$4,363)	15 (12.2)	15 (12.8)			Urban	93 (75.6)	80 (68.4)	0.212
Occupation					Rural or not sure	30 (24.4)	37 (31.6)	
Unemployed	16 (13.0)	20 (17.1)	0.589		Location²			
Health-related jobs	23 (18.7)	18 (15.4)			Tier 1 cities	22 (17.9)	13 (11.1)	0.273
Other jobs	84 (68.3)	79 (67.5)			Tier 2 cities	51 (41.5)	48 (41.0)	
WeChat business involvement					Other	50 (40.7)	56 (47.9)	
Involved at some level	13 (10.6)	16 (13.7)	0.461		Preferred type of medicine			
Not involved	110 (89.4)	101 (86.3)			TCM ³ as first choice	22 (17.9)	12 (10.3)	0.047
Marital status					Western medicine as first choice	53 (43.1)	42 (35.9)	
Married	122 (99.2)	115 (98.3)	0.614		Depends	48 (39.0)	63 (53.8)	
Other	1 (0.8)	2 (1.7)			Number of children			
Current pregnancy status					1	98 (79.7)	92 (78.6)	0.842
Not pregnant	115 (93.5)	113 (96.6)	0.377		2	25 (20.3)	25 (21.4)	
Not sure or Pregnant	8 (6.5)	4 (3.4)			Mean (SD)	Mean (SD)		
					Mother's age (years)	30.0 (3.47)	30.9 (3.66)	0.055
					Children's age total (months)	31.2 (38.61)	33.8 (43.22)	0.632
					Youngest child's age (months)	15.0 (8.94)	15.3 (8.69)	0.821
If they take care of the children (Yes)					Time spent taking care of the children (hours/day)			
Mother	122 (99.2)	115 (98.3)	0.614		Mother	14.1 (7.98)	14.2 (7.32)	0.915
Father	109 (88.6)	100 (85.5)	0.467		Father	4.6 (4.64)	4.5 (5.06)	0.814
Paternal grandparents	69 (56.1)	72 (61.5)	0.392		Paternal grandparents	5.5 (6.95)	5.7 (6.57)	0.820
Maternal grandparents	67 (54.5)	65 (55.6)	0.866		Maternal grandparents	6.7 (8.10)	5.5 (6.92)	0.195
Nanny	22 (17.9)	18 (15.4)	0.603		Nanny	2.2 (5.97)	1.4 (4.36)	0.260
Daycare	10 (8.1)	11 (9.4)	0.727		Daycare	1.0 (4.03)	0.9 (3.29)	0.722
Other	4 (3.3)	9 (7.7)	0.159		Other	0.4 (2.63)	0.4 (2.09)	0.990

¹ p values were calculated using Chi-square test, Fisher's exact test, or independent t-test. ² Tier 1 cities: Beijing, Shanghai, Guangzhou, Shenzhen; Tier 2 cities: Provincial capital cities excluding tier 1 cities. ³ TCM: Traditional Chinese Medicine

Table 3.3 Health literacy level (n=240).

		Control (n=123)				Intervention (n=117)			
		Often %	Sometimes %	Rarely %	Mean (SD)	Often %	Sometimes %	Rarely %	Mean (SD)
1. How often do you need someone to help you when you are given information to read by your doctor, nurse or pharmacist?	Pre	14.6	58.5	26.8	2.12(0.635)	11.1	59.0	29.9	2.19(0.615)
	Post	15.4	52.0	32.5	2.17(0.674)	9.4	59.8	30.8	2.21(0.599)
2. When you need help, can you easily get hold of someone to assist you?	Pre	49.6	41.5	8.9	2.41(0.651)	48.7	41.0	10.3	2.38(0.668)
	Post	52.8	35.8	11.4	2.41(0.689)	52.1	39.3	8.5	2.44(0.648)
3. How often do you need help to fill in official documents?	Pre	23.6	53.7	22.8	1.99(0.683)	23.1	50.4	26.5	2.03(0.706)
	Post	27.6	48.8	23.6	1.96(0.717)	17.9	52.1	29.9	2.12(0.684)
Functional health literacy (Average of items 1-3)		Pre			2.17(0.460)				2.20(0.483)
	Post				2.18(0.504)				2.26(0.443)
4. When you talk to a doctor or nurse, do you give them all the information they need to help you?	Pre	83.7	13.8	2.4	2.81(0.450)	87.2	12.0	0.9	2.86(0.369)
	Post	85.4	13.0	1.6	2.84(0.412)	83.8	14.5	1.7	2.82(0.428)
5. When you talk to a doctor or nurse, do you ask all the questions you want or need to ask?	Pre	87.8	10.6	1.6	2.86(0.391)	82.1	17.9	0.0	2.82(0.385)
	Post	88.6	10.6	0.8	2.88(0.353)	82.9	16.2	0.9	2.82(0.407)
6. When you talk to a doctor or nurse, do you make sure they explain anything that you do not understand?	Pre	73.2	22.8	4.1	2.69(0.545)	64.1	33.3	2.6	2.62(0.539)
	Post	64.2	33.3	2.4	2.62(0.536)	63.2	32.5	4.3	2.59(0.575)
Interactive health literacy (Average of items 4-6)		Pre			2.79(0.347)				2.77(0.325)
	Post				2.78(0.301)				2.74(0.359)
7. Are you someone who likes to find out lots of different information about your health?	Pre	68.3	29.3	2.4	2.66(0.525)	77.8	19.7	2.6	2.75(0.490)
	Post	65.0	30.1	4.9	2.60(0.583)	70.1	29.1	0.9	2.69(0.482)
8. How often do you think carefully about whether the health information you see makes sense in your particular situation?	Pre	70.7	26.8	2.4	2.68(0.517)	78.6	17.9	3.4	2.75(0.507)
	Post	77.2	22.0	0.8	2.76(0.445)	72.6	22.2	5.1	2.68(0.570)
9. How often do you think about whether the information about your health can be trusted?	Pre	68.3	29.3	2.4	2.66(0.525)	69.2	28.2	2.6	2.67(0.525)
	Post	61.0	37.4	1.6	2.59(0.525)	72.6	26.5	0.9	2.72(0.471)
10. Are you the sort of person who might question your doctor or nurse's advice based on your own research?	Pre	17.9	64.2	17.9	2.00(0.601)	12.8	70.9	16.2	1.97(0.540)
	Post	24.4	61.0	14.6	2.10(0.620)	12.8	65.8	21.4	1.91(0.581)
Critical health literacy (Average of items 7-10)		Pre			2.50(0.388)				2.53(0.367)
	Post				2.51(0.357)				2.50(0.373)

Table 3.4 Level of empowerment (n=240).

		Control (n=123)					Intervention (n=117)				
		Not at all %	To a small degree %	To a fairly high degree %	To a very high degree %	Mean (SD)	Not at all %	To a small degree %	To a fairly high degree %	To a very high degree %	Mean (SD)
11. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	Pre	3.3	39.0	39.8	17.9	2.72(0.792)	0.9	47.0	37.6	3.3	2.66(0.733)
	Post	1.6	36.6	39.8	22.0	2.82(0.790)	5.1	31.6	41.9	21.4	2.79(0.836)
12. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	Pre	3.3	39.0	39.0	18.7	2.73(0.800)	0.9	39.3	43.6	16.2	2.75(0.730)
	Post	3.3	35.0	43.1	18.7	2.77(0.787)	4.3	28.2	43.6	23.9	2.87(0.826)
13. When at home, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diet, lifestyle, disease care, etc.)	Pre	0.0	4.9	37.4	57.7	3.53(0.591)	0.0	5.1	51.3	43.6	3.38(0.585)
	Post	0.0	7.3	42.3	50.4	3.43(0.628)	0.0	7.7	47.0	45.3	3.38(0.626)
14. When at home, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diet, lifestyle, disease care, etc.)	Pre	0.8	4.9	42.6	51.6	3.45(0.631)	0.0	3.4	50.4	46.2	3.43(0.562)
	Post	0.0	3.3	43.9	52.8	3.49(0.564)	0.0	6.0	46.2	47.9	3.42(0.605)
Empowerment (Average of items 11-14)	Pre					3.10(0.529)					3.06(0.483)
	Post					3.13(0.519)					3.12(0.577)

Table 3.5 eHealth literacy level (n=240).

		Control (n=123)						Intervention (n=117)					
		Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %	Mean (SD)	Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %	Mean (SD)
1. I don't understand the meaning of symbols (e.g. BMI, pH, OGTT, etc.) used in health information on the Internet.	Pre	8.1	23.6	18.7	37.4	12.2	2.78(1.177)	10.3	23.9	11.1	36.8	17.9	2.72(1.292)
	Post	12.2	22.0	11.4	38.2	16.3	2.76(1.302)	12.0	21.4	16.2	39.3	11.1	2.84(1.231)
2. I find health information on the Internet hard to understand.	Pre	7.3	30.1	32.5	25.2	4.9	3.10(1.020)	8.5	30.8	31.6	25.6	3.4	3.15(1.014)
	Post	14.6	36.6	22.8	21.1	4.9	3.35(1.116)	11.1	44.4	26.5	17.1	0.9	3.48(0.934)
3. I find the use of math formulas (e.g., formula of calculating BMI, fetal movements, energy expenditure, etc.) to explain health information on the Internet is difficult to understand.	Pre	8.1	34.1	25.2	26.0	6.5	3.11(1.088)	12.8	26.5	21.4	29.1	10.3	3.03(1.221)
	Post	16.3	35.0	15.4	25.2	8.1	3.26(1.234)	14.5	32.5	17.9	23.9	11.1	3.15(1.257)
Functional eHealth literacy (Average of items 1-3)	Pre						3.00(0.915)						2.97(1.030)
	Post						3.12(1.060)						3.16(0.953)
4. I can use search engines to effectively find health information on the Internet.	Pre	4.9	21.1	22.0	40.7	11.4	3.33(1.083)	0.9	19.7	26.5	38.5	14.5	3.46(0.996)
	Post	2.4	13.0	25.2	41.5	17.9	3.59(1.007)	2.6	21.4	27.4	37.6	11.1	3.33(1.017)
5. I try to find new health information on the Internet.	Pre	1.6	16.3	17.1	54.5	10.6	3.56(0.942)	0.9	9.4	26.5	47.9	15.4	3.68(0.879)
	Post	3.3	11.4	25.2	47.2	13.0	3.55(0.968)	4.3	0.3	17.9	56.4	11.1	3.60(0.965)
6. From the health information on the Internet, I can select what I need.	Pre	1.6	8.1	19.5	61.0	9.8	3.69(0.821)		4.3	17.1	65.8	12.8	3.87(0.676)
	Post	1.6	8.1	20.3	56.1	13.8	3.72(0.862)	3.4	6.8	17.1	62.4	10.3	3.69(0.876)
7. I can understand the health information I find on the Internet.	Pre	1.6	7.3	21.1	62.6	7.3	3.67(0.786)		7.7	22.	59.8	10.3	3.73(0.750)
	Post	0.0	12.2	22.8	48.8	16.3	3.69(0.888)	1.7	5.1	23.9	58.1	11.1	3.72(0.797)
Interactive eHealth literacy (Average of items 4-7)	Pre						3.56(0.698)						3.68(0.607)
	Post						3.64(0.734)						3.59(0.736)
8. I think over if the health information on the Internet applies to my situation.	Pre	1.6	2.4	9.8	69.9	16.3	3.97(0.712)		1.7	11.1	67.5	19.7	4.05(0.614)
	Post	0.8	0.8	17.1	58.5	22.8	4.02(0.713)	1.7	1.7	14.5	64.1	17.9	3.95(0.741)
9. I try to use multiple sources to verify if the health information on the Internet is correct.	Pre	1.6	4.1	16.3	65.0	13.0	3.84(0.762)	0.9	4.3	15.4	63.2	16.2	3.90(0.747)
	Post	1.6	4.1	17.1	59.3	17.9	3.88(0.806)	0.9	5.1	18.8	56.4	18.8	3.87(0.804)
10. I check the validity and reliability of health information on the Internet.	Pre	2.4	4.1	19.5	62.6	11.4	3.76(0.800)		9.4	14.5	63.2	12.8	3.79(0.783)
	Post	0.8	7.3	22.0	57.7	12.2	3.73(0.800)	0.9	3.4	21.4	59.0	15.4	3.85(0.750)
11. I review many people's opinions and discussions so that I can make decisions or take actions that are good for my health.	Pre	1.6	0.8	12.2	69.9	15.4	3.97(0.677)		3.4	11.1	66.7	18.8	4.01(0.663)
	Post	0.8	4.9	16.3	61.0	17.1	3.89(0.770)	0.9	2.6	17.9	61.5	17.1	3.91(0.726)
12. When I question the health information on the Internet, I use other channels to verify it.	Pre	1.6	4.9	8.9	66.7	17.9	3.94(0.782)		2.6	14.	61.5	21.4	4.02(0.682)
	Post	0.0	5.7	17.1	57.7	19.5	3.91(0.768)	0.9	1.7	17.1	58.1	22.2	3.99(0.737)
Critical eHealth literacy (Average of items 8-12)	Pre						3.90(0.643)						3.95(0.545)
	Post						3.88(0.611)						3.91(0.634)

Table 3.6 Use of health information from WeChat (n=240).

		Control (n=123)						Intervention (n=117)					
		Never %	Rarely %	Sometimes %	Very often %	Always %	Mean (SD)*	Never %	Rarely %	Sometimes %	Very often %	Always %	Mean (SD)*
1. How often do you find health-related information through WeChat? (Obtain)	Pre	1.6	13.0	35.0	43.1	7.3	3.41 (0.868)	0.9	11.1	33.3	47.9	6.8	3.49 (0.816)
	Post	0.8	18.7	28.5	44.7	7.3	3.39 (0.902)	0.0	11.1	44.4	38.5	6.0	3.39 (0.765)
2. How often do you share health-related articles with others? (Share)	Pre	7.3	26.8	39.8	26.0	0.0	2.85 (0.897)	6.0	31.6	39.3	18.8	4.3	2.84 (0.946)
	Post	5.7	33.3	35.0	23.6	2.4	2.84 (0.935)	4.3	39.3	41.9	12.8	1.7	2.68 (0.816)
		Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %		Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %	
3. I feel confident using health-related information from WeChat to make health decisions. (Apply)	Pre	4.9	25.2	44.7	24.4	0.8	2.91 (0.849)	1.7	26.5	50.4	17.1	4.3	2.96 (0.824)
	Post	2.4	34.1	35.0	26.8	1.6	2.91 (0.878)	2.6	35.9	35.0	23.9	2.6	2.88 (0.892)
4. I can tell high quality health resources from low quality health resources on WeChat.(Appraise)	Pre	3.3	10.6	26.8	51.2	8.1	3.50 (0.909)	0.9	11.1	34.2	47.0	6.8	3.48 (0.816)
	Post	3.3	16.3	24.4	45.5	10.6	3.44 (0.993)	0.0	12.0	24.8	50.4	12.8	3.64 (0.856)

*Options are coded as 1, 2, 3, 4, 5 with a higher value represents more frequent use of health information from WeChat, or more confidence in using health information from WeChat.

Table 3.7 Impact of the intervention on health literacy and empowerment (n=240).

	Post intervention FHL	Post intervention IHL	Post intervention CHL	Post intervention Empowerment
Model Summary	R²=0.416, F=9.871, p<0.001	R²=0.201, F=3.482, p<0.001	R²=0.268, F=5.067, p<0.001	R²=0.289, F=5.648, p<0.001
	B (SE)	B (SE)	B (SE)	B (SE)
Intervention				
Control	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Intervention	0.075 (0.051)	-0.029 (0.041)	-0.026 (0.043)	0.010(0.064)
Age	0.003 (0.009)	0.003 (0.008)	0.016 (0.008)	0.018(0.012)
Child's age	-0.001 (0.001)	0.000 (0.001)	-0.001 (0.001)	-0.001(0.001)
Education				
High school degree or less	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Some college or vocational school	-0.072 (0.128)	0.019 (0.105)	-0.189 (0.111)	-0.208(0.162)
Bachelor's degree	-0.111 (0.120)	0.035 (0.098)	-0.142 (0.105)	-0.206(0.152)
Master's degree or higher	-0.220 (0.133)	0.078 (0.108)	-0.101 (0.117)	-0.217(0.168)
Occupation				
Unemployed	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Other jobs	0.019 (0.074)	0.024 (0.060)	0.041 (0.063)	-0.042(0.093)
Health-related jobs	0.280 (0.098) *	0.062 (0.075)	0.011 (0.079)	-0.114(0.118)
Household monthly income (CNY (USD))				
< ¥5,000 (<\$727)	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
¥5,000 – 10,000 (\$727 – 1,454)	0.195 (0.095) *	0.013 (0.077)	-0.076 (0.081)	0.117(0.120)
¥10,001 – 15,000 (\$1,455 – 2,181)	0.204 (0.098) *	0.028 (0.080)	-0.020 (0.084)	-0.048(0.124)
¥15,001 – 20,000 (\$2,182 – 2,908)	0.249 (0.104) *	-0.035 (0.085)	0.009 (0.089)	0.011(0.132)
¥20,001 – 30,000 (\$2,908 – 4,362)	0.254 (0.115) *	0.002 (0.093)	0.086 (0.098)	-0.006(0.145)
≥ ¥30,001 (≥ \$4,363)	0.280 (0.110) *	-0.107 (0.090)	-0.022 (0.094)	0.094(0.140)
Residency				
Rural	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Not sure	-0.150 (0.161)	-0.151 (0.130)	-0.018 (0.137)	0.120(0.203)
Urban	-0.005 (0.065)	-0.070 (0.053)	-0.041 (0.056)	0.026(0.083)
Pre-intervention FHL	0.520 (0.057) **	-	-	-
Pre-intervention IHL	-	0.415 (0.061) **	-	-
Pre-intervention CHL	-	-	0.459 (0.060) **	-
Baseline EMP	-	-	-	0.566(0.065) **

Regression coefficients and standard errors were generated from multiple linear regression. Post-intervention scores were modeled as the outcome variable of the intervention adjusting for pre-intervention scores, age, child's age, education, occupation, household income, and residency.

*p<0.05, **p<0.001

Table 3.8 Impact of the intervention on eHealth literacy (n=240).

	Post intervention eFHL	Post intervention eIHL	Post intervention eCHL
Model Summary	R²=0.521, F=15.117, p<0.001	R²=0.275, F=5.254, p<0.001	R²=0.189, F=3.241, p<0.001
	B (SE)	B (SE)	B (SE)
Intervention			
Control	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Intervention	0.061 (0.097)	-0.064 (0.087)	0.036 (0.078)
Age	0.024 (0.018)	0.014 (0.016)	0.005 (0.014)
Child's age	-0.004 (0.001) *	-0.005 (0.001) **	-0.003 (0.001) *
Education			
High school or less	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Some college or vocational school	0.280 (0.244)	0.139 (0.219)	0.349 (0.196)
Bachelor's degree	0.230 (0.230)	-0.054 (0.206)	0.300 (0.185)
Master's degree or higher	0.551 (0.254) *	-0.040 (0.229)	0.404 (0.204) *
Occupation			
Unemployed	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Other jobs	0.058 (0.141)	0.006 (0.126)	-0.047 (0.113)
Health-related jobs	0.528 (0.194) *	0.326 (0.159) *	0.155 (0.142)
Household monthly income (CNY (USD))			
< ¥5,000 (<\$727)	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
¥5,000 – 10,000 (\$727 – 1,454)	0.045 (0.181)	0.264 (0.163)	0.245 (0.145)
¥10,001 – 15,000 (\$1,455 – 2,181)	0.131 (0.187)	0.326 (0.170)	0.323 (0.151) *
¥15,001 – 20,000 (\$2,182 – 2,908)	0.090 (0.201)	0.021 (0.179)	0.149 (0.161)
¥20,001 – 30,000 (\$2,908 – 4,362)	-0.059 (0.220)	0.300 (0.196)	0.345 (0.176)
≥ ¥30,001 (≥ \$4,363)	0.044 (0.212)	0.234 (0.188)	0.369 (0.169) *
Residency			
Rural	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Not sure	0.255 (0.306)	0.611 (0.274) *	0.476 (0.246)
Urban	-0.060 (0.124)	0.217 (0.111)	-0.007 (0.100)
Pre-intervention eFHL	0.576 (0.057) **	-	-
Pre-intervention eIHL	-	0.361 (0.067) **	-
Pre-intervention eCHL	-	-	0.250 (0.065) **

Regression coefficients and standard errors were generated from multiple linear regression. Post-intervention scores were modeled as the outcome variable of the intervention adjusting for pre-intervention scores, age, child's age, education, occupation, household income, and residency.

*p<0.05, **p<0.001

Table 3.9 Impact of the intervention on use of health information on WeChat (n=240).

	Obtain	Share	Apply	Appraise
	B(SE)	B(SE)	B(SE)	B(SE)
Intervention	0.173(0.266)	-0.127(0.261)	-0.07(0.243)	-0.21(0.281)
Time	-0.11(0.243)	-0.177(0.201)	-0.196(0.228)	-0.348(0.232)
Intervention*Time	-0.116(0.324)	-0.169(0.297)	0.036(0.337)	0.766(0.342) *
Education				
High school degree or less	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Some college or vocational school	-0.108(0.46)	0.418(0.605)	0.109(0.504)	-0.051(0.458)
Bachelor's degree	0.351(0.465)	0.244(0.597)	0.008(0.482)	-0.033(0.43)
Master's degree or higher	0.655(0.521)	0.575(0.655)	-0.03(0.556)	0.112(0.503)
Occupation				
Unemployed	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Other jobs	0.652(0.408)	1.499 (0.373) **	0.169(0.423)	-0.22(0.493)
Health-related jobs	-0.062(0.286)	0.216(0.269)	0.066(0.299)	0.287(0.366)
Household monthly income (CNY (USD))				
< ¥5,000 (<\$727)	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
¥5,000 – 10,000 (\$727 – 1,454)	0.442(0.378)	0.003(0.479)	-0.175(0.336)	-0.624(0.347)
¥10,001 – 15,000 (\$1,455 – 2,181)	0.179(0.414)	-0.517(0.494)	-0.691(0.347) *	-0.363(0.375)
¥15,001 – 20,000 (\$2,182 – 2,908)	0.058(0.45)	-0.392(0.515)	-0.730(0.362) *	-0.323(0.384)
¥20,001 – 30,000 (\$2,908 – 4,362)	0.196(0.497)	-0.155(0.553)	-0.444(0.419)	0.504(0.505)
≥ ¥30,001 (≥ \$4,363)	0.394(0.439)	-0.775(0.542)	-1.132(0.45) *	0.125(0.463)
Residency				
Rural	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>	<i>Reference</i>
Not sure	0.127(0.26)	-0.024(0.254)	-0.232(0.27)	-0.002(0.288)
Urban	-0.729(0.621)	-0.72(0.865)	-0.686(0.613)	-0.03(0.561)
Age	0.029(0.036)	0.054(0.035)	-0.006(0.033)	-0.01(0.041)
Child's age	-0.005(0.003)	-0.006(0.003)	0.001(0.003)	0.003(0.004)
Functional health literacy (FHL)	-0.276(0.286)	-0.673(0.267) *	0.269(0.236)	0.049(0.292)
Interactive health literacy (IHL)	-0.173(0.329)	-0.42(0.328)	-0.091(0.266)	0.138(0.294)
Critical health literacy (CHL)	0.732 (0.341) *	-0.13(0.308)	-0.365(0.29)	-0.173(0.336)
Empowerment (EMP)	-0.054(0.222)	0.761(0.216) **	0.257(0.196)	0.254(0.201)
Functional eHealth literacy (eFHL)	0.065(0.138)	-0.198(0.135)	0.314(0.127) *	0.471(0.143) **
Interactive eHealth literacy (eIHL)	0.415 (0.193) *	0.509 (0.19) **	0.706(0.222) **	0.867(0.214) **
Critical eHealth literacy (eCHL)	0.878 (0.221) **	0.298(0.199)	0.141(0.22)	0.437(0.225)

Regression coefficients and standard errors were generated from longitudinal ordinal logistic regression.

Intervention, time (pre- and post-intervention), the interaction between intervention and time, education, occupation, household income, residency, age, child's age, FHL, IHL, CHL, EMP, eFHL, eIHL, and eCHL were included in the model to predict use of health information on WeChat.

Obtain and share were re-coded as 1=never or rarely, 2=sometime, and 3=very often or always. Apply and appraise were re-coded as 1=strongly disagree or disagree, 2=neutral, and 3=agree or strongly agree.

*p<0.05, **p<0.001

Table 3.10 Supplemental analysis.

	Control lost follow up	Control with follow up	Intervention lost follow up	Intervention with follow up
	n=76	n=123	n=73	n=117
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Functional health literacy (FHL)	2.13(0.490)	2.17(0.460)	2.23(0.470)	2.20(0.483)
Interactive health literacy (IHL)	2.84(0.269)	2.79(0.347)	2.78(0.382)	2.77(0.325)
Critical health literacy (CHL)	2.60(0.410)	2.50(0.388)	2.54(0.393)	2.53(0.367)
Empowerment (EMP)	3.19(0.556)	3.10(0.529)	3.27(0.585)	3.06(0.483)
Functional eHealth literacy (eFHL)	2.86(0.882)	3.00(0.915)	2.83(0.928)	2.97(1.030)
Interactive eHealth literacy (eIHL)	3.69(0.662)	3.56(0.698)	3.69(0.690)	3.68(0.607)
Critical eHealth literacy (eCHL)	4.06(0.669)	3.90(0.643)	3.98(0.636)	3.95(0.545)
Obtain	3.39(0.865)	3.41(0.868)	3.47(0.883)	3.49(0.816)
Share	2.89(0.810)	2.85(0.897)	3.00(0.943)	2.84(0.946)
Apply	3.17(0.737)	2.91(0.849)	3.19(0.981)	2.96(0.824)
Appraise	3.66(0.841)	3.50(0.909)	3.63(0.791)	3.48(0.816)

Table 3.11 Characteristics of focus group participants (n=16).

Variables	n		Variables	n
Education			Location¹	
Some college or vocational school	1		Tier 1 cities	0
Bachelor's degree	10		Tier 2 cities	11
Master's degree or higher	5		Other	5
Occupation			WeChat business	
Unemployed	1		Part-time without other jobs	1
Health-related jobs	5		Not in WeChat business	15
Other jobs	10		Choice of medical practice	
Household monthly income (CNY)			TCM as first choice	1
< 5,000 (< 727 USD)	1		Western medicine as first choice	7
5,000 – 10,000 (727 – 1,454 USD)	1		Not sure	8
10,001 – 15,000 (1,455 – 2,181 USD)	7		Number of children	
15,001 – 20,000 (2,182 – 2,908 USD)	2		1	11
20,001 – 30,000 (2,908 – 4,362 USD)	1		2	5
≥ 30,001 (≥ 4,363 USD)	4			
Marital status			Variables	Mean (SD)
Married	16		Age (years)	31.8(5.08)
Current pregnancy status			Children age total (months)	44.1(58.08)
Not pregnant	16		Youngest child's age (months)	11.8(6.23)
Residency				
Urban	12			
Rural	4			
If they take care of the children (Yes)			Time spent taking care of the children (hours/day)	
Mother	16		Mother	12.4(4.99)
Father	16		Father	6.6(6.65)
Paternal grandparents	11		Paternal grandparents	5.8(5.17)
Maternal grandparents	12		Maternal grandparents	7.3(7.07)
Nanny	4		Nanny	2.2(4.54)
Daycare	1		Daycare	0.3(1.25)
Other	0		Other	0(0)

¹ Tier 1 cities: Beijing, Shanghai, Guangzhou, Shenzhen; Tier 2 cities: Provincial capital cities excluding tier 1 cities.

Table 3.12 Focus group pre- post- intervention summary (n=16).

	Pre	Post	p-value
	Mean (SD)	Mean (SD)	
Functional health literacy (FHL)	2.25 (0.49)	2.33 (0.46)	0.463
Interactive health literacy (IHL)	2.73 (0.41)	2.79 (0.34)	0.317
Critical health literacy (CHL)	2.59 (0.26)	2.63 (0.33)	0.856
Empowerment (EMP)	3.06 (0.38)	3.08 (0.55)	0.892
Functional eHealth literacy (eFHL)	3.67 (0.97)	3.77 (0.80)	0.377
Interactive eHealth literacy (eIHL)	3.83 (0.72)	3.53 (1.02)	0.473
Critical eHealth literacy (eCHL)	4.21 (0.55)	4.05 (0.70)	0.166
Obtain	3.88 (0.719)	3.69 (0.704)	0.257
Share	2.94 (0.998)	2.94 (0.680)	1.000
Apply	3.00 (0.894)	3.00 (1.033)	1.000
Appraise	3.75 (0.856)	3.63 (1.025)	0.480

p values generated from Wilcoxon signed-rank test.

Table 3.13 Subgroup analysis.

	n	Intervention assignment	Pre	Post	p
Functional health literacy (FHL)	62	Control	1.80 (0.27)	1.95 (0.44)	0.015
	57	Intervention	1.79 (0.26)	2.06 (0.39)	<0.001
Interactive health literacy (IHL)	123	Control	2.79 (0.35)	2.78 (0.30)	0.731
	117	Intervention	2.77 (0.33)	2.74 (0.36)	0.516
Critical health literacy (CHL)	105	Control	2.41 (0.35)	2.47 (0.36)	0.095
	104	Intervention	2.48 (0.35)	2.47 (0.37)	0.861
Empowerment (EMP)	72	Control	2.74 (0.33)	2.93 (0.43)	0.001
	76	Intervention	2.76 (0.24)	2.93 (0.57)	0.005
Functional eHealth literacy (eFHL)	74	Control	2.38 (0.53)	2.68 (0.93)	0.006
	69	Intervention	2.24 (0.54)	2.62 (0.70)	<0.001
Interactive eHealth literacy (eIHL)	75	Control	3.15 (0.57)	3.40 (0.66)	0.012
	76	Intervention	3.36 (0.43)	3.45 (0.61)	0.152
Critical eHealth literacy (eCHL)	92	Control	3.67 (0.57)	3.79 (0.63)	0.197
	82	Intervention	3.70 (0.40)	3.77 (0.60)	0.377
Obtain	114	Control	3.29 (0.77)	3.35 (0.90)	0.64
	109	Intervention	3.38 (0.73)	3.36 (0.75)	0.714
Share	91	Control	2.44 (0.67)	2.65 (0.90)	0.032
	90	Intervention	2.43 (0.64)	2.57 (0.79)	0.222
Apply	92	Control	2.53 (0.62)	2.78 (0.89)	0.019
	92	Intervention	2.62 (0.53)	2.76 (0.83)	0.15
Appraise	113	Control	2.84 (0.91)	3.37 (0.97)	<0.001
	109	Intervention	2.82 (0.89)	3.59 (0.84)	<0.001

Participants with pre-intervention score below 50 percentile were included in the analysis.

P values were driven from paired t-test or Wilcoxon signed-rank test.

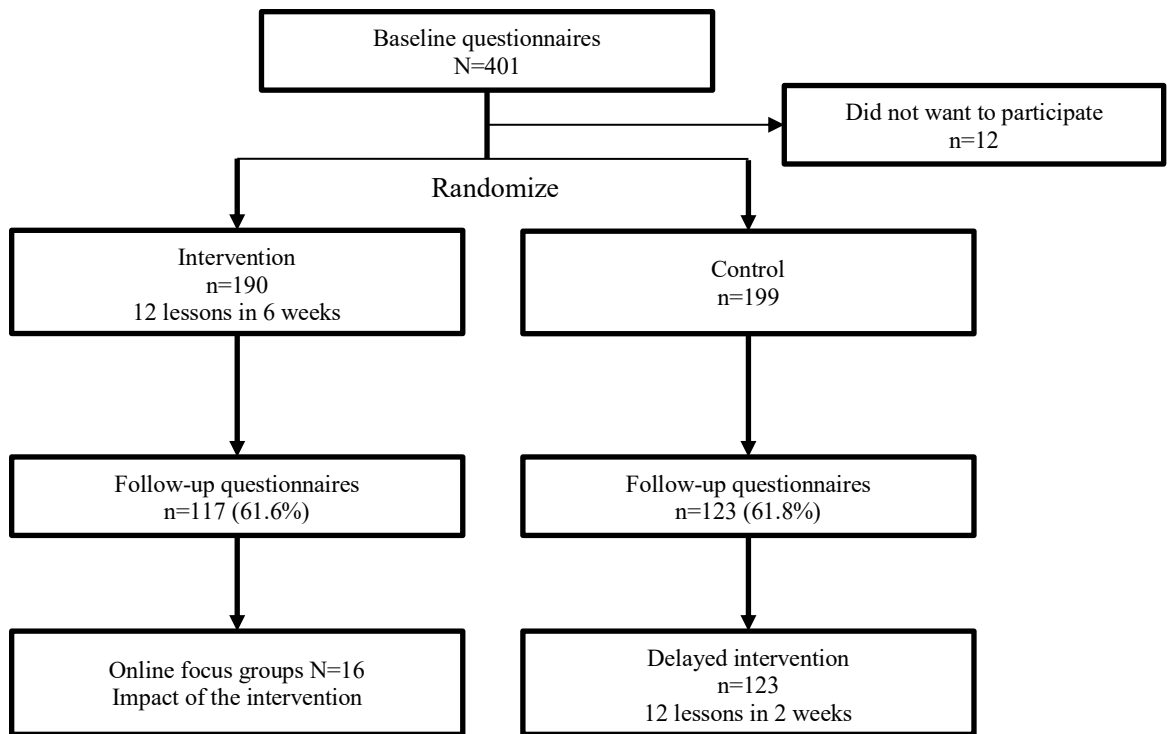


Figure 3.1 Overview of the study design.

1. What are some of your **favorite/the most impressive/the most helpful** lessons?
2. What are some of the **less helpful/interesting** lessons? Why?
3. How has your ability to **understand** health information changed since you started to receive the lessons?
4. How has your way of **finding/obtaining** health information changed since you started to receive the lessons? How did you look for health information before and how do you look for health information now?
5. How has your ability to **communicate** health information changed?
6. How have the intervention lessons change your ways of **passing/sharing** health information to others?
7. How has your way of **evaluating** health information changed since you started to receive the lessons? How has your confidence in distinguishing high-quality from low-quality health information changed? How did you make sure the health information is trustworthy before (if you did think about the trustworthiness of the health information)? And how do you make sure the health information is trustworthy now?
8. How has your way of **applying** health information changed since the intervention? Apply means, for example, you read an article about which oil is the best for baby's health, and you bought that type of oil and feed it to your baby. What's your process of making use of the health information before and after?
9. When you make decisions related to health (e.g. what food to eat, what medication to take, how to feed your child), has your **amount of control** over these decisions changed?
10. How has being a part of in the WeChat 0-3 YO nutrition group and receiving free nutrition advice from us changed your abilities to find, appraise, and apply health information?
11. How do you feel about the health literacy lessons and exercises overall? Do you have any additional comments?

Figure 3.2 Focus group guide.

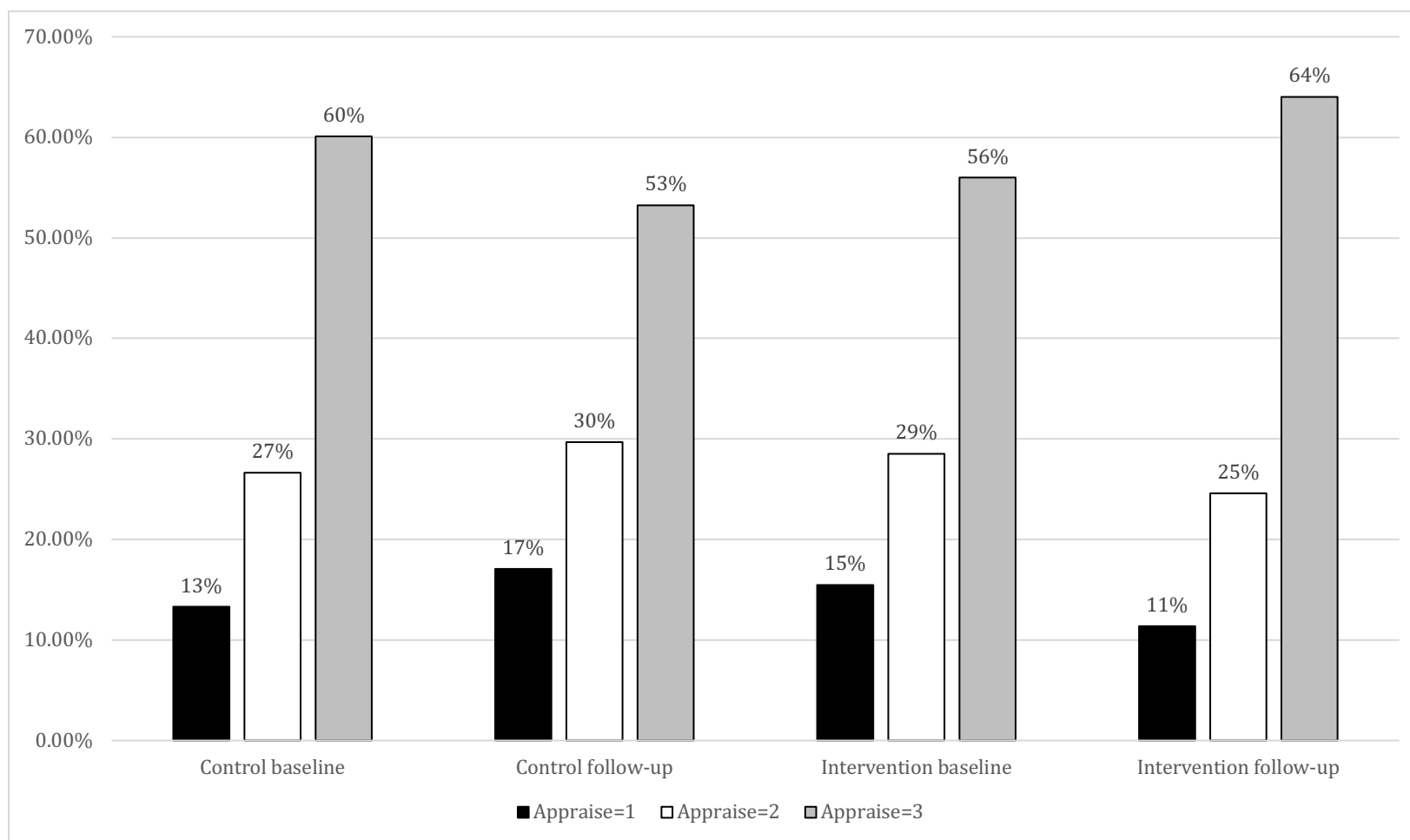


Figure 3.3 Predicted probabilities of confidence in appraising health information on WeChat.

Confidence of appraising health information on WeChat and appraise were re-coded as 1=strongly disagree or disagree, 2=neutral, and 3=agree or strongly agree.

3.8 References

- Alsop, R., & Heinsohn, N. (2005). *Measuring empowerment in practice: structuring analysis and framing indicators*. Washington, DC: World Bank.
- Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2018). *Thematic Analysis*. In: Liamputtong P. (eds) *Handbook of Research Methods in Health Social Sciences*. Singapore: Springer.
- Carbone, E., & Smith, S. (2019). Empowerment & health literacy: Reintegrating critical health literacy. *Health literacy in clinical practice and public health: New initiatives and lessons learned at the intersection with other disciplines*. (Unpublished book chapter)
- Chen, J., Hou, X., Zhao, W., & Fu, Y. (2016). Users' perception and utility of health information based on WeChat. *Management Science and Engineering*, 10(3), 18-23.
doi://dx.doi.org/10.3968/n
- Chen, Q., Pearlman, J., Beffa-Negrini, P., & Carbone, E. (2019). *Examining functional, interactive, and critical health literacy, eHealth literacy and empowerment among Chinese women with young children*. (Unpublished manuscript)
- Chen, Q. (2017). *Reading the information in applications is like eating fast food": Motherhood and social media* (Master's Thesis) Available from Lund University Libraries. Retrieved from
<http://lup.lub.lu.se/luur/download?func=downloadFile&recordId=8906812&fileId=8916755>
- Chen, X., Goodson, P., Acosta, S., Barry, A. E., & McKyer, L. E. (2018). Assessing health literacy among Chinese speakers in the U.S. with limited English proficiency. *Health Literacy Research and Practice*, 2(2), 94-106. doi:10.3928/24748307-20180405-01
- China Internet Network Information Center. (2017). *2016 年中国社交应用用户行为研究报告 [2016 China social app user behavior research report]*. Beijing: China Internet Network Information Center. Retrieved from
<https://cnnic.cn/hlwfzyj/hlwxyzbg/sqbg/201712/P020171227483413972757.pdf>
- China Internet Network Information Center. (2018). *第 41 次中国互联网发展状况统计报告 [The 41st China statistical report on Internet development]*. Beijing: China Internet Network Information Center. Retrieved from
<http://www.cnnic.net.cn/hlwfzyj/hlwxyzbg/hlwjbg/201801/P020180131509544165973.pdf>
- Chinn, D., & McCarthy, C. (2013). All Aspects of Health Literacy Scale (AAHLS): developing a tool to measure functional, communicative and critical health literacy in primary healthcare settings. *Patient Education and Counseling*, 90(2), 247-253.

- Chou, W. S., Oh, A., & Klein, W. M. (2018). Addressing health-related misinformation on social media. *Jama*, 320(23), 2417-2418.
- Crondahl, K., & Eklund Karlsson, L. (2016). The Nexus Between Health Literacy and Empowerment: A Scoping Review. *SAGE Open*, 6(2), 1-7. doi:10.1177/2158244016646410
- Feng, A. (2013). 孕产妇母婴健康素养现况调查及其妊娠结局相关研究 [Research on health literacy and pregnancy outcomes among pregnant women] Available from China Masters' Theses Full-text Database. Retrieved from <http://cdmd.cnki.com.cn/Article/CDMD-10422-1014123124.htm>
- Ferguson, B. (2008). Health literacy and health disparities: The role they play in maternal and child health. *Nursing for Women's Health*, 12(4), 286-298.
- Fredriksen, E. H., Harris, J., & Moland, K. M. (2016). Web-based discussion forums on pregnancy complaints and maternal health literacy in Norway: A qualitative study. *Journal of Medical Internet Research*, 18(5), e113. doi:10.2196/jmir.5270
- Gan, C., & Li, H. (2018). Understanding the effects of gratifications on the continuance intention to use WeChat in China: A perspective on uses and gratifications. *Computers in Human Behavior*, 78, 306-315.
- Gao, L., Larsson, M., & Luo, S. (2013). Internet use by Chinese women seeking pregnancy-related information. *Midwifery*, 29(7), 730-735.
- Goh, E. C., & Kuczynski, L. (2010). 'Only children' and their coalition of parents: Considering grandparents and parents as joint caregivers in urban Xiamen, China. *Asian Journal of Social Psychology*, 13(4), 221-231.
- He, A. J. (2014). The doctor-patient relationship, defensive medicine and overprescription in Chinese public hospitals: Evidence from a cross-sectional survey in Shenzhen city. *Social Science & Medicine*, 123, 64-71.
- Hong, Y., Fan, Z., & Huang, B. (2017). 通过微信平台向孕妇传输孕期保健知识的效果及对产
前不良情绪的影响 [Effect of transmission of maternal healthcare knowledge through
WeChat platform for pregnant women and the influence on prenatal adverse emotions].
Clinical Medicine & Engineering, 24(7), 1027-1028.
- Hsu, W., Chiang, C., & Yang, S. (2014). The effect of individual factors on health behaviors among college students: the mediating effects of eHealth literacy. *Journal of Medical Internet Research*, 16(12), e287. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/25499086>
- Huang, H., Jian, K., Cai, Y., & Zhang, J. (2014). 不同宣教方式提高孕产妇母婴健康素养的效果
研究 [Impact of different education methods on maternal and child health literacy]. *China*

- Health Industry*, 11(29), 77-77. Retrieved from <http://www.cqvip.com/qk/87229x/201429/663720663.html>
- Ishikawa, H., Takeuchi, T., & Yano, E. (2008). Measuring functional, communicative, and critical health literacy among diabetic patients. *Diabetes Care*, 31(5), 874-879.
- Jiang, T. (2016). 影响卫生政务微信平台健康传播效果因素探究 [What factors influence the impact of health communication by WeChat public health official accounts]. *Guangzhou 10th Health Education Academic Symposium*, Guangzhou. 157-159.
- Li, J., Wang, P., Kong, X., Liang, H., Zhang, X., & Shi, L. (2016). Patient satisfaction between primary care providers and hospitals: a cross-sectional survey in Jilin Province, China. *International Journal for Quality in Health Care*, 28(3), 346-354.
- Li, W. (2017). 健康谣言在微信平台传播的成因探析 [Exploring the cause of widespread health rumors on WeChat platform]. *Journal of Western Radio and Television*, (15), 12-13.
- Li, X. (2016). 微屏时代谁在传播健康? —— 对微信平台健康养生信息兴起的传播学分析 [Who is spreading health information at the age of micro screen? -- An analysis of the communication of health information on WeChat platform]. *Modern Communication: Journal of Communication University of China*, (4), 21-26.
- Li, Y., & Liu, R. (2015). 对初产妇加用微信公众平台健康教育效果的观察 [Observation on the effect of health education for primipara with WeChat public platform]. *Chinese Journal of Medicinal Guide*, (3), 317-318.
- Liu, Y. (2016). 健康类微信公众号主体分析 [Analysis on Health WeChat Official Accounts]. *Shanxi Science and Technology*, 31(5), 120-122.
- Lupton, D. (2017). 'It just gives me a bit of peace of mind': Australian women's use of digital media for pregnancy and early motherhood. *Societies*, 7(3), 25.
- Lv, J., Jiang, H., & Wu, H. (2012). 3500 例母婴健康素养基本知识及技能健康教育的效果评价 [Evaluation of a maternal and child health literacy basic knowledge and skills health education with 3,500 pregnant women]. *China Health Care & Nutrition*, 12, 5390-5391.
- National Health and Family Planning Commission. (2012). 关于印发《母婴健康素养——基本知识与技能（试行）》的通知 [Notice on the "Maternal and Infantile Health Literacy: Basic Knowledge and Skills"]. Retrieved from <http://www.nhfp.gov.cn/zwgk/ztwj/201304/6d2dd1401b274173b62809c54799be1d.shtml>
- National Health and Family Planning Commission. (2017). 2017 年 1 月全面两孩政策工作进展专题新闻发布会文字实录 [January 2017 Progress of Full-scale two-child policy press

- conference transcript]. Retrieved from <http://www.nhfpc.gov.cn/zhuz/xwfb/201701/7ea4318bf0f7450aaf91d184e02e5dcf.shtml>
- National Health Commission. (2019). *健康中国行动(2019—2030 年)*[*The Healthy China Action (2019-2030)*]. Retrieved from <http://www.nhc.gov.cn/guihuaxxs/s3585u/201907/e9275fb95d5b4295be8308415d4cd1b2.shtml>
- Norman, C. D., & Skinner, H. A. (2006). eHealth literacy: essential skills for consumer health in a networked world. *Journal of Medical Internet Research*, 8(2), 1-11. doi:10.2196/jmir.8.2.e9
- Nutbeam, D. (1998). Health promotion glossary. *Health Promotion International*, 13(4), 349-364. doi:10.1093/heapro/13.4.349
- Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15(3), 259-267.
- Ohnishi, M., Nakamura, K., & Takano, T. (2005). Improvement in maternal health literacy among pregnant women who did not complete compulsory education: policy implications for community care services. *Health Policy*, 72(2), 157-164. doi:10.1016/j.healthpol.2004.11.007
- Poushter, J. (2016). *Smartphone ownership and Internet usage continues to climb in emerging economies*. Retrieved from <http://sl.pulso.cl/wp-content/uploads/2016/02/2258581.pdf>
- Prescott, J., & Mackie, L. (2017). "You sort of go down a rabbit hole...You're just going to keep on searching": A qualitative study of searching online for pregnancy-related information during pregnancy. *Journal of Medical Internet Research*, 19(6), e194. doi:10.2196/jmir.6302
- Prestin, A., Vieux, S. N., & Chou, W. S. (2015). Is online health activity alive and well or flatlining? Findings from 10 years of the Health Information National Trends Survey. *Journal of Health Communication*, 20(7), 790-798.
- Qi, X., & Melhuish, E. C. (2017). Early childhood education and care in China: History, current trends and challenges. *Early Years*, 37(3), 268-284.
- Reisner, S. L., Randazzo, R. K., White Hughto, J. M., Peitzmeier, S., DuBois, L. Z., Pardee, D. J., . . . Potter, J. (2018). Sensitive health topics with underserved patient populations: Methodological considerations for online focus group discussions. *Qualitative Health Research*, 28(10), 1658-1673.
- Sayakhot, P., & Carolan-Olah, M. (2016). Internet use by pregnant women seeking pregnancy-related information: a systematic review. *BMC Pregnancy and Childbirth*, 16(1), 65.
- Stewart, K., & Williams, M. (2005). Researching online populations: the use of online focus groups for social research. *Qualitative Research*, 5(4), 395-416.

- Tang, Z., Wang, F., & Fu, H. (2014). 高校学生电子媒介健康素养量表的编制及评价 [Development and assessment on the eHealth Literacy Scale for college students]. *Chinese Journal of Health Education*, 30(1), 35-38.
- Tencent. (2019). 腾讯公布 2019 年第一季度及中期业绩 [Tencent releases its first quarter and interim performance in 2019]. Retrieved from <http://www.tencent.com/zh-cn/articles/15000771557911821.pdf>
- Wu, Q., Ye, X., Wu, Y., Zhao, L., & Wu, J. (2017). 全面健康素养测量量表的汉化及信效度分析 [The Chinesization of All Aspects of Health Literacy Scale and Its Reliability and Validity]. *Chinese General Practice*, 20(10), 1229-1233.
- Xia, H. (2017). 微信平台在初产妇围产期健康教育中的应用 [The application of WeChat platform in perinatal health education among primipara]. *Today Nurse*, (11), 76-77.
- Xie, B. (2011). Effects of an eHealth literacy intervention for older adults. *Journal of Medical Internet Research*, 13(4), e90. doi:10.2196/jmir.1880
- Xu, W., & Zhang, S. (2014). Chinese pediatricians face a crisis: should they stay or leave? *Pediatrics*, 134(6), 1045-1047.
- Yi, J., Ma, Y., Li, Z., Zhao, Q., & Liu, G. (2017). 基于微信平台的孕妇学校教育在提高产后母乳喂养率中的应用价值 [Values of WeChat-based pregnant women education in improving breastfeeding rate]. *Guangdong Medical Journal*, 38(12), 1944-1947.
- Zhang, H., Dong, Y., Sun, Z., Gao, H., Zhao, K., Wang, S., . . . Zhuang, Y. (2017). 大学生健康素养微信公众平台干预效果评价 [Effect evaluation of using WeChat public platform on health literacy intervention among college students]. *Chinese Journal of School Health*, 38(11), 1644-1647.
- Zhang, L., Liao, P., Li, Y., & Guan, H. (2015). 孕产妇母婴健康素养现状及影响因素分析 [Current situation of maternal and infantile health literacy and influencing factors]. *Maternal and Child Health Care of China*, 30(36), 6553-6556. Retrieved from <http://www.cqvip.com/qk/90631x/201536/666990207.html>
- Zhang, P., Ding, J., Chen, Z., & Zhang, C. (2010). 2009 年 2 045 名中国儿科医生循证医学知晓度横断面调查 [A cross-sectional survey on awareness of evidence-based medicine in 2,045 Chinese pediatricians in 2009]. *Chin J Evid Based Pediatr*, 5(3), 172-179.
- Zhang, R., Chen, Y., & Luo, X. (2011). 北京市朝阳区孕产妇母婴健康知识认知情况调查 [Survey on knowledge of maternal and child health in Chaoyang district, Beijing]. *Chinese Journal of Child Health Care*, 19(11), 1058-1061.

- Zhang, X., Wen, D., Liang, J., & Lei, J. (2017). How the public uses social media WeChat to obtain health information in china: a survey study. *BMC Medical Informatics and Decision Making*, 17(Suppl 2), 71-79. doi:10.1186/s12911-017-0470-0
- Zhuang, R., Xiang, Y., Han, T., Yang, G., & Zhang, Y. (2016). Cell phone-based health education messaging improves health literacy. *African Health Sciences*, 16(1), 311-318.
- Zou, X., Shi, Y., & Zhou, Y. (2013). 北京市海淀区母婴健康素养现状的调查分析 [Investigation on maternal and infant health literacy in Haidian District, Beijing]. *Chinese Journal of Health Education*, 29(4), 331-334. Retrieved from <http://www.cqvip.com/qk/80686x/201304/45988107.html>

APPENDIX A

INFORMED CONSENT: IN PERSON INTERVIEWS

Consent Form for Participation in a Research Study
University of Massachusetts Amherst

Researcher(s):	Dr. Elena Carbone, Qiong Chen
Study Title:	Health literacy, eHealth literacy and WeChat health information
Funding Agency:	UMass Amherst School of Public Health and Health Sciences

1. WHAT IS THIS FORM?

This form is called a Consent Form. This consent form will give you the information you will need to understand why this study is being done and why you are being invited to participate. It will also describe what you will need to do to participate and any known risks, inconveniences or discomforts that you may have while participating. We encourage you to take some time to think this over and ask questions now and at any other time. If you decide to participate, you will be asked to sign this form and you will be given a copy for your records.

2. WHAT IS THE PURPOSE OF THIS STUDY?

We are conducting this research study to explore the relationship between health literacy and eHealth literacy level and women's engagement in behaviors related to health information on WeChat. We would like to develop a WeChat-delivered health education intervention aiming to improve Chinese mothers' health literacy and eHealth literacy based on your input.

3. WHERE WILL THE STUDY TAKE PLACE AND HOW LONG WILL IT LAST?

This study will take place in Xinchang, Shaoxing, China in July 2018. It will take approximately 1 hour in total to complete the study. The total time of study includes up to 10 minutes for the questionnaire, and up to 50 minutes for an interview. The location of the screening will be online. We will schedule an in-person meeting with you at a location mutually determined by the you and the researcher.

4. WHO IS ELIGIBLE TO PARTICIPATE?

Eligible subjects must be female, at least 18 years old, have at least one child who is between 0 and three years old, currently a member of at least one WeChat mothers/parents group, and able to meet in-person with the researcher for the interview.

5. WHAT WILL I BE ASKED TO DO?

- If you are interested to participate, the researcher will schedule a one-hour meeting with you.
- At the meeting, you will be given the paper-based informed consent form to read and sign.
- Once you sign the informed consent form, the researcher will send you an online questionnaire. The questionnaire will ask you about your personal information, questions related to health literacy, eHealth literacy, and your behaviors regarding health information on WeChat. You will fill the questionnaire out on your phone. It will take on longer than 10 minutes.
- After completing the questionnaire, interview questions about your experience with health information on WeChat will be asked in a one-on-one setting. The interview will last no longer than 50 minutes.
- You will receive electronic educational materials via WeChat on health literacy and eHealth literacy developed based on this study in about three months after the interview.

University of Massachusetts Amherst-IRB (413) 545-3428	
Approval Date: 07/09/2018	Protocol #: 2018-4809
Valid Through: 07/08/2019	
IRB Signature: <i>Yanag C. Shultz</i>	

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6. WHAT ARE MY BENEFITS OF BEING IN THIS STUDY?

There may be no direct benefits from participating in this study. However, you will receive educational materials on health literacy and eHealth literacy developed based on the results of this study, which may improve your literacy skills, your health, and your children's health. Your participation will help develop the health literacy promotion strategies, which may benefit Chinese mothers with young children in the future.

7. WHAT ARE MY RISKS OF BEING IN THIS STUDY?

We believe there are no known risks associated with this research study. However, as with any online related activity the risk of a breach of confidentiality is always possible. To the best of our ability your answers in this study will remain confidential. If you don't feel comfortable answering any of the questionnaire or interview questions, you can skip or stop at any time. The educational materials are evidence-based, non-invasive, and will not pose risks to your health and well-being. A possible inconvenience may be the time it takes to complete the study.

8. HOW WILL MY PERSONAL INFORMATION BE PROTECTED?

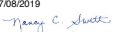
The following procedures will be used to protect the confidentiality of your study records. The screening forms and the questionnaires will be hosted by the Sojump website. Sojump is the largest online survey platform that has been widely used by research institutions in China (<https://www.wjx.cn/>). Data collected using Sojump website is password protected and accessible only by the researchers. We will transfer all the audio recordings collected from interviews to a password protected computer and then store them in Box (secure online storage at UMass Amherst). The records on the recording devices will be deleted. All audio recordings will be transcribed and translated into English. Participants will be assigned identification numbers (ID) and the ID will be used to de-identify all the data (questionnaire data and interview transcripts). The master key that links names and IDs will be stored in Box. Paper-based material (notes taken during interviews, paper-based informed consent forms) will be kept in a secure location in China and will be hand carried back to the U.S., where the material will be stored in a locked file cabinet in a locked room. The master key, audio recordings, and paper-based material will be destroyed/deleted three years after the close of the study. Findings and information from the study may be presented at various conferences and included in the development of manuscripts for publication for research purposes. Direct quotes from the interviews may be used in presentations and manuscripts, participants will not be identified in any publications or presentations.

9. WILL I RECEIVE ANY PAYMENT FOR TAKING PART IN THE STUDY?

No, you will not receive any payment for taking part in the study.

10. WHAT IF I HAVE QUESTIONS?

Take as long as you like before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the researcher Qiong Chen at (15988250611) or qiongchen@schoolph.umass.edu, or the Principal Investigator Dr. Elena Carbone via ecarbhone@nutrition.umass.edu. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at humansubjects@ora.umass.edu.

University of Massachusetts Amherst-IRB	
(413) 545-3428	
Approval Date: 07/09/2018	Protocol #: 2018-4809
Valid Through: 07/08/2019	
IRB Signature: 	

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11. CAN I STOP BEING IN THE STUDY?

You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate.

12. WHAT IF I AM INJURED?

The University of Massachusetts does not have a program for compensating subjects for injury or complications related to human subjects research, but the study personnel will assist you in getting treatment.

13. SUBJECT STATEMENT OF VOLUNTARY CONSENT

This study involves the audio recording of your interview with the researcher. Neither your name nor any other identifying information will be associated with the audio recording or the transcript. Only the research team will be able to listen to the recordings. Transcripts of your interview may be reproduced in whole or in part for use in presentations or written products that result from this study. Neither your name nor any other identifying information (such as your voice) will be used in presentations or in written products resulting from the study. On or before July, 20th, 2021, the recordings will be destroyed.

When signing this form I am agreeing to voluntarily enter this study. I have had a chance to read this consent form, and it was explained to me in a language which I use and understand. I have had the opportunity to ask questions and have received satisfactory answers. I understand that I can withdraw at any time. A copy of this signed Informed Consent Form has been given to me.

Please check one of the following boxes:

I agree to participate and I am allowing the researcher to audio record me as part of this research during a one-on-one interview. I understand that direct quotes may be used in presentations and manuscripts anonymously.

I agree to participate but I don't want to be audio recorded. However, I agree that the researcher can take notes during the interview. I understand that direct quotes may be used in presentations and manuscripts anonymously.

If you cannot agree any of the above options please see the researcher as you may be ineligible to participate in this study.

Participant Signature: _____

Print Name: _____

Date: _____

University of Massachusetts Amherst-IRB	
(413) 545-3428	
Approval Date: 07/09/2018	Protocol #: 2018-4809
Valid Through: 07/08/2019	
IRB Signature: <i>Mary C. Smith</i>	

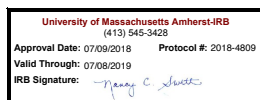
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By signing below I indicate that the participant has read and, to the best of my knowledge, understands the details contained in this document and has been given a copy.

Signature of Person
Obtaining Consent

Print Name:

Date:



APPENDIX B

INFORMED CONSENT: INTERVENTION

Consent Form for Participation in a Research Study
University of Massachusetts Amherst

Researcher(s):	Dr. Elena Carbone, Qiong Chen
Study Title:	Improving Chinese Mothers' Health Literacy: A WeChat Intervention
Funding Agency:	UMass Amherst School of Public Health and Health Sciences

1. WHAT IS THIS FORM?

This form is called a Consent Form. This consent form will give you the information you will need to understand why this study is being done and why you are being invited to participate. It will also describe what you will need to do to participate and any known risks, inconveniences or discomforts that you may have while participating. We encourage you to take some time to think this over and ask questions now and at any other time. If you decide to participate, you will be asked to click the "I agree" button.

2. WHAT IS THE PURPOSE OF THIS STUDY?

We are conducting this study to assess the current status of health literacy and eHealth literacy level and to explore the relationship between the two among women of reproductive age in China; and to evaluate the impact of a WeChat-delivered health education intervention on women's health literacy, eHealth literacy, and behaviors related to health information on WeChat.

3. WHERE WILL THE STUDY TAKE PLACE AND HOW LONG WILL IT LAST?

This study will take place between July 2018 and early 2019. The location of the study will be at your cellphone. It will take you approximately 2 hours and 15 minutes: up to 10 minutes for screening and baseline questionnaire, 12 intervention sessions for a total of 2 hours in 6 weeks (10 minutes per session), and 5 minutes for the follow-up questionnaire.

4. WHO IS ELIGIBLE TO PARTICIPATE?

Eligible subjects must be female, at least 18 years old, have at least one child who is between 0 and three years old, and currently living in mainland China.

5. WHAT WILL I BE ASKED TO DO?

- If you are eligible, you will be asked to stay as WeChat friends with researcher for about 5-6 months.
- You will first receive an online baseline questionnaire sent from the researcher via WeChat. The questionnaire includes questions on your contact information, demographics, health literacy, eHealth literacy, and behaviors related to health information on WeChat. It will take no longer than 10 minutes to complete.
- Once you complete the baseline questionnaire, the researcher will invite you to join a WeChat group with the focus of nutrition-related questions. You can ask only nutrition-related questions in the groups and the questions will be answered by Registered Dietitians. If you don't want to be part of the group, you can still participate in this study. You can simply stay as WeChat friends with the researcher.
- In about two months after completing the baseline questionnaire, you will receive an online follow-up questionnaire via WeChat. The questionnaire includes questions on your contact

information, health literacy, eHealth literacy, and behaviors related to health information on WeChat. It will take no longer than 5 minutes to complete.

e. You will receive about 12 intervention modules either between the baseline and the follow-up questionnaires, or after filling out the follow-up questionnaire. Each module may take about 10 minutes to go through. For example, a possible intervention module "Where can I find reliable health information online?" could include the following messages:

- A 30 seconds to 1 minute voice message to introduce the module.
- A picture summarizing the take-away messages of the module.
- A link to an article describing the characteristics of different types of online health resources using text, pictures, or videos (e.g., government websites, educational institutions, professional organizations, and companies);
- A link to an article which contains examples and links of reliable websites and WeChat official accounts;
- A link to an exercise that evaluates the learning objectives of the module and tracks the intervention compliance: A friend of yours asks you a question, "When can I give my 4-month-old baby yogurt?" Could you find something from a reliable online source to address this question? Please paste the link you found below.

Other possible intervention modules are: "How can I tell if a piece of online health information is true or false?", "How do I make the most out of a clinical appointment with a pediatrician?", "What should I do when I have a different opinion on child care with my parents-in-law?"

f. Once the study is completed, you will be reminded to unfriend the researcher on WeChat and leave the WeChat group. However, you can stay connected if you want. No further information will be collected by the researcher once the study is completed.

6. WHAT ARE MY BENEFITS OF BEING IN THIS STUDY?

There may be no direct benefits from participating in this study. However, you will receive educational materials on health literacy and eHealth literacy developed based on the results of this study, which may improve your literacy skills, your health, and your children's health. Your participation will help develop the health literacy promotion strategies, which may benefit Chinese mothers with young children in the future.

7. WHAT ARE MY RISKS OF BEING IN THIS STUDY?

We believe there are no known risks associated with this research study. However, as with any online related activity the risk of a breach of confidentiality is always possible. To the best of our ability your answers in this study will remain confidential. If you don't feel comfortable answering any of the questions, you can skip or stop at any time. The intervention modules are evidence-based, non-invasive, and will not pose risks to your health and well-being. A possible inconvenience may be the time it takes to complete the study.

8. HOW WILL MY PERSONAL INFORMATION BE PROTECTED?

The following procedures will be used to protect the confidentiality of your study records. The screening forms and the questionnaires will be hosted by the Sojump website. Sojump is the largest online survey platform that has been widely used by research institutions in China (<https://www.wjx.cn/>). Data collected using Sojump website is password protected and accessible only by the researcher. Participants will be assigned identification numbers (ID) and the ID will be used to de-identify all the data. The master key that links names and IDs will be stored in Box

(secure online storage at UMass Amherst). The master key will be destroyed/deleted three years after the close of the study.

Findings and information from the study may be presented at various conferences and included in the development of manuscripts for publication for research purposes. All information will be presented in summary format and participants will not be identified in any publications or presentations.

9. WHAT IF I HAVE QUESTIONS?

Take as long as you like before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the researcher Qiong Chen at (15988250611) or qiongchen@schoolph.umass.edu, or the Principal Investigator Dr. Elena Carbone via ecarbone@nutrition.umass.edu. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at humansubjects@ora.umass.edu.

10. CAN I STOP BEING IN THE STUDY?

You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate.

11. SUBJECT STATEMENT OF VOLUNTARY CONSENT

By clicking "I agree" below you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this research study. Please print a copy of this page for your records.

I Agree

I Do Not
Agree

APPENDIX C

INFORMED CONSENT: ONLINE FOCUS GROUPS

Consent Form for Participation in a Research Study
University of Massachusetts Amherst

Researcher(s):	Dr. Elena Carbone, Qiong Chen
Study Title:	WeChat Health Literacy Intervention Focus Group Study
Funding Agency:	UMass Amherst School of Public Health and Health Sciences

1. WHAT IS THIS FORM?

This form is called a Consent Form. This consent form will give you the information you will need to understand why this study is being done and why you are being invited to participate. It will also describe what you will need to do to participate and any known risks, inconveniences or discomforts that you may have while participating. We encourage you to take some time to think this over and ask questions now and at any other time. If you decide to participate, you will be asked to enter your name and click the "I agree" button.

2. WHY ARE WE DOING THIS RESEARCH STUDY?

We are conducting this research study to explore the impact of the "12 health literacy lessons". We would like to learn your experiences with the lessons, how they changed your way of finding and using health information, and how we could improve these lessons to help more mothers like you.

3. WHERE WILL THIS RESEARCH STUDY TAKE PLACE AND HOW MANY PEOPLE WILL PARTICIPATE?

This study will take place in April 2019. The location of the study will be at your cellphone within the WeChat app in a group chat environment. We expect to have two groups, each group will have about 8-15 participants.

4. WHAT ARE SOME OF THE IMPORTANT ASPECTS OF THIS RESEARCH STUDY THAT I SHOULD BE AWARE OF?

- 1) This consent is being sought for research and that participation in this study is voluntary;
- 2) The purposes of the research is to find out your experiences with the health literacy lessons. The expected duration of your active participation is about 1 hour over the course of 2-5 days. We will invite 8-15 women including you to join a WeChat group chat. The researcher Qiong Chen and the Registered Dietitian Qianzhi Jiang will also be in the group. We will be asking you questions related to your experiences with the health literacy lessons;
- 3) We believe there are no known risks associated with this research study; however, a risk of breach of confidentiality always exists and we will try our best to protect your personal information;
- 4) You may not directly benefit from this research; however, your participation will help develop the health literacy promotion strategies, which may benefit Chinese mothers with young children in the future.

5. WHO CAN PARTICIPATE IN THIS RESEARCH STUDY?

Participants who are currently enrolled in the health literacy study are eligible to participate in this focus group study. Participants must have completed some of the health literacy lessons.

6. WHAT WILL I BE ASKED TO DO AND HOW MUCH TIME WILL IT TAKE?

If you agree to take part in this study, you will be asked to:

- 1) You will be invited to join a WeChat group for the focus group discussion together with 7-14 other women;

- 2) The researcher Qiong Chen and the Registered Dietitian Qianzhi Jiang will be in the group as well. We will be asking you questions related to your experiences with our health literacy lessons;
- 3) Type of questions may include: How do you feel about the health literacy lessons? How have they changed your way of accessing and using health information? What's your favorite/least favorite lessons and why?
- 4) You may skip any question you feel uncomfortable answering.

We encourage you only to share your experiences and thoughts that are related to our questions/topics. We would like to remind you to be respectful to other participants and do not send any offensive comments. If anyone sends an offensive message, the researcher or the dietitian will first send her a warning. If she sends another offensive message, we will remove her from the group. We would like you to help us to create a safe space for all the participants to share their thoughts. Over the course of 2-5 days, we will be asking the group questions. You can answer questions or participate in the discussion whenever you have time during the 2-5 days. The total active participation time is expected to be 1 hour.

7. WILL BEING IN THIS RESEARCH STUDY HELP ME IN ANY WAY?

You may not directly benefit from this research; however, your participation will help develop the health literacy promotion strategies, which may benefit Chinese mothers with young children in the future.

8. WHAT ARE MY RISKS OF BEING IN THIS RESEARCH STUDY?

We believe there are minimal risks associated with this research study; however, a risk of breach of confidentiality always exists and we have taken the steps to minimize this risk as outlined in section 9 below. If you don't feel comfortable answering any of the questions, you don't have to answer or you can leave the chat group at any time. A possible inconvenience may be the time it takes to complete the study.

9. HOW WILL MY PERSONAL INFORMATION BE PROTECTED?

Your privacy and confidentiality is important to us. The following procedures will be used to protect the confidentiality of your study records.

This consent form will be collected electronically through Sojump. Sojump is the largest online survey platform that has been widely used by research institutions in China (<https://www.wjx.cn/>). Consent forms collected using Sojump website is password protected and accessible only by the researcher. E-signed consent forms will be stored securely and separately from the research data.

The chat history in the WeChat group will be used as study records. Participants will be assigned identification numbers (ID) and the ID will be used to de-identify all the data. The de-identified chat history and the master key that links names and IDs will be stored in separate documents in Box. Box is the secure online storage at UMass Amherst. Information on Box is password protected and accessible only by the researcher. The master key will be destroyed/deleted three years after the close of the study. The chat history on researchers' phone will be deleted once it is transferred to Box. The researchers will also ask all participants to delete the chat history from their phones once the online discussion is completed.

Please be advised that although the researchers will take every precaution to maintain confidentiality of the data, the nature of focus groups prevents the researchers from guaranteeing confidentiality. The researchers would like to remind participants to respect the privacy of your fellow participants and not repeat what is said in the focus group to others.

Findings and information from the study may be presented at various conferences and included in the development of manuscripts for publication for research purposes. All information will be presented in summary format and participants will not be identified in any publications or presentations.

10. WILL MY INFORMATION BE USED FOR RESEARCH IN THE FUTURE?

Identifiers might be removed and the de-identified information may be used for future research without additional informed consent from you.

11. WILL I BE GIVEN ANY MONEY OR OTHER COMPENSATION FOR BEING IN THIS RESEARCH STUDY?

A compensation of 30 CNY will be given upon the completion of the focus group discussion. If you decide to terminate your participation early, a partial compensation of 5 CNY will be given after the entire study is completed. All monetary compensation will be distributed using electronic transaction through WeChat Pay. Since you are being compensated for your participation in this study, your personal information may be released to the accounting officials at University of Massachusetts, Amherst. This information will be kept confidential and will only be used to process payment.

12. WHO CAN I TALK TO IF I HAVE QUESTIONS?

Take as long as you like before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the researcher Qiong Chen at (WeChat: 15988250611) or qiongchen@schoolph.umass.edu, or the Principal Investigator Dr. Elena Carbone via ecarbone@nutrition.umass.edu. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at humansubjects@ora.umass.edu.

13. WHAT HAPPENS IF I SAY YES, BUT I CHANGE MY MIND LATER?

You do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate.

14. WHAT IF I AM INJURED?

The University of Massachusetts does not have a program for compensating subjects for injury or complications related to human subjects research, but the study personnel will assist you in getting treatment.

15. SUBJECT STATEMENT OF VOLUNTARY CONSENT

By entering your name and clicking "I agree" below you are indicating that you:

- ✓ Have read and understood this consent form and agree to voluntarily enter this study;
- ✓ Have had the opportunity to ask questions and have received satisfactory answers;
- ✓ Have been informed that you can withdraw at any time;
- ✓ Agree to maintain the confidentiality of the information discussed by all participants and researchers during the focus group session.

If you cannot agree to the above stipulation please contact the researcher as you may be ineligible to participate in this study.

Please print a copy or save a screenshot of this page for your records.

Your name: _____

I Agree

I Do Not
Agree

APPENDIX D

SCREENING FORM AND PRE-QUESTIONNAIRE

Intervention screening form & baseline questionnaire (online via Sojump)

Screening form

Dear Mom,

Before you officially take part in this study, please answer the questions below. If you are not eligible, your answer will be destroyed. If you are eligible, your answers will become part of the study materials, and we will protect your information as confidential and safeguard it from unauthorized disclosure. Only project personnel will have access to the information contained in your screening form. If the screening form indicates that you are eligible to participate, you will receive an Informed Consent Form. If you don't feel comfortable filling out any of the questions, you can skip them. You can also stop at any time.

1. What's your gender?
 - A. Male (→ End survey when click next question)
 - B. Female
 - C. Other (→ End survey when click next question)
2. Do you have a child who is between 0 and 3 years old? (Born after August 1st, 2015 or ≤ 36 months old)
 - A. Yes
 - B. No (→ End survey when click next question)
3. Are you older than 18 years?
 - A. Yes
 - B. No (→ End survey when click next question)

Congratulations, you are eligible to participate in this study! Please read the information below carefully.

(Informed consent form for intervention)

By clicking "I agree" below you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this research study. Please print a copy of this page for your records.

- ☐ I agree
- ☐ I don't agree (→ End survey when click next question)

Baseline questionnaire

Thank you for being a part of our study. In this questionnaire, we are going to ask you to answer some questions about your health literacy and eHealth literacy, your experiences using WeChat for health information, and your background. All information will be confidential. You can skip questions you don't want to answer or stop at any time.

Section 1. Health literacy

The questions in this section will ask you about your experiences of finding and using health-related information. Please tick one response for each question.

1. How often do you need someone to help you when you are given information to read by your doctor, nurse or pharmacist?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
2. When you need help, can you easily get hold of someone to assist you?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely

Intervention screening form & baseline questionnaire (online via Sojump)

3. How often do you need help to fill in official documents?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
4. When you talk to a doctor or nurse, do you give them all the information they need to help you?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
5. When you talk to a doctor or nurse, do you ask all the questions you want or need to ask?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
6. When you talk to a doctor or nurse, do you make sure they explain anything that you do not understand?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
7. Are you someone who likes to find out lots of different information about your health?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
8. How often do you think carefully about whether the health information you see makes sense in your particular situation?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
9. How often do you think about whether the information about your health can be trusted?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
10. Are you the sort of person who might question your doctor or nurse's advice based on your own research?	<input type="checkbox"/> Yes, definitely	<input type="checkbox"/> Maybe/ Sometimes	<input type="checkbox"/> Not really

11. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all
12. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all
13. When at home, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diet, lifestyle, disease care, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all
14. When at home, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diet, lifestyle, disease care, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all

Section 2. eHealth literacy

The questions in this section will ask you about your experiences of finding and using health-related information from the Internet. Please tick one response for each question.

1. I don't understand the meaning of symbols used in health information (eg., BMI, pH, OGTT)	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
2. I find health information on the Internet hard to understand.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
3. I find the use of math formulas (e.g., formula of calculating BMI, fetal movements, energy expenditure, etc.) to explain health information on the Internet is difficult to understand.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree

Intervention screening form & baseline questionnaire (online via Sojump)

4. I can use search engines to effectively find health information on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
5. I try to find new health information on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
6. From the health information on the Internet, I can select what I need.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
7. I can understand the health information I find on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
8. I think over if the health information on the Internet applies to my situation.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
9. I try to use multiple sources to verify if the health information on the Internet is correct.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
10. I check the validity and reliability of health information on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
11. I review many people's opinions and discussions so that I can make decisions or take actions that are good for my health.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
12. When I question the health information on the Internet, I use other channels to verify it.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree

Section 3. Behaviors on WeChat

The questions in this section will ask you about your experiences using WeChat for health information. Please tick one response for each question.

1. How often do you search for health-related information through WeChat? (e.g. read articles from subscribed official accounts, use search engine within WeChat, read articles from friends on moment, one-on-one chat, or group chat).	<input type="checkbox"/> Never	<input type="checkbox"/> Rarely	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Very often	<input type="checkbox"/> Always
2. How often do you share health-related articles with others (post on moments, send to friends, or send to groups)?	<input type="checkbox"/> Never	<input type="checkbox"/> Rarely	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Very often	<input type="checkbox"/> Always
3. I feel confident using health-related information from WeChat to make health decisions.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
4. I can tell high quality health resources from low quality health resources on WeChat.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree

Section 4. Personal factors

This section will ask you some basic information about your.

1. How many children do you have? _____
2. Fill in your child/children's birthday:
Child 1 : _____mm/dd/yy
Child 2 : _____mm/dd/yy
Child 3 : _____mm/dd/yy
If you have more children, fill in their birthdays : _____mm/dd/yy
3. How old are you? _____
4. What is the highest level of education you were able to complete?
 - A. Less than high school degree
 - B. High school degree
 - C. Some college or vocational school after high school
 - D. Bachelor's degree or equivalent
 - E. Master's degree or higher
5. What's your occupation?
 - A. Unemployed
 - B. Health-related jobs (e.g. doctor, nurse, pharmacist, etc.)
 - C. Other jobs
6. Are you currently in the WeChat-based maternal and child-related business? (Sell maternal and child-related products on WeChat, e.g. diapers, formula, kids' clothing, toys, etc.)
 - A. Yes, I am a full-time WeChat business owner (work \geq 40 hours a week). I don't have another job besides this.
 - B. Yes, I am a part-time WeChat business owner (work < 40 hours a week). I also have another job.
 - C. Yes, I am a part-time WeChat business owner (work < 40 hours a week). I don't have another job besides this.
 - D. No, I am not currently in the WeChat business.
7. What's your marital status?
 - A. Never married
 - B. Married
 - C. Living in a marriage-like relationship
 - D. Divorced/separated
 - E. Widowed
8. How many hours a day on average do the following people take care of your child who is 3 years old or younger? Fill in a number between 0 and 24:

Yourself: _____hours/day

Your partner: _____hours/day

Your partner's parents: _____hours/day

Your parents: _____hours/day

Nanny: _____hours/day

Daycare: _____hours/day

Other: _____hours/day

Intervention screening form & baseline questionnaire (online via Sojump)

9. What's your household monthly income?
- A. Less than 5,000 CNY
 - B. 5,000 to 10,000 CNY
 - C. 10,001 to 15,000 CNY
 - D. 15,001 to 20,000 CNY
 - E. 20,001 to 30,000 CNY
 - F. 30,001 CNY or higher
10. What's your residency status?
- A. Urban residency
 - B. Rural residency
 - C. Not sure
11. What's your current place of residence? Province____City____District____
12. Are you currently pregnant?
- A. Yes
 - B. No
 - C. Not sure
13. When you need medical care, what's your preferred type of medicine?
- A. Traditional Chinese Medicine as first choice
 - B. Western Medicine as first choice
 - C. Depends

Contact information

(Please enter your name and phone number. We will protect the confidentiality of your study records.)

Name:_____

Cell phone number:_____

Thank you for taking the time to answer these questions!

APPENDIX E

POST-QUESTIONNAIRE

Follow-up questionnaire (online via Sojump)

Dear Mom,

Thank you for completing a pre-questionnaire before and being a part of our study. In this follow-up questionnaire, we are going to ask you to answer some questions about your health literacy, eHealth literacy, your experiences of using WeChat for health information, *[your experiences with the health literacy lessons (only intervention participants will get this section of questions),]* and your contact information. All information will be confidential. You can stop at any time if you don't want to participate.

After you successfully submit the questionnaire, we will send you a 5 CNY red packet. Your answer to the questions will not impact your eligibility for receiving the incentives. Your honest response is very important to us.

Section 1. Health literacy

The questions in this section will ask you about your experiences of finding and using health-related information. Please tick one response for each question.

1. How often do you need someone to help you when you are given information to read by your doctor, nurse or pharmacist?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
2. When you need help, can you easily get hold of someone to assist you?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
3. How often do you need help to fill in official documents?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
4. When you talk to a doctor or nurse, do you give them all the information they need to help you?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
5. When you talk to a doctor or nurse, do you ask all the questions you want or need to ask?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
6. When you talk to a doctor or nurse, do you make sure they explain anything that you do not understand?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
7. Are you someone who likes to find out lots of different information about your health?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
8. How often do you think carefully about whether the health information you see makes sense in your particular situation?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
9. How often do you think about whether the information about your health can be trusted?	<input type="checkbox"/> Often	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Rarely
10. Are you the sort of person who might question your doctor or nurse's advice based on your own research?	<input type="checkbox"/> Yes, definitely	<input type="checkbox"/> Maybe/ Sometimes	<input type="checkbox"/> Not really

11. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all
12. When seeking help from health care providers, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diagnostic tests, drugs, treatment plans, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all
13. When at home, to what degree do you feel you have control over decisions regarding your own personal health? (e.g. diet, lifestyle, disease care, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all

Follow-up questionnaire (online via Sojump)

14. When at home, to what degree do you feel you have control over decisions regarding your child/children's health? (e.g. diet, lifestyle, disease care, etc.)	<input type="checkbox"/> To a very high degree	<input type="checkbox"/> To a fairly high degree	<input type="checkbox"/> To a small degree	<input type="checkbox"/> Not at all
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Section 2. eHealth literacy

The questions in this section will ask you about your experiences of finding and using health-related information from the Internet. Please tick one response for each question.

1. I don't understand the meaning of symbols used in health information (eg., BMI, pH, OGTT)	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
2. I find health information on the Internet hard to understand.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
3. I find the use of math formulas (e.g., formula of calculating BMI, fetal movements, energy expenditure, etc.) to explain health information on the Internet is difficult to understand.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
4. I can use search engines to effectively find health information on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
5. I try to find new health information on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
6. From the health information on the Internet, I can select what I need.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
7. I can understand the health information I find on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
8. I think over if the health information on the Internet applies to my situation.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
9. I try to use multiple sources to verify if the health information on the Internet is correct.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
10. I check the validity and reliability of health information on the Internet.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
11. I review many people's opinions and discussions so that I can make decisions or take actions that are good for my health.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
12. When I question the health information on the Internet, I use other channels to verify it.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree

Follow-up questionnaire (online via Sojump)

Section 3. Behaviors on WeChat

The questions in this section will ask you about your experiences using WeChat for health information. Please tick one response for each question.

1. How often do you search for health-related information through WeChat? (e.g. read articles from subscribed official accounts, use search engine within WeChat, read articles from friends on moment, one-on-one chat, or group chat).	<input type="checkbox"/> Never	<input type="checkbox"/> Rarely	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Very often	<input type="checkbox"/> Always
2. How often do you share health-related articles with others (post on moments, send to friends, or send to groups)?	<input type="checkbox"/> Never	<input type="checkbox"/> Rarely	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Very often	<input type="checkbox"/> Always
3. I feel confident using health-related information from WeChat to make health decisions.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree
4. I can tell high quality health resources from low quality health resources on WeChat.	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neutral	<input type="checkbox"/> Agree	<input type="checkbox"/> Strongly agree

Section 4. Intervention participation (only participants in the intervention group will get these questions)

The questions in this section will ask you about your experiences with the health literacy lessons. Please tick one response for each question.

1. Have you read the intervention lessons?			
1. How can I tell if the health information I'm reading is reliable? (Part 1)	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
2. How can I tell if the health information I'm reading is reliable? (Part 2)	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
3. Is an online encyclopedia a reliable information source?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
4. Are online forums or chat groups reliable information sources?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
5. How can I tell if a WeChat official account is reliable?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
6. What can I do when I suspect that what I'm reading is not true?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
7. How do I make the most out of a clinical appointment with my child's doctor?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
8. Are online medical consultation sites reliable?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
9. How do I communicate with other family members about my child's health?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
10. Who should I listen to when different doctors have different opinions?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
11. How do I interpret the latest health research in the news?	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember
12. Summary	<input type="checkbox"/> No, I didn't read it	<input type="checkbox"/> Yes, I read it	<input type="checkbox"/> I don't remember

Follow-up questionnaire (online via Sojump)

2. What comments do you have about the lessons that you have read?

Section 5. Contact information

(Please enter your name and phone number. We will protect the confidentiality of your study records.)

Name: _____

Cell phone number: _____

Thank you for taking the time to answer these questions!

APPENDIX F

SAMPLE INTERVENTION LESSON

Lesson 5. How can I tell if a WeChat official account is reliable?











Voice Message:

Dear mom,












Do you have WeChat maternal and infant official accounts subscriptions? What makes you decide to follow them not the others? How do you know who to trust, especially when they have different opinions? We will discuss how to evaluate WeChat official accounts today.

Article:

Are you subscribers of at least some of the WeChat official accounts below?

排名	公众号	发布次数/篇数
1	 年糕妈妈 niangao-mama	30/172
2	 窈窕妈妈 ilimum	30/104
3	 妈妈手册 jqfans	30/120
4	 六妈罗罗 liumaluoluo	26/26
5	 畅儿妈妈 wojiachanger1	16/17
6	 凯叔讲故事 kaishujianggushi	30/215
7	 崔玉涛的育学园 cuiyutao2015	30/78
8	 芝芝妈妈 zhizhimammy	12/12
9	 爱儿康 arkang666666	30/121
10	 小小包麻麻 xxbmm123	30/212







Most popular maternal and infant WeChat official accounts in the past month based on one of the third-party ranking websites, gsdata.

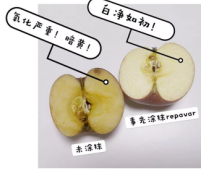


排名	公众号	发布次数/篇数
1	 丁香医生 DingXiangYiSheng	83/254
2	 丁香园 dingxiangwang	74/138
3	 脉脉养生 mmajiu	30/129
4	 丁香妈妈 DingXiangMaMi	29/141
5	 三甲传真 sanjiachuanzhen	30/51
6	 新老人 xinlaoren	30/240
7	 BTV我是大医生官微 woshidayisheng	30/143
8	 健康时报 jksb2013	60/126
9	 健康养生 jkys563	30/240
10	 养生固本健康人生 infnitus_ysgbjkrs	30/30
11	 壹心理 yixinli	30/202

Most popular health WeChat official accounts in the past month based on gsdata.

These official accounts are very popular, but is the information trustworthy? We selected some of the health-focused maternal and infant accounts. Let's take a closer look of some of the representative accounts using our criteria described in lesson 1 and 2.

A. Niangao-mama

		
<p>Started by a “Niangao-mama”, who has a master in medicine.</p>	<p>Written by “Niangao-mama”, not sure if it means the founder or any employee.</p>	<p>Some articles have references cited, and reviewed by a pediatrician.</p>
		
<p>Has a child-rearing encyclopedia; however, no author name or reference are provided for the information.</p>	<p>Sells courses and products.</p>	<p>Paid online course run by people with advanced degrees or certificates.</p>

<p>8:51</p> <p>× 年糕妈妈</p>  <p>结果不到一个小时，未做处理的一半苹果已经被氧化得不成样子了，暗黄很明显，还有些干瘪。</p> <p>而事先涂上 repavar VC 精华的苹果还是白净如初，水当当的。</p>  <p>由此可见，repavar 的抗氧化能力很厉害的～</p>	<p>2:38</p> <p>× 年糕妈妈</p> <p>2个月瘦身12斤，这样的减肥方法有效又不伤身</p> <p>年糕妈妈 昨天</p> <p>天气越来越冷了，每天早晨有两件事最让人头疼：从暖烘烘的被窝里爬起来，和换衣服的时候照镜子。</p> <p>看着肚子上肉眼可见的“胖三斤”，真是后悔秋天贴了那么多膘啊。</p> <p>后台也经常收到妈妈们关于胖和减肥的“困扰”。但很多人并不是真的有多胖，而是生完孩子以后整个人变得“厚重”了，小肚腩、蝴蝶臂、水肿腿、大象腿……真的好烦啊！每天捏捏肚子上的肉就忍不住嫌弃自己，可是冬天这么冷，根本不想出门运动好么！</p> <p>就没有吃得好吃得好、能轻松点瘦下来的方法吗？</p> <p>还真有！</p>	<p>2:39</p> <p>× 年糕妈妈</p> <p>左医生今年已经47岁了，三年前，她尝试了轻断食，用不到2个月的时间减掉12斤。身为科普专家，左医生经常需要参加电视台的拍摄，轻断食成为了她在镜头前保持良好形象的制胜法宝。</p> <p>▼轻断食前</p>  <p>▼轻断食后</p> 
<p>In an advertisement, used apples to show the antioxidant properties of the skincare product.</p>	<p>An advertisement entitled “Losing 6 kg in 2 months, the method is effective and safe”. It sells a course on intermittent fasting targeting moms.</p>	<p>Uses personal experiences/testimonials in the ads.</p>

1 Who runs it?

Started by a mother who has a Master’s degree in medicine, graduated from Zhejiang University. She now has a team to manage the account. They sell online courses on maternal and infant health such as weight loss class and parenting class, and have an online store to sell all kinds of products such as infant foods, toys, makeups, etc.

2 How is the information produced?

This account covers health education articles, more general topics such as safety issues, stories, making fun of partners and mothers themselves/chicken soup for the soul, and advertisements. The health education articles are usually written by “Niangao-mama”. However, Niango-mama can be the person who started the account (has a master’s degree in Medicine), or can be any employee who works for the account Niango-mama. They cover a variety of topics such as feeding, prenatal and perinatal care, infant care, infant sleep, child health, etc. Some of the health education articles cited references, but not all of them. Frequently cited references include Sears intimate parenting encyclopedia, Heidi parenting encyclopedia, Healthychildren, NHS, Baby Center, and journal articles. Some articles are reviewed by a pediatrician. Advertisements are usually written by other editors. No editorial policy can be found.




3 Where does the information come from?

Not all the health education articles cited references. Advertisements use a lot of testimonials.

4 Too good to be true?


Some advertisements do sound too good to be true, such as “losing 6 kgs in 2 months”, or “After using this product, all my friends say my skin looks brighter”.

B.DingXiangMaMi

		
<p>DingXingMami is an account targeting maternal and infant health by the company DXY. They provide health information, sell online courses, and products.</p>	<p>Online courses are taught by doctors or people with advanced degrees in health. Topics include infant sleep guide, disease care, complementary food preparation, etc.</p>	<p>Articles are written by different health care professionals or people with advanced degrees in the field.</p>

		
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In one article, a master in nutrition and food safety concluded that walnut oil is not superior to other type of vegetable oils.	Another article (advertisement) is written by a Registered Dietitian.	In this advertisement, the RD recommended walnut oil, then recommended a specific brand of walnut oil that can be purchased on their online shopping platform.
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<p>9:40 丁香妈妈</p> <p>二手烟不仅会引发儿童哮喘、婴儿猝死综合症、气管炎、中耳炎，同样也会引发肺炎。如果家里有人吸烟，最好戒除。</p> <p>大家也许不知道，在中国，每年大概有 0.21 亿儿童发生肺炎；平均每 17 分钟就有 1 名 5 岁以下的儿童死于肺炎链球菌相关的疾病。</p> <p>但这一切其实是可以避免的。孩子年龄尚小，家长一定要注重预防及早期控制。如果怀疑孩子得了肺炎，就尽早去医院诊断，否则拖延发展成重症肺炎，那时候可就后悔莫及了。</p> <p>参考来源： 1. update 2. WHO 儿童急性呼吸道感染防治指南 3. 肺炎球菌免疫性疫苗预防专家共识 (2017 版)</p>	<p>9:39 丁香妈妈</p>  <p>图片来源: 123rf.com.cn 正版图片库</p> <p>孩子一旦患上肺炎，不仅痛苦难受，对于家庭来说，治疗费用也是一笔不小的开支。</p> <p>根据上海市的一项临床统计数据，2 岁以下儿童的肺炎住院次均费用高达 7000~8000 元。</p> <p>直隸市的住院总费用是全国平均水平的 3.48 倍。上海市数据提示¹⁰，2011 年肺炎患者平均住院日为 13.04，住院次均总费用为 10 971 元，患者平均住院日和费用数据呈 U 形分布，即 <2 岁儿童和 >50 岁老年患者住院和治疗费用明显高于其他人群，其中 <12 月龄儿童住院次均费用为 8 918 元，12~23 月龄为 7 385 元，30~64 岁为 10 160 元，≥65 岁为 14 520 元，而 24 月龄至 34 岁均低于 7 000 元。此外，2011 年上</p> <p>图片来源: 肺炎球菌免疫性疫苗预防专家共识(2017 版)</p>	<p>9:40 丁香妈妈</p> <p>据《中国 0~6 岁儿童营养发展报告》的报道</p> <p>6~24 月龄儿童贫血率最高，我国 2 岁以内婴幼儿贫血率达到 31.1%。</p> <p>也就是说，对于 6~24 月龄的宝宝，每 10 个里面就有 3 个贫血。</p> <p>仅仅吃高铁米粉，并不能达到宝宝每日必需的铁含量。</p> <p>6~12 月龄的宝宝，每天需要补铁 10 mg，这相当于得吃 100~200 g 的高铁米粉，而我们建议每天给宝宝吃的米粉大约只有 25~30 g。</p> <p>及时给宝宝吃肉，才是保证营养的好方法。</p>
Sometimes references are listed, but not for all articles.	Sometimes in the text the authors cite information from WHO, journal articles, clinical guidelines, and governmental reports.	

1 Who runs it?

It is run by the health care company DXY. This account specifically targets maternal and child health. Similar to Niangao-mama, they also sell online courses on maternal and infant health such as weight loss class and parenting class, and have an online store to sell all kinds of products such as infant foods, toys, makeups, etc.

ding

2 How is the information produced?

Different to Niangao-mama, the health education articles are written by different healthcare professionals or people with advanced degrees in health-related field. All the health education articles on DingXiangMaMi can also be found on the website DXY. DXY has a group of authors and a group of reviewers who are health care professionals. However, detailed editorial policy cannot be found on the DingXiangMaMi WeChat account.

3 Where does the information come from?




Some articles provide a list of the references at the end but not for all articles. Some articles cite reference in the text but do not provide a list of references at the end. References usually come from scientific journal articles, organizations like WHO, and clinical guidelines if the information is provided.

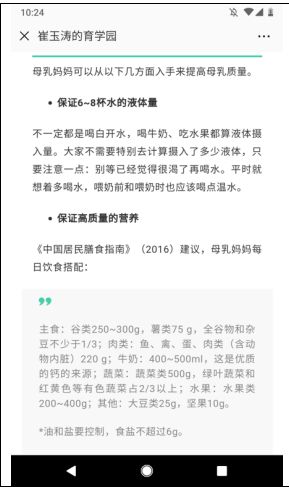


4 Too good to be true?

Sometimes the advertisements may provide biased information. For example, an advertisement on what type of oil is the best for infants concluded that walnut oil is the recommended one by an RD. However,

another article without any advertisements has a different conclusion that walnut oil is not better than other types of vegetable oil.

C. Cuiyutao2015

 <p>10:22</p> <p>崔玉涛的育学园</p> <p>崔玉涛唯一认证官方订阅号，为中国家庭提供婴幼儿健康、养育、护理指导，全面解决育儿难题。</p> <p>2632篇原创文章 158位朋友关注</p> <p>进入公众号 取消关注</p> <p>APP下载 育儿宝典 活动园地</p> <p>消息</p> <p>起疹子、发痒、脱皮.....这种皮肤问题护理方法不对，只会越治越糟！...</p> <p>3位朋友读过</p> <p>冬季高发</p>	 <p>10:23</p> <p>崔玉涛的育学园</p> <p>今儿小编就和大家分享一些关于湿疹的知识，希望每个宝宝都能健康康的，远离湿疹这个“大坏蛋”。</p> <p>(除了湿疹的知识，还有超值福利哦~赶快去文末查看吧！)</p> <p>首先，小编先带大家了解一下引起湿疹的原因。</p> <p>一个重要的原因就是宝宝皮肤屏障功能差，发育不成熟，抵御不了外界的刺激，被以细菌为主的刺激物入侵后，就会引起湿疹。</p> <p>我们的皮肤表层是由角质细胞和细胞外基质组成</p>	 <p>10:24</p> <p>崔玉涛的育学园</p> <p>如果有宝宝过敏而自己忌口了鸡蛋、牛奶，母乳妈妈可以通过适当增加肉类、不含奶的钙剂等来补充蛋白质和钙质。如果不爱吃肉，或者是素食主义者，那么要特别注意维生素B12的补充。可以吃综合维生素弥补营养的缺失，必要时咨询营养科的医生哦。</p> <p>与有经验的妈妈交流科学育儿 崔玉涛的育学园APP</p> <p>点下方“阅读原文”下载育学园app</p> <p>更多关于育儿知识内容等着你</p>
It's run by a pediatrician Dr. Cui.	However, most of the articles are written by editors. We cannot find any information on who the editors are.	Most of the time no references are cited at the end of the articles.

 <p>10:24</p> <p>崔玉涛的育学园</p> <p>母乳妈妈可以从以下方面入手来提高母乳质量。</p> <ul style="list-style-type: none">保证6-8杯水的液体量 <p>不一定是喝白开水，喝牛奶、吃水果都算液体摄入量。大家不需要特别去计算摄入了多少液体，只要注意一点：别等已经觉得很渴了再喝水。平时就想着多喝水，喂奶前和喂奶时也应该喝点温水。</p> <ul style="list-style-type: none">保证高质量的营养 <p>《中国居民膳食指南》（2016）建议，母乳妈妈每日饮食搭配：</p> <p>主食：谷类250-300g，薯类75g，全谷物和杂豆不少于1/3；肉类：鱼、禽、蛋、肉类（含动物内脏）220g；牛奶：400-500ml，这是优质的钙的来源；蔬菜：蔬菜类500g，绿叶蔬菜和红黄色等有颜色蔬菜占2/3以上；水果：水果类200-400g；其他：大豆类25g，坚果10g。</p> <p>*油和盐要控制，食品不超过6g。</p>	 <p>10:23</p> <p>崔玉涛的育学园</p> <p>那就是碧浪的抑菌洗衣凝珠。</p> <p>它是日本原装进口产品，品质和口碑绝对有保障，它可是日本妈妈最爱的洗衣产品，在日本和欧洲的销量NO.1，据说在日本每0.3秒就会卖出一颗哦。</p> <p>它可以长效抑菌长达18个小时。</p> <p>区别于衣物消毒剂，它不是直接杀灭细菌，而是利用特殊的工艺抑制细菌的滋生，让细菌的数量保持在合理的范围，既不会破坏宝宝肠道菌群的平衡，也不会因为细菌泛滥影响宝宝的健康。</p> <p>尤其是对金黄色葡萄球菌这个引起皮肤感染最常见</p>	 <p>10:38</p> <p>崔医生谈育儿</p> <p>会员专享</p> <p>8分钟和1个育儿难题说再见！</p> <p>每周三、五、日准时更新 第486期——超过80万家长加入会员</p> <p>加入会员</p> <p>宝宝夜醒只能靠奶睡接觉？解决办法在这里！</p> <p>相信很多家长在养育宝宝的过程中都有这样的体会，</p> <p>宝宝一旦出现频繁夜醒的情况，</p> <p>家长往往往... 成为会员</p>
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Sometimes references are cited in the text, for example, from the Dietary Guidelines and AAP.	An article on “eczema” is actually an advertisement at the end.	They also sell membership to their App. Members have access to more health information such as educational videos by Dr. Cui, online courses by healthcare professionals, etc.
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1 Who runs it?

It was started by a pediatrician Dr. Cui. They have an App targeting mothers, which offers some free information and paid membership. Dr. Cui also has an offline private pediatric clinic. This account also sells Dr. Cui’s books.

2 How is the information produced?

Most of the health education articles on the official account are written by editors. Whether the articles are reviewed the doctor is unknown. The credentials of the editors are also unknown.

3 Where does the information come from?

Occasionally some articles may cite other references in the text, such as the Dietary Guidelines or the AAP; however, most of the time references are not provided.

4 Too good to be true?

Advertisements do not seem to be too exaggerated, however, they are always included in articles that seem to be educational. For example, an article discussing eczema may be followed by an advertisement of a laundry detergent.

Summary

WeChat Official Accounts	Overall rating for health information
Niangao-Mama	Pros: Covers wide range of health topics, sometimes reviewed by doctors. Cons: Mostly written by one person although she has a master’s degree in pediatrics. More ads than “meat”! Some advertisements can be exaggerated.
DingXiangMaMi	Pros: Covers wide range of health topics, written by a lot of health care professionals, may have a peer review system according to DXY. Cons: More and more ads! Advertisements may provide biased health information.
Cuiyutao2015	Pros: Covers wide range of health topics. Fewer advertisements compare to Niango-Mama and DingXiangMaMi. Cons: Author/editor information is not clear, where the information is coming from is also not clear. Health information mixed with advertisement.

The popular WeChat maternal and infant health official accounts are not perfect. They more or less have some advertisements. To find reliable health information on WeChat official accounts:

- Information is more reliable if author/reviewer information and references can easily be found.
- Watch for advertisement! If the purpose of an article is to sell a product, the information may be biased even if it’s written by a healthcare professional.
- Compare across multiple information sources to see if you are getting the consistent information.




References

Lesson 1 and lesson 2

Exercise




Your friend is following two WeChat maternal and infant official accounts, Yihe Health and Little Bao Mom. Which one do you think it's a better source of health information? Use the following screenshots to help you make a decision.




Yihe Health

 <p>This account provides health information, online courses run by doctors, online medical consultation.</p>	 <p>It has videos by doctors, online courses, and educational articles on various health topics.</p>	 <p>Sells online courses taught by doctors, but do not sell any other products.</p>
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<p>This article answers the question whether the quality of breastmilk will be affected by mother's diet.</p>	<p>It cited AAP, NIH, and UPTODAE in the text.</p>	<p>It is written by a doctor. A short bio is provided at the end of the article. A list of references is also provided.</p>

Little Bao's Mom

		
<p>It's run by a mother. Topics cover complementary food feeding, maternal and infant</p>	<p>It has its own platform to sell products.</p>	<p>The author is a mother of two children.</p>

products comparing, and child rearing knowledge.		
 <p>The latest message has more advertisement than health-related articles.</p>	 <p>Articles are written by the mom, however, we don't know her credentials besides that she is a mother of two children.</p>	 <p>Not all health-related articles provide references. Some articles may cite other resources in text, such as AAP or dietary guidelines.</p>

- A. Yihe Health is a better source of health information.
- B. Little Bao's Mom is a better source of health information.
- C. I am not sure.

BIBLIOGRAPHY

- Alsop, R., & Heinsohn, N. (2005). *Measuring empowerment in practice: structuring analysis and framing indicators*. Washington, DC: World Bank.
- An, Z., & Chou, C. (2016). Social support for first-time Chinese mothers in contexts of provider-recipient relationships. *Health Communication, 31*(4), 504-512.
doi:10.1080/10410236.2014.973556
- Barsell, D. J., Everhart, R. S., Miadich, S. A., & Trujillo, M. A. (2018). Examining health behaviors, health literacy, and self-efficacy in college students with chronic conditions. *American Journal of Health Education, 49*(5), 305-311.
doi:10.1080/19325037.2018.1486758
- Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2018). *Thematic Analysis*. In: Liamputtong P. (eds) *Handbook of Research Methods in Health Social Sciences*. Singapore: Springer.
- Carbone, E., & Smith, S. (2019). Empowerment & health literacy: Reintegrating critical health literacy. *Health literacy in clinical practice and public health: New initiatives and lessons learned at the intersection with other disciplines*. (Unpublished book chapter)
- Chen, J., Hou, X., Zhao, W., & Fu, Y. (2016). Users' perception and utility of health information based on WeChat. *Management Science and Engineering, 10*(3), 18-23.
doi://dx.doi.org/10.3968/n
- Chen, Q., Pearlman, J., Beffa-Negrini, P., & Carbone, E. (2019). *Examining functional, interactive, and critical health literacy, eHealth literacy and empowerment among Chinese women with young children*. (Unpublished manuscript)
- Chen, Q. (2017). *Reading the information in applications is like eating fast food": Motherhood and social media* (Master's Thesis) Available from Lund University Libraries. Retrieved from
<http://lup.lub.lu.se/luur/download?func=downloadFile&recordId=8906812&fileId=8916755>
- Chen, X., Goodson, P., Acosta, S., Barry, A. E., & McKyer, L. E. (2018). Assessing health literacy among Chinese speakers in the U.S. with limited English proficiency. *Health Literacy Research and Practice, 2*(2), 94-106. doi:10.3928/24748307-20180405-01
- China Internet Network Information Center. (2017). *2016 年中国社交应用用户行为研究报告 [2016 China social app user behavior research report]*. Beijing: China Internet Network Information Center. Retrieved from
<https://cnnic.cn/hlwfzyj/hlwxbg/sqbg/201712/P020171227483413972757.pdf>
- China Internet Network Information Center. (2018). *第 41 次中国互联网发展状况统计报告 [The 41st China statistical report on Internet development]*. Beijing: China Internet Network

- Information Center. Retrieved from <http://www.cnnic.net.cn/hlwfzyj/hlwzbg/hlwtjbg/201801/P020180131509544165973.pdf>
- Chinn, D., & McCarthy, C. (2013). All Aspects of Health Literacy Scale (AAHLS): developing a tool to measure functional, communicative and critical health literacy in primary healthcare settings. *Patient Education and Counseling*, 90(2), 247-253.
- Chou, W. S., Oh, A., & Klein, W. M. (2018). Addressing health-related misinformation on social media. *Jama*, 320(23), 2417-2418.
- Crondahl, K., & Eklund Karlsson, L. (2016). The Nexus Between Health Literacy and Empowerment: A Scoping Review. *SAGE Open*, 6(2), 1-7. doi:10.1177/2158244016646410
- Cyril, S., Smith, B. J., & Renzaho, A. M. (2015). Systematic review of empowerment measures in health promotion. *Health Promotion International*, 31(4), 809-826.
- Diviani, N., Van den Putte, B., Meppelink, C. S., & van Weert, J. C. (2016). Exploring the role of health literacy in the evaluation of online health information: insights from a mixed-methods study. *Patient Education and Counseling*, 99(6), 1017-1025.
- Feng, A. (2013). 孕产妇母婴健康素养现状调查及其妊娠结局相关研究 [Research on health literacy and pregnancy outcomes among pregnant women] Available from China Masters' Theses Full-text Database. Retrieved from <http://cdmd.cnki.com.cn/Article/CDMD-10422-1014123124.htm>
- Ferguson, B. (2008). Health literacy and health disparities: The role they play in maternal and child health. *Nursing for Women's Health*, 12(4), 286-298.
- Fredriksen, E. H., Harris, J., & Moland, K. M. (2016). Web-based discussion forums on pregnancy complaints and maternal health literacy in Norway: A qualitative study. *Journal of Medical Internet Research*, 18(5), e113. doi:10.2196/jmir.5270
- Fung, F. Y., & Linn, Y. C. (2015). Developing traditional Chinese medicine in the era of evidence-based medicine: current evidences and challenges. *Evidence-Based Complementary and Alternative Medicine*, 2015, 1-9.
- Gan, C., & Li, H. (2018). Understanding the effects of gratifications on the continuance intention to use WeChat in China: A perspective on uses and gratifications. *Computers in Human Behavior*, 78, 306-315.
- Gao, L., Larsson, M., & Luo, S. (2013). Internet use by Chinese women seeking pregnancy-related information. *Midwifery*, 29(7), 730-735.
- Goh, E. C., & Kuczynski, L. (2010). 'Only children' and their coalition of parents: Considering grandparents and parents as joint caregivers in urban Xiamen, China. *Asian Journal of Social Psychology*, 13(4), 221-231.

- Griffith, J., & Monkman, H. (2017). Usability and eHealth Literacy Evaluation of a Mobile Health Application Prototype to Track Diagnostic Imaging Examinations. *Studies in Health Technology and Informatics*, 234, 150-155. doi:10.3233/978-1-61499-742-9-150
- He, A. J. (2014). The doctor–patient relationship, defensive medicine and overprescription in Chinese public hospitals: Evidence from a cross-sectional survey in Shenzhen city. *Social Science & Medicine*, 123, 64-71.
- Hong, Y., Fan, Z., & Huang, B. (2017). 通过微信平台向孕妇传输孕期保健知识的效果及对产
前不良情绪的影响 [Effect of transmission of maternal healthcare knowledge through
WeChat platform for pregnant women and the influence on prenatal adverse emotions].
Clinical Medicine & Engineering, 24(7), 1027-1028.
- Hsu, W., Chiang, C., & Yang, S. (2014). The effect of individual factors on health behaviors
among college students: the mediating effects of eHealth literacy. *Journal of Medical
Internet Research*, 16(12), e287. Retrieved from
<http://www.ncbi.nlm.nih.gov/pubmed/25499086>
- Hu, J., Zhang, J., Zhao, W., Zhang, Y., Zhang, L., & Shang, H. (2011). Cochrane systematic
reviews of Chinese herbal medicines: an overview. *PLoS One*, 6(12), 1-6.
- Huang, H., Jian, K., Cai, Y., & Zhang, J. (2014). 不同宣教方式提高孕妇母婴健康素养的效果
研究 [Impact of different education methods on maternal and child health literacy]. *China
Health Industry*, 11(29), 77-77. Retrieved from
<http://www.cqvip.com/qk/87229x/201429/663720663.html>
- Ishikawa, H., Takeuchi, T., & Yano, E. (2008). Measuring functional, communicative, and
critical health literacy among diabetic patients. *Diabetes Care*, 31(5), 874-879.
- Ji, G., Hu, X., Zou, W., Wu, Z., & Chu, C. (2017). 安徽省相关人群母婴健康素养调查报告
[Investigation report on Maternal and child health literacy in Anhui Province]. *Chinese
Journal of Health Education*, 33(3), 203-207. Retrieved from
<http://www.cqvip.com/qk/80686x/201703/671863456.html>
- Jiang, T. (2016). 影响卫生政务微信平台健康传播效果因素探究 [What factors influence the
impact of health communication by WeChat public health official accounts]. *Guangzhou
10th Health Education Academic Symposium*, Guangzhou. 157-159.
- Jing, X., Pan, C., Zhou, Y., Wu, Y., Yang, Q., An, Y., . . . Gao, W. (2016). 重庆市北碚区母婴健
康素养现状分析 [Investigation on maternal and infant health literacy in Beibei District of
Chongqing]. *Chinese Journal of Health Education*, 32(1), 45-48. Retrieved from
<http://lib.cqvip.com/qk/80686X/201601/668069430.html>
- Johri, M., Subramanian, S. V., Koné, G. K., Dudeja, S., Chandra, D., Minoyan, N., . . . Pahwa, S.
(2016). Maternal health literacy is associated with early childhood nutritional status in India.
The Journal of Nutrition, 146(7), 1402-1410. doi:10.3945/jn.115.226290

- Johri, M., Subramanian, S. V., Sylvestre, M., Dudeja, S., Chandra, D., Koné, G. K., . . . Pahwa, S. (2015). Association between maternal health literacy and child vaccination in India: a cross-sectional study. *Journal of Epidemiology and Community Health*, 69(9), 849-857. doi:10.1136/jech-2014-205436
- Kohan, S., Ghasemi, S., & Dodangeh, M. (2008). Associations between maternal health literacy and prenatal care and pregnancy outcome. *Iranian Journal of Nursing and Midwifery Research*, 12(4), 146-152.
- Lee, J. Y. (2016). *Maternal health literacy among low-income mothers with infants* (Doctoral dissertation) Available from UT Electronic Theses and Dissertations. Retrieved from <https://repositories.lib.utexas.edu/handle/2152/40335>
- Li, J., Wang, P., Kong, X., Liang, H., Zhang, X., & Shi, L. (2016). Patient satisfaction between primary care providers and hospitals: a cross-sectional survey in Jilin Province, China. *International Journal for Quality in Health Care*, 28(3), 346-354.
- Li, W. (2017). 健康谣言在微信平台中传播的成因探析 [Exploring the cause of widespread health rumors on WeChat platform]. *Journal of Western Radio and Television*, (15), 12-13.
- Li, X. (2016). 微屏时代谁在传播健康? —— 对微信平台健康养生信息兴起的传播学分析 [Who is spreading health information at the age of micro screen? -- An analysis of the communication of health information on WeChat platform]. *Modern Communication: Journal of Communication University of China*, (4), 21-26.
- Li, Y., & Liu, R. (2015). 对初产妇加用微信公众平台健康教育效果的观察 [Observation on the effect of health education for primipara with WeChat public platform]. *Chinese Journal of Medicinal Guide*, (3), 317-318.
- Liu, S., Chuang, W., Lam, W., Jiang, Z., & Cheng, Y. (2015). Safety surveillance of traditional Chinese medicine: current and future. *Drug Safety*, 38(2), 117-128.
- Liu, Y. (2016). 健康类微信公众号主体分析 [Analysis on Health WeChat Official Accounts]. *Shanxi Science and Technology*, 31(5), 120-122.
- Lupton, D. (2017). 'It just gives me a bit of peace of mind': Australian women's use of digital media for pregnancy and early motherhood. *Societies*, 7(3), 25.
- Lv, J., Jiang, H., & Wu, H. (2012). 3500 例母婴健康素养基本知识与技能健康教育的效果评价 [Evaluation of a maternal and child health literacy basic knowledge and skills health education with 3,500 pregnant women]. *China Health Care & Nutrition*, 12, 5390-5391.
- Mitsutake, S., Shibata, A., Ishii, K., Okazaki, K., & Oka, K. (2011). Developing Japanese version of the eHealth Literacy Scale (eHEALS). *Japanese Journal of Public Health*, 58(5), 361-371.

- National Health and Family Planning Commission. (2012). 关于印发《母婴健康素养——基本知识与技能（试行）》的通知 [Notice on the "Maternal and Infantile Health Literacy: Basic Knowledge and Skills"]. Retrieved from <http://www.nhfpc.gov.cn/zwgk/ztwj/201304/6d2dd1401b274173b62809c54799be1d.shtml>
- National Health and Family Planning Commission. (2017). 2017 年 1 月全面两孩政策工作进展专题新闻发布会文字实录 [January 2017 Progress of Full-scale two-child policy press conference transcript]. Retrieved from <http://www.nhfpc.gov.cn/zhuz/xwfb/201701/7ea4318bf0f7450aaf91d184e02e5dcf.shtml>
- National Health Commission. (2019). 健康中国行动 (2019—2030 年) [The Healthy China Action (2019-2030)]. Retrieved from <http://www.nhc.gov.cn/guihuaxxs/s3585u/201907/e9275fb95d5b4295be8308415d4cd1b2.shtml>
- National Health Commission Department of Planning and Information. (2019). 2018 年我国卫生健康事业发展统计公报 [2018 China's health care development statistics bulletin]. Retrieved from <http://www.nhc.gov.cn/guihuaxxs/s10748/201905/9b8d52727cf346049de8acce25ffcbd0.shtml>
- Norman, C. D., & Skinner, H. A. (2006). eHealth literacy: essential skills for consumer health in a networked world. *Journal of Medical Internet Research*, 8(2), 1-11. doi:10.2196/jmir.8.2.e9
- Nutbeam, D. (1998). Health promotion glossary. *Health Promotion International*, 13(4), 349-364. doi:10.1093/heapro/13.4.349
- Nutbeam, D. (2000). Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promotion International*, 15(3), 259-267.
- Ohnishi, M., Nakamura, K., & Takano, T. (2005). Improvement in maternal health literacy among pregnant women who did not complete compulsory education: policy implications for community care services. *Health Policy*, 72(2), 157-164. doi:10.1016/j.healthpol.2004.11.007
- Poushter, J. (2016). *Smartphone ownership and Internet usage continues to climb in emerging economies*. Retrieved from <http://sl.pulso.cl/wp-content/uploads/2016/02/2258581.pdf>
- Prescott, J., & Mackie, L. (2017). "You sort of go down a rabbit hole...You're just going to keep on searching": A qualitative study of searching online for pregnancy-related information during pregnancy. *Journal of Medical Internet Research*, 19(6), e194. doi:10.2196/jmir.6302
- Prestin, A., Vieux, S. N., & Chou, W. S. (2015). Is online health activity alive and well or flatlining? Findings from 10 years of the Health Information National Trends Survey. *Journal of Health Communication*, 20(7), 790-798.

- Qi, X., & Melhuish, E. C. (2017). Early childhood education and care in China: History, current trends and challenges. *Early Years*, 37(3), 268-284.
- Reisner, S. L., Randazzo, R. K., White Hughto, J. M., Peitzmeier, S., DuBois, L. Z., Pardee, D. J., . . . Potter, J. (2018). Sensitive health topics with underserved patient populations: Methodological considerations for online focus group discussions. *Qualitative Health Research*, 28(10), 1658-1673.
- Sayakhot, P., & Carolan-Olah, M. (2016). Internet use by pregnant women seeking pregnancy-related information: a systematic review. *BMC Pregnancy and Childbirth*, 16(1), 65.
- Stewart, K., & Williams, M. (2005). Researching online populations: the use of online focus groups for social research. *Qualitative Research*, 5(4), 395-416.
- Tang, X., Lu, Y., & Li, M. (2017). 苏州市孕产妇母婴健康素养调查 [Research on maternal and infant health literacy in Suzhou]. *Jiangsu Prev Med*, 28(5), 598-599.
- Tang, Z., Wang, F., & Fu, H. (2014). 高校学生电子媒介健康素养量表的编制及评价 [Development and assessment on the eHealth Literacy Scale for college students]. *Chinese Journal of Health Education*, 30(1), 35-38.
- Tencent. (2019). 腾讯公布 2019 年第一季度及中期业绩 [Tencent releases its first quarter and interim performance in 2019]. Retrieved from <http://www.tencent.com/zh-cn/articles/15000771557911821.pdf>
- Wang, B. (2017). 北京市昌平区孕妇母婴健康素养现况调查分析 [Investigation and analysis of current maternal health literacy in Changping District Beijing]. *China Health Care & Nutrition*, 27(4), 307-308. doi:10.3969/j.issn.1004-7484.2017.04.444
- Wu, Q., Ye, X., Wu, Y., Zhao, L., & Wu, J. (2017). 全面健康素养测量量表的汉化及信效度分析 [The Chinesization of All Aspects of Health Literacy Scale and Its Reliability and Validity]. *Chinese General Practice*, 20(10), 1229-1233.
- Xia, H. (2017). 微信平台在初产妇围产期健康教育中的应用 [The application of WeChat platform in perinatal health education among primipara]. *Today Nurse*, (11), 76-77.
- Xie, B. (2011). Effects of an eHealth literacy intervention for older adults. *Journal of Medical Internet Research*, 13(4), e90. doi:10.2196/jmir.1880
- Xu, H., Yao, M., Wang, X., Pang, S., & Zhao, F. (2016). 唐山市孕妇母婴健康素养现状调查分析 [Investigation and analysis of current maternal health literacy in Tangshan]. *Chinese Journal of Health Education*, 32(8), 746-749.
- Xu, W., & Zhang, S. (2014). Chinese pediatricians face a crisis: should they stay or leave? *Pediatrics*, 134(6), 1045-1047.

- Yang, S., Chen, S., & Li, B. (2016). The role of business and friendships on WeChat business: An emerging business model in China. *Journal of Global Marketing*, 29(4), 174-187.
- Yi, J., Ma, Y., Li, Z., Zhao, Q., & Liu, G. (2017). 基于微信平台的孕妇学校教育在提高产后母乳喂养率中的应用价值 [Values of WeChat-based pregnant women education in improving breastfeeding rate]. *Guangdong Medical Journal*, 38(12), 1944-1947.
- Yin, H. S., Sanders, L. M., Rothman, R. L., Shustak, R., Eden, S. K., Shintani, A., . . . Perrin, E. M. (2014). Parent health literacy and "obesogenic" feeding and physical activity-related infant care behaviors. *The Journal of Pediatrics*, 164(3), 83.e1. doi:10.1016/j.jpeds.2013.11.014
- Zhang, H., Dong, Y., Sun, Z., Gao, H., Zhao, K., Wang, S., . . . Zhuang, Y. (2017). 大学生健康素养微信公众平台干预效果评价 [Effect evaluation of using WeChat public platform on health literacy intervention among college students]. *Chinese Journal of School Health*, 38(11), 1644-1647.
- Zhang, L., Liao, P., Li, Y., & Guan, H. (2015). 孕产妇母婴健康素养现状及影响因素分析 [Current situation of maternal and infantile health literacy and influencing factors]. *Maternal and Child Health Care of China*, 30(36), 6553-6556. Retrieved from <http://www.cqvip.com/qk/90631x/201536/666990207.html>
- Zhang, P., Ding, J., Chen, Z., & Zhang, C. (2010). 2009 年 2 045 名中国儿科医生循证医学知晓度横断面调查 [A cross-sectional survey on awareness of evidence-based medicine in 2,045 Chinese pediatricians in 2009]. *Chin J Evid Based Pediatr*, 5(3), 172-179.
- Zhang, R., Chen, Y., & Luo, X. (2011). 北京市朝阳区孕产妇母婴健康知识认知情况调查 [Survey on knowledge of maternal and child health in Chaoyang district, Beijing]. *Chinese Journal of Child Health Care*, 19(11), 1058-1061.
- Zhang, X., Wen, D., Liang, J., & Lei, J. (2017). How the public uses social media WeChat to obtain health information in china: a survey study. *BMC Medical Informatics and Decision Making*, 17(Suppl 2), 71-79. doi:10.1186/s12911-017-0470-0
- Zhuang, R., Xiang, Y., Han, T., Yang, G., & Zhang, Y. (2016). Cell phone-based health education messaging improves health literacy. *African Health Sciences*, 16(1), 311-318.
- Zou, X., Shi, Y., & Zhou, Y. (2013). 北京市海淀区母婴健康素养现状的调查分析 [Investigation on maternal and infant health literacy in Haidian District, Beijing]. *Chinese Journal of Health Education*, 29(4), 331-334. Retrieved from <http://www.cqvip.com/qk/80686x/201304/45988107.html>