



Effect of an Internet-based mental health promotion intervention among immigrant Chinese women: A quasi-experimental study

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ARTICLE INFO

Keywords:

Emigrant and immigrant
Internet-based
Intervention
Mental health
Women

ABSTRACT

Background: Owing to a lack of social support, child-rearing Chinese women in Japan experience mental health disorders, such as depression and parenting stress. Effective interventions to improve the mental health of these women are lacking. This study aimed to develop an Internet-based mental health promotion intervention for this subsection of the population and evaluate the effectiveness of the intervention.

Methods: We used a quasi-experimental pre- and post-test design whereby the results of the intervention group were compared with those of a control group. Seventy-three child-rearing women were recruited from online groups of Chinese residents in Japan. In the Internet-based intervention, participants utilised an information provision application and attended online parenting workshops. The intervention group participated in the online workshops once a week for six weeks and accessed the application, whereas the control group did not. The outcome measures included the levels of mental health distress, depression, social support, and parenting stress. Data were collected from February to April 2022. Data analysis was performed using repeated-measures analysis of variance.

Results: Mental health distress ($F = 16.478$, $p < 0.001$, $\eta^2 = 0.210$) and depression ($F = 13.078$, $p = 0.001$, $\eta^2 = 0.174$) were significantly affected in the intervention group compared with the control group. There were no significant differences in social support and parenting stress between the groups. The Internet-based mental health promotion intervention was highly appraised by the participants.

Conclusions: This study developed an Internet-based mental health promotion intervention that involved an information provision application and parenting workshops. The intervention significantly reduced the mental health distress and depression of Chinese women in Japan but did not affect social support and parenting stress. The findings suggest that this intervention could be applied to foreign women with multicultural backgrounds in diverse settings to improve their psychological well-being.

1. Introduction

Since the 1980s, the number of immigrant workers in Japan has increased owing to labour shortages (Kawai, 1993). As of June 2023, the number of foreign residents in Japan was approximately 3.2 million, accounting for 2.6% of the Japanese population. Although the coronavirus disease 2019 (COVID-19) pandemic has led to a 5.9% decrease in foreign migration movements in Japan, as measured from 2019 to 2021, the foreign resident population has increased by 35.7%, compared with the last major influx after the Tohoku earthquake in 2012. Chinese immigrants became the largest foreign group in Japan in 2007 when

they exceeded the number of Korean immigrants. Chinese women have constituted the largest foreign female population in Japan since 2006, accounting for 26.2% of the overall foreign women population, as of June 2023 (Immigration Services Agency of Japan, 2023).

Mental health problems among immigrant women have been reported in countries with high immigration rates (Almutairi et al., 2022; Guruge et al., 2015). With increasing immigrant populations in Japan, the Multicultural Coexistence Promotion Plan was developed by the Japanese Ministry of Internal Affairs and Communication in 2006. This Plan aimed to track the development of multicultural coexistence in Japan and assist different cultures in Japan to live harmoniously as

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<https://doi.org/10.1016/j.ssmph.2024.101686>

Received 15 December 2023; Received in revised form 27 May 2024; Accepted 30 May 2024

Available online 1 June 2024

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members of a communal society (Ministry of Internal Affairs and Communications, Japan, 2006). The Plan was updated in 2020 to include communication support, life support, support for raising awareness, social support for social participation, and the promotion of regional revitalisation and a response to globalisation (Ministry of Internal Affairs and Communications, Japan, 2020). However, as of April 2022, 47% of local governments had not yet implemented the Plan (Ministry of Internal Affairs and Communications, 2022). Consequently, immigrant women still lack effective social support mechanisms when experiencing mental distress and social isolation (Kita et al., 2015).

Owing to the difficulties associated with pregnancy, childbirth, and child-rearing, Chinese women in Japan often experience mental health problems, such as postpartum depression and parenting stress (Jin et al., 2016; You & Emori, 2010). Furthermore, high COVID-19 concerns are linked to poor mental health in Chinese women in Japan (Luo & Sato, 2021a). However, although several studies propose that Chinese women who are pregnant, have given birth, or are raising children in Japan experience high levels of parenting stress and loneliness and receive inadequate social support (Wakimizu & Wang, 2022), only one nursing intervention has been developed to prevent postpartum depression among these vulnerable women (Jin et al., 2020). Moreover, another study has shown that social support reduces parenting stress and positively affects mental health among Chinese women in Japan (Luo & Sato, 2021b). Thus, we posit that appropriate social support is needed to help improve the mental health and overall quality of life of these women.

A previous qualitative study has identified the child-rearing and mental health promotion needs of Chinese women to be concrete support, information provision, caring and understanding, and social network building. The study proposed that providing practical information and help with building community ties would strengthen social support (Luo et al., 2022). Lee et al. (2013) recommend offering Internet-based tools and materials to provide informational support and interactive talks, while Liem et al. (2021) suggest that Internet-based mental health services can improve the well-being of the immigrant population. Several Internet- and mobile-based interventions have been implemented to reduce the burden of mental disorders among immigrant populations in various countries (Spanhel et al., 2021). During the COVID-19 pandemic, Internet-based interventions played an essential role in maintaining individuals' mental health and well-being (Mahoney et al., 2021; Serlachius et al., 2021). Furthermore, Internet-based interventions may be a possible approach to reducing stress, anxiety, and depression in prenatal women (Bright et al., 2022). Among immigrant Chinese women, Internet-based information resources have been widely desired (Gong & Bharj, 2022), and an Internet-based education programme can help increase their social support and decrease parenting stress (Song et al., 2022). However, Internet-based interventions to improve mental health are still lacking. Thus, we have developed a mental health promotion programme based on the parenting and mental health needs of Chinese women in Japan to provide practical information and assist them in building social networks.

This study aimed to evaluate the effects of an Internet-based mental health promotion programme on the mental health, depression, social support, and parenting stress of Chinese women in Japan.

2. Methods

2.1. Design

The study design was a quasi-experimental pre-test–post-test design with a control group. This study was registered in the UMIN Clinical Trials Registry under registration number UMIN000046260.

Based on the qualitative study findings that providing informational support and assistance with social network building to Chinese women living in Japan can improve their mental health (Luo et al., 2022), the mental health intervention was developed in this study. Information

provision includes items related to child-rearing, Japanese medication, education, and child-rearing policy, as well as general life information. Social network building includes overcoming social isolation, joining child-rearing communication groups, and creating strong community ties. Thus, to meet our target population's needs, this programme comprised two components: developing and using a smartphone application to provide information and conducting online parenting workshops. The intervention was implemented from February to April 2022.

First, to provide the necessary and accurate information, we developed a smartphone application (iOS and Android). This application was named 'Love for mom' (<http://loveformom.online/>), and it included six types of content: overviews of parenting in Japan, information relating to child-rearing, vaccinations, childcare services, social support services, and children's development. All information in this application was provided in Chinese.

Second, to build the mother's social network, online parenting workshops were conducted using the Zoom Video Communication platform. Meanwhile, to allow the women to communicate conveniently, an online parenting group comprising all participants in the intervention group was created on WeChat, a Chinese multipurpose messaging social media platform developed by Tencent. We conducted 70–90-min parenting workshops twice a week for six weeks. The workshops took place in the evening on weekdays and during the daytime on weekends. Participants chose a convenient day to attend during the week and committed to attending at least once a week. Before each week, the research staff announced the opening time in advance for the WeChat group. The parenting workshops had three main focuses: introducing the use of the 'Love for mom' application, parenting skills, and social network building. Each workshop was structured similarly with a combination of icebreakers (5 min), an introduction to the 'Love for mom' application (15 min), parenting experience sharing (40 min), and time for free discussion (10–30 min). Each week's workshop contained the same contents of the introduction to the 'Love for mom' application and included different parenting experiences and discussions. A psychological expert in children's development and education—also a Chinese mother living in Japan—and a bilingual nursing researcher with parenting workshop and focus group discussion experience, attended each workshop to answer questions and to ensure that the workshops ran smoothly. Each session was video recorded; after each workshop, all content regarding parenting difficulties and experiences, as well as the free discussions, were recorded and organised into a readable file and sent to the WeChat group for participants to review at their convenience. All workshops were facilitated by Chinese individuals.

2.2. Instruments with validity and reliability

Both the pre- and the post-intervention tests collected demographic information and measured variables of mental health distress, depression, social support, and parenting stress. Additionally, assessments of the mental health promotion intervention were added to the post-intervention test for participants in the intervention group. Mental health distress and depression were considered the primary outcomes, with social support and parenting stress considered secondary outcomes.

2.2.1. Mental health distress

Mental health distress was evaluated using the 12-item General Health Questionnaire (GHQ-12) developed by Goldberg and Williams (1988). The self-administered GHQ-12 was designed to identify persons at risk of developing common, mental health issues with the absence of psychosis associated with depression, anxiety, somatic symptoms, and social dysfunction (Vanheule & Bogaerts, 2005). The Chinese version of the GHQ-12 has been extensively used, and its reliability and validity are considered good (Li et al., 2009; Liang et al., 2016). The questionnaire utilises a four-point Likert scale from 0 = *not at all* to 3 = *much more than usual*. Total scores range from 0 to 36, with a higher score indicating

more severe mental health distress. The Cronbach's alpha of the GHQ-12 in this study was 0.854.

2.2.2. Depression

Depression was assessed using the Center for Epidemiologic Studies Depression Scale (CES-D) developed by Radloff (1977). The Chinese version of the CES-D has been used to assess depression in different Chinese populations, including immigrant Chinese women (Li & Hicks, 2010), and has shown good reliability and validity (Cheung & Bagley, 1998; Niu et al., 2021). The CES-D comprises 20 items, scored from 0 = rarely or none of the time to 3 = most or all of the time. Total scores range from 0 to 60, with higher scores indicating greater severity of depression. Cronbach's alpha of the CES-D in this study was 0.867.

2.2.3. Social support

Social support was assessed using the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988). The reliability and validity of the Chinese version of the MSPSS were found to be good in a previous study (Nie et al., 2020). It comprises 12 items, scored on a seven-point Likert scale from 1 = very strongly disagree to 7 = very strongly agree. The participants' scores were computed by adding the item scores, with higher scores indicating higher levels of perceived social support. The Cronbach's alpha for this study sample was 0.910.

2.2.4. Parenting stress

The Child-rearing Stress Scale (CRSS), developed by Shimizu and Masuda (2001), is used among immigrant mothers residing in Japan. The Chinese version of the CRSS was translated by You and Emori (2010), and its reliability and validity were found to be good in a previous study (Luo & Sato, 2021b). It comprises 40 items across 10 subscales, with each item scored from 1 = strongly disagree to 4 = strongly agree. A higher total score—the sum of the subscale scores—indicates a higher level of parenting stress. Its Cronbach's alpha coefficient in this study was 0.934.

2.2.5. Demographic characteristics

The demographic data collected were age, employment status, number of children, use of childcare facilities, duration of residence in Japan, planned length of stay in Japan, level of education, status of residence, family structure, annual household income, nationality of spouse, and proficiency in the Japanese language.

2.2.6. Assessment of the mental health promotion programme

We developed several sets of items to be used in the intervention group to assess the quality of the application and parenting workshops. The measured aspects included satisfaction, usability, convenience, the functionality of the 'Love for mom' application, as well as 'hoping the parenting workshops will continue'. Each item was scored on a scale from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating higher satisfaction levels.

2.3. Sampling and recruitment

The participants were recruited from various online groups of Chinese residents in Japan using WeChat. Online groups included second-hand goods platforms for buying, selling, and exchanging used items; Chinese restaurant consumer groups; Chinese product shops; and associations of Chinese students. Snowball sampling was used to recruit more participants.

2.3.1. Inclusion and exclusion criteria

We enrolled participants who met the following inclusion criteria: participants had to be (1) Chinese women living in Japan; (2) pregnant or rearing at least one child under the age of six years old; (3) able to speak, read, and understand Mandarin Chinese. Respondents were excluded if they (1) were unable to read the materials and utilise

electronic equipment, and (2) had intellectual disabilities.

2.3.2. Sample size and power

The sample size for this study was calculated using G*Power for a repeated-measures ANOVA with a within-between interaction. Calculations were based on a priori power analysis, assuming an effect size of 0.25, a significance level of 0.05, and a power of 0.95, resulting in a requirement for 36 participants. Therefore, at least 18 participants were included in each group.

Fig. 1 shows a flowchart of the recruitment process and how the participants were assigned to the groups. Of the 80 women who were approached, 73 met the inclusion criteria. The 73 recruited participants were then assigned to a group depending on their answers to the two initial questions: 'Are you able to download and use the 'Love for mom' application on your mobile phone?' and 'Are you able to attend the online parenting workshops once a week for six weeks?' Only participants who answered 'yes' to both questions were assigned to the intervention group ($n = 38$), while those remaining were assigned to the control group ($n = 35$). Finally, 64 women completed the pre- and post-test questionnaires, and the data were analysed (intervention: 32, control: 32). Seven participants were unreachable, and two participants in the intervention group did not complete the intervention owing to scheduling conflicts and subsequently dropped out.

2.4. Quality appraisal

The outcomes were measured pre- and post-intervention using electronic questionnaires. All participants were assigned reference numbers when completing the questionnaires to ensure anonymity. All questionnaires were created and distributed using the Internet-based survey platform Wenjuanxing, a popular Chinese platform. All measurements were performed using the Chinese versions of the above-mentioned scales.

2.5. Data analysis

Data were analysed using IBM SPSS Statistics version 26.0 (IBM, New York, NY, USA). Participants' demographic characteristics were summarised using descriptive statistics. The distribution of continuous variables was assessed using the Shapiro-Wilk normality test. Homogeneity was tested using independent *t*-tests for continuous variables and chi-squared tests for nominal variables. If significant differences in the variables of demographic characteristics between the intervention and control groups were found, these variables would be included as control variables in the effects analysis. The effect of the intervention was tested using a two-way repeated-measures ANOVA after normality and sphericity assumptions were met. Group (intervention/control) and time (pre-intervention/post-intervention testing) were set as factors, and group-by-time interactions were examined. A simple main effect was observed if a significant group-by-time interaction was found. Effect sizes calculated using the partial eta-squared values for small, medium, and large effects were 0.009, 0.058, and 0.137, respectively (Cohen, 1988). The results were presented as 95% confidence intervals.

2.6. Ethical considerations

This study was approved by the ethical review committee of the Faculty of Health Sciences, Hokkaido University (approval number 21-64). All participants provided verbal and written informed consent. As participants were allocated reference numbers when completing the questionnaires, their anonymity was ensured.

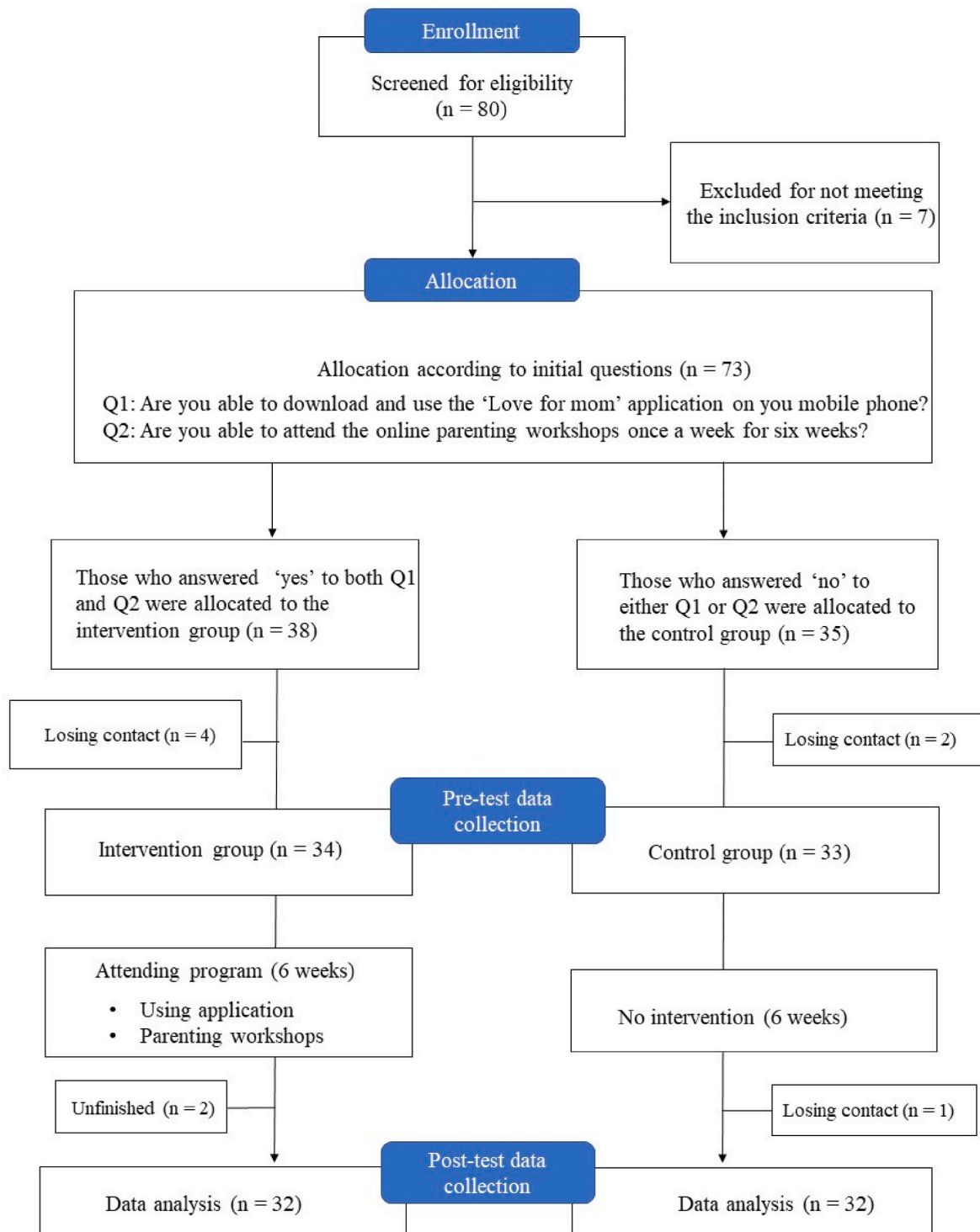


Fig. 1. Flow chart of participant recruitment and assignment.

3. Results

3.1. Sociodemographic characteristics

Participants' demographic factors and homogeneity test results for both groups are shown in Table 1. No significant differences were found in the homogeneity test between the two groups. The mean ages of the participants in the intervention and control groups were 33.56 years (± 3.64) and 34.16 (± 3.59) years, respectively. Most participants were in their 30s, used childcare facilities, were married to a Chinese

husband, and had a nuclear family structure. Over half were employed, had one child, planned to stay in Japan for more than 10 years, had an unlimited work permit status, an annual household income of between 30,000 and 70,000 USD, and a high level of Japanese language proficiency. Approximately half of the participants had an undergraduate level of education.

The results of the homogeneity test showed no demographic differences between the intervention and control groups. Moreover, there was no significant difference in the GHQ-12, CES-D, MSPSS, and CRSS scores at the pre-intervention testing stage (Table 2).

Table 1
Homogeneity test for descriptive characteristics of participants.

Variables	Total (n = 64)	IG (n = 32)	CG (n = 32)	t/ χ^2	p
	n (%)	n (%)	n (%)		
Age (in years)					
M (SD)	33.86 (3.60)	33.56 (3.64)	34.16 (3.59)	0.657	0.514
20–29	7 (10.94)	4 (12.50)	3 (9.38)	1.494	0.669
30–39	50 (78.13)	26 (81.25)	24 (75.00)		
40–49	7 (10.94)	2 (6.25)	5 (15.63)		
Employment status					
Employed	38 (59.38)	17 (53.13)	21 (65.63)	1.036	0.309
Unemployed	26 (40.63)	15 (46.88)	11 (34.38)		
Number of children					
1	34 (53.13)	17 (53.13)	17 (53.13)	0.000	1.000
≥2	30 (46.88)	15 (46.88)	15 (46.88)		
Use of childcare facilities					
Yes	48 (75.00)	24 (75.00)	24 (75.00)	0.000	1.000
No	16 (25.00)	8 (25.00)	8 (25.00)		
Duration of residence (in years)					
<10	33 (50.00)	18 (56.25)	14 (43.75)	1.000	0.317
≥10	33 (50.00)	14 (43.75)	18 (56.25)		
Planned length of stay (in years)					
<10	19 (29.69)	11 (34.38)	8 (25.00)	0.674	0.412
≥10	45 (70.31)	21 (65.63)	24 (75.00)		
Level of education					
High school or other	12 (18.75)	4 (12.50)	8 (25.00)	1.648	0.439
Undergraduate school	30 (46.88)	16 (50.00)	14 (43.75)		
Graduate school	22 (34.38)	12 (37.50)	10 (31.25)		
Status of residence					
Unlimited work permit ^a	39 (60.94)	19 (59.38)	20 (62.50)	0.402	0.818
Limited work permit ^b	11 (17.19)	5 (15.63)	6 (18.75)		
Non-work permit ^c	14 (21.88)	8 (25.00)	6 (18.75)		
Family structure					
Nuclear family	55 (85.94)	27 (84.38)	28 (87.50)	1.219	0.500
Extended family	9 (14.06)	5 (15.63)	4 (12.50)		
Annual household income (in USD)					
≤30,000	12 (18.75)	8 (25.00)	4 (12.50)	2.679	0.262
30,000–70,000	33 (51.56)	17 (53.13)	16 (50.00)		
>70,001	19 (29.69)	7 (21.88)	12 (37.50)		
Nationality of spouse					
Chinese	50 (78.13)	27 (84.38)	23 (71.88)	3.112	0.213
Japanese	13 (20.31)	4 (12.50)	9 (28.13)		
Other	1 (1.56)	1 (3.13)	0 (0.00)		
Japanese language proficiency					
Lower	19 (29.69)	11 (34.38)	8 (25.00)	0.674	0.412
Upper	45 (70.31)	21 (65.63)	24 (75.00)		

Abbreviations - IG: intervention group; CG: control group; M: mean; SD: standard deviation.

^a Unlimited work permit: permanent resident, spouse or child of Japanese national, and spouse or child of permanent resident.

^b Limited work permit: researcher, medical services, engineer/specialist in humanities/international services, business manager, etc.

^c Non-work permit: student, dependent for family stays, cultural activities, etc.

Table 2
Homogeneity test of study variables at pre-test (n = 64).

Variables	IG (n = 32)	CG (n = 32)	t	p
	M (SD)	M (SD)		
GHQ-12	13.19 (4.17)	10.69 (5.77)	1.986	0.051
CES-D	15.44 (8.43)	12.00 (7.05)	1.769	0.082
MSPSS	67.38 (10.04)	67.38 (8.02)	0.000	1.000
CRSS	88.81 (17.42)	86.81 (16.71)	0.469	0.641

Abbreviations - IG: intervention group; CG: control group; M: mean; SD: standard deviation; GHQ-12: 12-item General Health Questionnaire; CES-D: Center for Epidemiologic Studies Depression Scale; MSPSS: Multidimensional Scale of Perceived Social Support; CRSS: Child-rearing Stress Scale.

3.2. Effects of the intervention on mental health distress, depression, social support, and parenting stress

Table 3 demonstrates the effects of the intervention programme on social support, parenting stress, depression, and mental health distress. Regarding the primary outcome, we found that the GHQ-12 scores of the intervention group decreased from 13.19 to 10.34, whereas those of the control group increased slightly, from 10.69 to 10.91. The results show a significant main effect of time ($F = 7.020, p = 0.010, \eta^2 = 0.102$) and an interaction effect, indicating a significant difference between the two groups ($F = 9.555, p = 0.003, \eta^2 = 0.134$). To further explain the interaction, a simple main effect test was conducted for the GHQ-12, and the simple main effects of time in the intervention group were significant ($F = 16.478, p < 0.001, \eta^2 = 0.210$; Fig. 2). The CES-D scores in the intervention group decreased from 15.44 to 13.78, whereas those of the control group increased from 12.00 to 14.38. There was a significant group and time interaction effect in the CES-D ($F = 13.078, p = 0.001, \eta^2 = 0.174$). A simple main effect test was conducted for the CES-D, and

Table 3
Intervention effects on study variables (n = 64).

Variables	IG (n = 32)	CG (n = 32)	Effects			
			Source	F	p	η^2
GHQ-12						
Pre-test	13.19 (4.17)	10.69 (5.77)	Time	7.020	0.010	0.102
Post-test	10.34 (3.38)	10.91 (5.23)	Group	0.815	0.370	0.013
			Time × Group	9.555	0.003	0.134
CES-D						
Pre-test	15.44 (8.43)	12.00 (7.05)	Time	0.416	0.521	0.007
Post-test	13.78 (7.02)	14.38 (8.48)	Group	0.582	0.448	0.009
			Time × Group	13.078	0.001	0.174
MSPSS						
Pre-test	67.38 (10.04)	67.38 (8.02)	Time	1.074	0.304	0.017
Post-test	66.81 (8.77)	66.22 (8.58)	Group	0.021	0.886	0.000
			Time × Group	0.128	0.722	0.002
CRSS						
Pre-test	88.81 (17.42)	86.81 (16.71)	Time	0.007	0.935	0.000
Post-test	88.09 (19.05)	87.75 (16.91)	Group	0.079	0.780	0.001
			Time × Group	0.390	0.535	0.006

Abbreviations - IG: intervention group; CG: control group; M: mean; SD: standard deviation; GHQ-12: 12-item General Health Questionnaire; CES-D: Center for Epidemiologic Studies Depression Scale; MSPSS: Multidimensional Scale of Perceived Social Support; CRSS: Child-rearing Stress Scale.

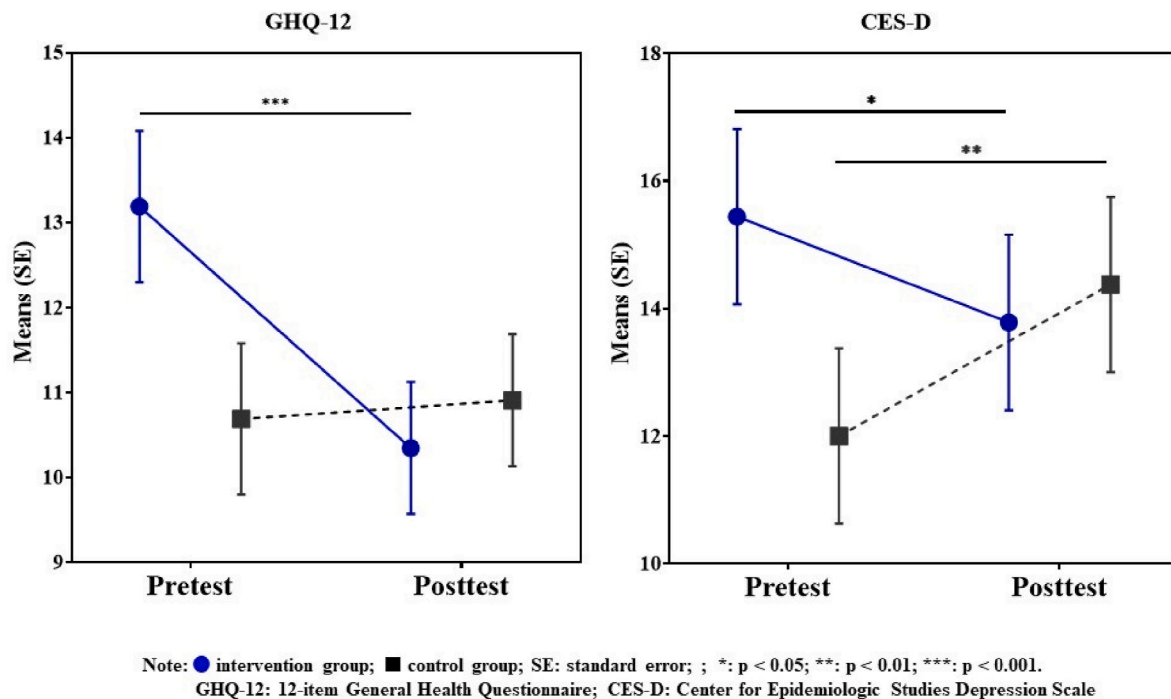


Fig. 2. Effects on depression and mental health distress.

the simple main effects of time in the intervention ($F = 4.415, p = 0.040, \eta^2 = 0.066$) and control groups ($F = 9.078, p = 0.004, \eta^2 = 0.128$) were significant (Fig. 2).

Regarding the secondary outcome, there were no significant effects on the total MSPSS scores ($F = 0.128, p = 0.722, \eta^2 = 0.002$) or CRSS scores ($F = 0.390, p = 0.535, \eta^2 = 0.006$).

3.3. Assessment of the mental health intervention programme by the intervention group

The intervention group’s appraisal of the mental health intervention programme is shown in Table 4. The mean satisfaction, usability, convenience, and functionality scores for the ‘Love for mom’ application were 3.97, 3.78, 3.97, and 3.69, respectively. Meanwhile, the mean scores for satisfaction, usability, convenience, and ‘hoping the parenting workshops will continue’ were 4.31, 4.31, 4.25, and 4.38, respectively. The relationship between the appraisal scores and demographic factors of participants in the intervention group is presented in Supplementary Tables 1 and 2

Table 4
 Appraisal of the mental health intervention by the intervention group ($n = 32$).

	M	SD	Min.–Max.
Assessment of the ‘Love for mom’ application			
Satisfaction	3.97	0.73	3–5
Usability	3.78	0.74	2–5
Convenience	3.97	0.68	3–5
Functionality	3.69	0.81	2–5
Assessment of parenting workshops			
Satisfaction	4.31	0.85	2–5
Usability	4.31	0.77	3–5
Convenience	4.25	0.90	2–5
Hoping parenting workshop continue	4.38	0.82	2–5

Abbreviations - M: mean; SD: standard deviation; Min: minimum; Max: maximum.

4. Discussion

Few effective interventions have been developed and implemented to improve immigrant women’s mental health, especially with regard to pregnancy, childbirth, and child-rearing (Luo et al., 2023). This study introduced a six-week Internet-based mental health promotion intervention programme, which includes parenting workshops and an information provision application, for Chinese women in Japan. The results of the intervention and control groups were compared. Following the intervention, the intervention group’s levels of mental health distress and depression improved, compared with the control group. Moreover, our programme, especially the online parenting workshops, was highly appraised by the intervention group.

This study was the first to develop such a programme for immigrant women in Japan. Internet-based intervention programmes have been developed to improve mental health variables among various immigrant populations in other countries and have played an essential role in enhancing immigrants’ health by decreasing depression-related stigma among immigrants in Australia (Kiroopoulos & Bauer, 2011) and providing health information among Turkish migrants in Germany (Samkange-Zeeb et al., 2015). Information provision applications aimed at pregnant and child-rearing women are also increasing globally, but the use rate of non-native-language-speaking women has been relatively low (Hughson et al., 2018). This Internet-based intervention programme utilised the participants’ native language to avoid language issues and developed the application and workshops, which resulted in improved mental health and decreased levels of depression symptoms among immigrant women. Thus, Internet-based interventions may be an effective approach to improve immigrant women’s mental health. Further, the ‘Love for Mom’ application could be expanded into multiple languages, allowing a broader range of immigrant women to access accurate information quickly and conveniently.

Depression, a critical mental health problem, has been documented in previous studies on immigrant women (O’Mahony & Donnelly, 2010; Playfair et al., 2017). Participants in the intervention group showed decreased depression levels, whereas those in the control group showed a significant increase in depression. This may be attributed to confounding variables owing to the COVID-19 pandemic. The outbreak of

COVID-19 not only influenced economies worldwide, sending many into crisis but also resulted in a high prevalence of depression among pregnant women in Japan (Matsushima & Horiguchi, 2022). Another possible reason for the increase in depression symptoms could be the stress caused by the cross-cultural environment (Jin et al., 2016). Future studies adopt a longitudinal design to observe the change in depressive symptoms among these women and provide evidence for policymakers and healthcare providers, to strengthen the child-rearing or living environment.

To date, only one nursing intervention has been developed for Chinese women in Japan, and no significant intervention effects on social support, stress, and postpartum depression were reported (Jin et al., 2020). Our study provided similar results—the findings showed no effects on social support and parenting stress. Parenting stress and social support for mothers are associated with socioeconomic variation (Parkes et al., 2015), which may lead to change taking place more slowly. Thus, the intervention programme's long-term effect should be assessed in the future. By contrast, a recent study reported that a mobile phone-based education intervention can reduce childcare stress and improve social support; however, this study included only immigrant Chinese women with newborn babies (Song et al., 2022). Our study participants included mothers of preschool children aged 0–6 years and who were relatively diverse. Future studies could consider narrowing the study participants, such as mothers of children under 3 years or mothers of children aged 3–6 years, which may show more significant effects.

Additionally, future studies could consider investigating the effects of the smartphone application and online parenting workshops separately. First, the effective and target populations may differ. Women who highly appraised the informational provision application had low Japanese proficiency, an unlimited or non-work permit status of residence, a long-term planned length of stay in Japan, and were living with extended family. Future evaluation of the smartphone application could focus on these target populations. However, online parenting workshops obtained high appraisals from all types of participants, which could comprise more general practice for immigrant Chinese women in Japan. Second, the optimally effective time points of smartphone applications and workshops may differ, requiring various intervention periods. A previous intervention study using an informational provision application for the immigrant population reported effective results with an intervention period of 2 h (Fernández-Gutiérrez et al., 2019), while workshops among immigrant women that utilised 6 months showed few effects (Karasz et al., 2015).

Our study has several limitations. First, we used a quasi-experimental design, in which the intervention and control groups were not assigned randomly but rather as a result of the participants' convenience. This design may introduce potential confounding factors. Although there were no significant differences in the baseline scores of mental health distress, depression, and parenting stress, the intervention group scored higher than the control group. This may be because the participants in the intervention group recognised the strained child-rearing environment or exhibited a high level of self-awareness of their mental health, leading them to participate in the intervention. Future studies should implement random allocation of participants to intervention and control groups to minimize this type of possible bias. Second, the small sample size may have limited the generalisability of the finding. Future studies should increase the sample size to enhance the ability to detect more subtle differences and provide a more comprehensive analysis of potential heterogeneity. Third, this study conducted tests at only two time points: pre- and post-intervention. There is a lack of a third or maintenance observation of all outcome measures, which assesses how stable the treatment effects are across time. A third test would give more credence to any significant treatment effects. Thus, the long-term effect with more than two repeated measures should be considered for future evaluation.

5. Conclusion

The Internet-based mental health promotion intervention programme we developed significantly improved depression and mental health distress among Chinese women in Japan but did not affect social support and parenting stress. The intervention group highly appraised the mental health promotion programme, especially the online parenting workshops. We recommend that informational provision applications and online parenting workshops be utilised to assist foreign women with multicultural backgrounds to improve their mental health status and quality of life.

Ethical statement

This study was approved by the ethical review committee of the Faculty of Health Sciences, Hokkaido University (approval number 21–64). All participants provided verbal and written informed consent. As participants were allocated reference numbers when completing the questionnaires, their anonymity was ensured. This study was registered in the UMIN Clinical Trials Registry under registration number UMIN000046260.

Funding statement

This research was supported by JST SPRING (grant number JPMJSP2119).

Conflict of interest

There is no conflict of interest to declare.

CRediT authorship contribution statement

Yunjie Luo: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Yasuhiko Ebina:** Writing – review & editing, Visualization, Validation, Supervision, Methodology, Conceptualization. **Yoko Sato:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization.

Data availability

Data will be made available on request.

Acknowledgements

We would like to thank all of the participants in the study, the Hokkaido University DX Doctoral Fellowship, and the Hokkaido University WISE Program for One Health Frontier Graduate School of Excellence.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2024.101686>.

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