Acceptability and usability of a WeChat-based intervention for depression in China: A mixed-methods study

Yuxi Tan[1,2,3,4,5], Emily G Lattie[6], Hui Xiang[3,4,5], Hui Tang[3,4,5], Ziwei Teng[3,4,5], Yan Qiu[3,4,5], Jindong Chen[3,4,5] and Haishan Wu[3,4,5] iD

Abstract

Background: As research on the use of mobile technology to deliver mental health support grows, the research from China is still very limited. How to design an acceptable and usable mobile mental health service model suitable for China's social and cultural environment remains to be studied.

Objective: To understand the acceptability and usability of a WeChat-based intervention among Chinese patients with depression, and to provide insights to promote future development of user-centered mobile mental health services design.

Methods: The research team developed a multi-theoretical intervention that includes seven modules: recovery lessons, recovery journal, coaching sessions, mindfulness, personalized support, regular assessments and feedback collection. Forty-two patients diagnosed with depressive disorder were recruited, with a mixed sample of patients who were using an antidepressant medication ($n = 29$) and patients who were not using an antidepressant medication ($n = 13$). A single-arm mixed-methods study was conducted to understand engagement, satisfaction, usability and potential clinical effectiveness of the intervention.

Results: There was a retention rate of 83.33% − 22 participants who used an antidepressant medication and 13 participants who did not use an antidepressant medication completed the final assessments. The median (upper quartile−lower quartile) of the completed 60 recovery journals and 7 coaching sessions was 56 (59−46) and 6 (7−4) times, respectively. Participants' satisfaction regarding their recovery progress, and on perceived helpfulness on different modules were high. The overall score of the user version of the Mobile Application Rating Scale was 4.23 (SD 0.44, range 1−5), indicating high acceptability and usability. Qualitative feedback identified three key themes: an efficient access to professional help, a personalized source of social support, and a facilitator of cognitive and behavioral change.

Conclusions: This study demonstrated that a WeChat-based intervention for depression was acceptable, and has the potential to promote personal recovery. More studies are needed to understand the efficacy and implementation of this model in real world.

Keywords

Depression, mental health, recovery-oriented service, digital health, mobile phone

[1]Medical Psychological Center, The Second Xiangya Hospital of Central South University, Changsha, China
[2]Medical Psychological Institute of Central South University, Changsha, China
[3]Department of Psychiatry, The Second Xiangya Hospital of Central South University, Changsha, China
[4]National Clinical Research Center for Mental Disorders, Changsha, China
[5]National Center for Mental Disorders, Changsha, China

[6]Department of Medical Social Sciences, Northwestern University, Chicago, IL, USA

Corresponding author:
Haishan Wu, Department of Psychiatry, The Second Xiangya Hospital of Central South University, 139 Middle Renmin Road, Changsha Hunan, 410011, China.
Email: wuhaishan@csu.edu.cn

Introduction

Background

Depression is one of the leading causes of disability worldwide, including in developing countries such as China.[1,2] Since the emergence of the coronavirus disease 2019 (COVID-19) pandemic, the prevalence of depression increased notably worldwide.[3] In this global depression crisis, more concerted efforts are needed for prevention, treatment and recovery, so as to fill the knowledge gap, raise awareness and alleviate the burden of global depression.[4]

As the first country affected by the COVID-19 virus, China responded strongly in early 2020. A study found that the prevalence of severe depression cases rose from 6.33% in 2018 to 7.54% in 2020, indicating a 19% increase.[5] With China's large population, the high prevalence rate of depression is recognized as a severe social problem and has attracted more and more public awareness and government attention in recent years.[6] Epidemiological investigations in China have found that most patients with a depressive disorder have social impairments. However, the rate of obtaining adequate treatment was very low. It is necessary to continuously increase the availability, accessibility and acceptability of mental health resources, so as to improve the utilization of health services for patients with depressive disorders.[7]

Over the past decade, a large number of web-based interventions emerged in the mobile application market, and COVID-19 further accelerated the development of mobile technologies.[8,9] Mobile health interventions have the potential to improve accessibility and effectiveness of mental health services. For example, users can utilize mobile devices to access psychological knowledge, obtain social support, access tele-medical consultation, or chat with robots anytime and anywhere.[10,11] The potential of mobile mental health services was also widely recognized by different stakeholders as acceptable, helpful and easy to use[12–14]. Effectiveness trails and reviews have demonstrated that mobile mental health apps can be effective in improving anxiety, depression, smoking cessation, stress, quality of life, etc., but more research is needed.[15,16]

However, existing mobile mental health interventions have faced challenges including poor rates of retention, lack of research on clinical patients, too much emphasis on technology and insufficient evidence of effectiveness[17–19]. Acceptability and usability tests can help gather feedback on satisfaction, technical problems and optimization suggestions from the perspective of users, and could provide significance guidance on producing pragmatic interventions for real-world consumers. Previous studies found that responsive human support and individualized content could improve patient experience.[12] However, many applications in the market lack reports on usability or user perception. How mobile techniques were used and perceived by consumers, and particularly by patients within China's mental health care system, still needs further study.

Furthermore, the existing research on mobile mental health interventions is mainly from western countries, but rarely from China.[20,21] Despite the rapid development of China's mobile application market,[22] we lack a solid understanding regarding user perceptions of using mobile health interventions within Chinese social and cultural environment. How to design mobile health interventions that meet the needs of mental health service users in China requires more research.

Aims

Considering the high prevalence rate and low treatment rate of depression in China, as well as the promising potential of rapidly developing mobile mental health services, there is a high public health potential for accessible, acceptable and effective web-based recovery service for depressive disorders based on Chinese cultural and social characteristics. Such an intervention could provide reference for promoting mental health both in China and in other low and middle-income countries. Based on the above reason, the research team developed a web-based service for the recovery of depressive disorders, based on previous user needs research.[14,23] The main purpose of this study is to evaluate the acceptability and usability of this service and to provide, providing a base for future clinical trials aimed at evaluating the effectiveness and implementation of the service.

Methods

Intervention

Based on previous assessments on need and preference,[14,23] study on literature and reference on health promotion theories such as Intervention Mapping,[24–26] Behavioral Intervention Techniques[27–29], and theories on recovery-oriented mental health services,[30] researchers developed a web-based recovery model appropriate for patients in the social-cultural environment of China, named *Personal Recovery-Oriented and Coach-Assisted* Training (*PROCAT*).

The main principles of this model include: (1) Focus on personal recovery: based on the framework of personal recovery,[30] interventions designed on this model focus on meeting patients' personal recovery needs, such as connectedness, hope, self-identity, meaning in life and empowerment, rather than focusing on clinical symptoms or medical treatment as the major goal. (2) Provide multiple models of evidence-based content: according to previous research on the effectiveness of different interventions,[31] and with the purpose to meet different preferences, interventions based on this model are required to adopt multiple evidence-based psychotherapy theories, such as cognitive behavior therapy, interpersonal relationship therapy,

positive psychology and mindfulness. (3) Rely on human support: considering the benefits of human support in web-based mental health interventions,[12,28] and the patient-reported need for social support,[23] this model requires the role of recovery coaches as one of the core elements. Recovery coaches provide interactions such as reminders, coaching sessions, personalized feedback and relevant resource recommendations. The coaches are not strictly required to be professionals but have to possess basic skills on psychological counseling. This model also recommends that interventions be provided through social platforms that are already familiar to and frequently used by potential participants like WeChat, so as to build a more available supportive interpersonal relationship. (4) Adoption of efficient learning techniques: this model emphasizes understanding through retelling and feedback based on personal relevant experience, so as to promote the mastery of knowledge.[32] The designs can include providing summary cards for convenient active review, spaced repetition with reminders and personalized feedback during coaching sessions. (5) Accessible and multiple engaging forms of intervention delivery: according to previous study on preference,[23] this model recommends to provide as many forms as possible to flexibly meet different preferences of participants, such as systematic self-help study combined with personalized coaching sessions, multimedia learning materials provided as text or audio or video, personalized communication provided by synchronous audio chat or asynchronous text messages.

Based on the concepts of PROCAT model, researchers in this study developed a WeChat-based recovery training for depressive disorders, named *My Magical Spirit Journey-A remote recovery training for depression*. The length of the training was 12 weeks, and all training were provided on the social media platform WeChat by its mini-program. WeChat mini-programs are streamlined and lightweight versions of apps that can be used within WeChat without the need for downloading and installing a separate app.[33] Considering that WeChat is the most popular social media app in China with more than 1.2 billion monthly active users,[34] a service that catering to consumers existing digital habits might enhance their acceptance and overall health care experience.[35] In addition, formative design research conducted by this research team found a user preference for WeChat over specifically designed apps.[14,23]

Specific designs include the following seven modules as can also be seen in Table 1. Screenshots of the designed mini-program are available in the Supplementary material.

1. Recovery lessons. Participants were reminded to check-in every weekday for 12 weeks to study evidence-based lessons that were designed for personal recovery. Lesson content included knowledge on depression, mindfulness, cognitive restructuring, behavioral activation, self-esteem and interpersonal relationships.[31]

Summary cards showed as Tips 1–60 and small quizzes were also provided to facilitate review of each lesson. All learning materials were edited and examined by at least two psychiatrists (DY, YY, HX and HT) who had at least five years of clinical experience. This module was provided by a mini-program in WeChat.

2. Recovery journals. Participants were asked to complete a journal every weekday along with the lessons, which consisted of self-reported sleep and mood, feedback on the lesson, a gratitude journal and other personalized feedback on recovery. This module was provided by a mini-program in WeChat.

3. Regular coaching. Coaching sessions based on motivational interviewing and supportive accountability[28,36] were a key element and intended to improve motivation, enhance knowledge absorption and provide feedback. Synchronous coaching sessions were provided at baseline and every two weeks (7 sessions in total), typically via the voice calls function of WeChat. Each session lasted 30–60 min and was audio recorded to ensure quality. All coaching sessions were semi-structured, with guidelines as follows: (1) gather basic information and provide individualized analysis of biopsychosocial factors of depression (mainly provided in the first 1–2 sessions), (2) set personal recovery goals (primarily in the first 1–2 sessions), and following up on progress in later sessions, (3) discover and acknowledge participants' progress and efforts, to facilitate motivation on continuous participation and actions for change in each session (provided in each session), (4) assist in understanding, application and feedback on the content to achieve personal recovery goal (provided from the second session onward), such as to assist in the practice of mindfulness, emotion management skills, etc., (5) individualized Q&A on the content and questions related to depression and recovery, and (6) in the final session, summarize the progress over the entire 12 weeks, with the purpose to boost confidence and encourage continued growth in the future. In addition, the coach gathered the participants' overall feedback and suggestions on the future optimization on the service. While previous evidence showed that human support in mobile intervention does not require to be provided by highly qualified professionals,[37] this early-stage study still equipped a PhD-level psychiatrist (YT) as the coach and two experienced psychiatrists as supervisors (HX and HT) considering a higher level of expertise was necessary to ensure safety and quality control. The selection criteria and coaching protocol were adapted from a previous study, which required their coaches to have a bachelor's degree in related field, and to provide service according to the protocol.[38] The guideline of the coaching protocol for quality control in this service can be found in Supplementary material 1. Considering that the participants in this

Table 1. Modules and schedule of the intervention.

Modules	Contents	Time point	Total number
1. Recovery lessons	Lessons, summary cards and quiz	Every weekday during 12 training weeks	60
2. Recovery journals	Self-report monitoring of sleep and mood, feedback on lessons, gratitude journal, etc.	Every weekday for 12 weeks	60
3. Coaching sessions	Based on motivational interviewing	Baseline, and every 2 weeks	7
4. Mindfulness	Meditation tools recommendation	Varied (mainly at the beginning of training)	Varied
5. Regular assessments	Nine-item Patient Health Questionnaire (PHQ-9) [39] Seven-item Generalized Anxiety Disorder Scale (GAD-7) [40] The Somatic Self-rating Scale (SSS) [41] General life impact General Self-Efficacy Scale (GSES) [42]	Baseline, week 4, week 8, week 12	4
6. Personalized support	Customized content as needed	Varied	Varied
	Reminders of check-in and coaching	Varied	Varied
7. Feedback collection	Qualitative feedback gathered from coaching sessions	Baseline, and every 2 weeks	7
	Satisfaction questionnaire	Week 12	1

study were patients with a mental health diagnosis, we believe that it is necessary to improve the professional level and experience requirements, which means the coaches in this service need to meet the following standards: (1) have advanced training in mental health care, (2) have received basic systematic training in psychological counseling, as well as specialized training in cognitive behavioral therapy, and (3) have been engaged in related work in the psychiatric department for at least one year, and (4) are familiar with the intervention content and process, and participate in biweekly supervision for quality control.

4. Mindfulness. Considering there are already multiple mindfulness-related self-help tools in China's mobile application market at present, the research team decided not to design another platform. Instead, the lessons included relevant knowledges, and the coach would recommend several existing mindfulness tools for participants to choose at the beginning of training

which were reviewed and tested by the research team. In each coaching session, the coach would follow-up the usage and perceived effect of these tools, and recommend continuous practice if possible. During personal support, the coach would also remind the use of mindfulness if relevant. Recommended tools included several third-party mini-programs or apps that are publicly accessible in WeChat or mobile app market. The criteria for selecting existing mindfulness tools include: (1) focus on providing mindfulness-related meditation practices, and provides relevant concepts of mindfulness-based therapy; (2) a user rating above 4 points (range 0–5) in the app market; and (3) a research team rating of above 4 points on each dimension of the user version of the Mobile Application Rating Scale (uMARS) to ensure quality and usability.

5. Regular assessments. Participants were invited to fill out a self-rating assessment at baseline and every four weeks throughout the 12-week program, including

nine-item Patient Health Questionnaire (PHQ-9),[39] seven-item Generalized Anxiety Disorder scale (GAD-7),[40] the Somatic Self-rating Scales (SSS),[41] general life impact (range 0–10), and General Self-Efficacy Scale (GSES).[42] See Section 2.3 for further description of these scales. After every assessments, a results report with personalized advice was provided to the participant by the coach.

6. Personalized support. In addition to the above-described regularly scheduled synchronous coaching sessions, the coach also provided asynchronous text-based personal feedback as needed within 48 h during the training. For instance, further explanation of knowledge in the lessons, recommendations on related books or articles were provided in response to participants' questions. Reminders were also sent as needed to prompt participants to read the lessons and fill out journals, to schedule a coaching session every two weeks, or fill out the assessment every four weeks. This module was provided through text message function in WeChat.

7. Feedback collection. At the end of training, participants were invited to fill out a satisfaction questionnaire, along with an adapted usability scale using the user version of the Mobile Application Rating Scale (uMARS)[43] to gather feedback on the quality on the WeChat mini-program. The scale is described in Section 2.3. Subjective feedback on satisfaction with the training were also collected during coaching sessions and daily communication with the coach.

Recruitment

Participants were recruited from a psychiatric outpatient department of a major general hospital in central south area of China. The target sample was at least 40 participants, with at least 10 participants who were not using an antidepressant, considering the need to conduct a primary comparison on the difference between participants accepting an antidepressant (AA) and those not accepting an antidepressant (NA). The reason for selecting 40 participants as the target number was that previous studies have shown that 20 participants are sufficient to provide feedback on almost 95% of usability issues, while 10 participants can provide feedback on 80% of usability issues.[44] In addition, qualitative research suggests that theoretical saturation can generally be achieved within 12 interviews, and the basic elements can be discovered within the early 6 interviews.[45] In order to collect sufficient qualitative data in the NA subgroup, we believe that 10 participants not taking an antidepressant were needed. Considering that the anticipated dropout rate could be around 20%, 12–13 participants for this subgroup were preferred. At the same time, we anticipated that the majority of clinically diagnosed patients in the hospital recruitment process would be taking

antidepressants, so we allowed for the recruitment of more eligible participants accepting an antidepressant (AA), in order to increase the likelihood of discovering more feedback on acceptability and usability. Therefore, the estimated total recruitment number was around 40, and the prerequisite was that there must be at least 10 NA subgroup participants.

Eligible participants were required to: (1) be 18–45 years old; (2) own a smartphone equipped with WeChat and currently use it as their main social media; and (3) have a diagnosis of a depressive disorder. Exclusion criteria included: (1) experiencing suicide ideation for most of the time within two weeks before inclusion (corresponding to a score of 2 or above in PHQ-9 item 9), or had suicidal behavior within two weeks before inclusion, or if the researcher were unable to assess the degree of suicidality; (2) experienced psychotic depression within two weeks before inclusion; and (3) had a diagnosis of dementia, substance abuse, bipolar disorder, or psychotic disorders. This study has been approved by the Ethics Committee of Xiangya Second Hospital. Prior to the start of the study, the purpose and methods of this study were fully informed and an informed consent was signed. The entire study was conducted anonymously to ensure patient privacy and data security. Each participant was provided a compensation of 300 RMB (approximately 46.5 USD) for completing all assessments. Compensation was not for service use or treatment adherence.

Measures and analysis

Mixed quantitative and qualitative methods were employed to assess acceptability and usability of this WeChat-based depression recovery service, and to gather participants' perspectives and suggestions for future optimization. Clinical outcome measures were also assessed and analyzed.

Quantitative data consisted of the following aspects:

1. Engagement. Engagement data includes retention rate and completion rates of training tasks. Retention rate was defined as the proportion of participants who can still be contacted after the twelfth week of intervention, have not requested to withdraw from the study, and have completed the final evaluation after the training. Another indicator of engagement was the training completion rate of retained participants, including the proportion of completed 60 recovery journals (completion refers to submission of small quizzes along with each lesson and attached recovery journal), and 7 coaching sessions. The reasons for choosing these two indicators were that these two modules were conceptualized as key elements likely to have the greatest intervention effects

in service, which could be collected conveniently and analyzed objectively.

2. Satisfaction on recovery progress, which is subjectively assessed by three 0–10 score questions, 0 means the lowest degree, 10 means the highest degree: (1) How satisfied are you with your current recovery status? (2) How much do you think your recovery goals have been achieved in the past 12 weeks? (3) How much do you think the recovery goals that have been achieved so far are attributed to this training?

3. Perceived helpfulness on each element, which is subjectively assessed by scoring from 0–100 on each module followed by the question: How helpful do you think this module has been to you?

4. Usability assessed by uMARS. The user version of Mobile Application Rating measure (uMARS)[43,46] is widely recognized for gauging the quality of mobile health apps comprehensively and multidimensionally. It evaluated four objective app qualities: engagement (customization, entertainment, interactivity, fit to target group, etc), functionality (performance, navigation, gestural design, ease of use), aesthetics (graphics, layout, visual appeal), information (quality, quantity, visual information, goals, credibility, description), and one subjective quality (worth recommending, stimulates repeat use, overall satisfaction rating), on a 5-point scale. Although uMARS was originally designed to evaluate the usability of apps, the main difference in usage between WeChat mini-programs and apps for users is whether to open them through WeChat or directly from the smartphone. Whether an app is opened from a home screen or from WeChat likely does not affect the evaluation of the above scale dimensions, so uMARS was considered suitable for usability evaluation of WeChat mini-programs.

5. Clinical outcome, including the following scales. (1) The Nine-Item Patient Health Questionnaire (PHQ-9)[39] is a frequently utilized instrument in both clinical and research settings with established validity and reliability. It evaluates depressive symptoms on a scale of 0 to 27 scores with items on mood, interest, ability, sleep, appetite, and fatigue over the past two weeks, and higher score indicates higher levels of depressive symptoms. (2) seven-item Generalized Anxiety Disorder scale (GAD-7)[40] is also a widely used measures on generalized anxiety disorder symptoms in diverse clinical and research settings. It uses seven questions to determine the frequency and severity of symptoms over the past two weeks by a total score from 0 to 21, and higher score indicates more severe level of anxiety. (3) The Somatic Self-rating Scales (SSS)[41,47] was developed by Chinese scholars and has been proven to have good reliability and validity, which can be used to evaluate somatization symptoms and reflect physiological disorders related to

psychological factors. This scale consists of 20 self-report items, with a total score from 20–80, and higher score indicates higher level of somatic symptoms. Considering that participants in this study may also be troubled by somatization symptoms, this scale is used to assist in evaluating changes in somatization symptoms. (4) A 0–10 score general life impact question was used to assess the degree of impact that depression has laid on their general life: 0 points for no adverse effects, 10 points for serious impact on daily life. (5) General Self-Efficacy Scale (GSES)[42] is a widely used tool that measures individual's perceived self-efficacy in facing life's challenges. The scale consists of ten items that explore beliefs in overcoming difficulties and achieving desired outcomes. Respondents rate their agreement on a Likert scale, with cumulative scores ranging from 10 to 40 to indicate general self-efficacy, and higher score indicates higher levels of self-efficacy.

Descriptive statistics and preliminary comparison of outcomes between participants accepting an antidepressant (AA) and not accepting an antidepressant (NA) were analyzed using IBM SPSS version 24.0 (IBM Corp.).

Qualitative data were gathered to further understand users' perceptions during their recovery process and to gather more insights for future optimization. These parts of data were mainly collected from every two weeks' coaching sessions, from daily communication with the coach, and from open-ended questions from satisfaction survey at the end of 12-week training. Qualitative data were analyzed using Braun and Clarke's 6 steps of thematic analysis methods[48] by QSR International's NVivo 12.0 to identify themes and subthemes.

Results

Participants

42 eligible participants were recruited. The mean age was 26.00 years (SD 7.88). Most participants were female (n = 37). The average length of experiencing a depressive disorder was 2.50 (SD = 2.74) years. 29 participants were accepting an antidepressant during the study, 8 of which were accepting an antidepressant for the first time when they were recruited. 13 participants did not accepting any antidepressant during the study. No participant was engaged in regular psychotherapy during the study.

The average PHQ-9 score of 42 participants at baseline was 13.31 (SD = 6.76), and the average GAD-7 score was 9.52 (SD = 5.17). The average Somatic Self-rating Scale score was 43.57 (SD = 12.20). The average general life impact was 5.86 (SD = 2.29). The average GSES score was 19.69 (SD = 6.20).

Engagement, satisfaction, helpfulness, and usability

Among the 42 recruited participants, 5 participants dropped out within the first 2 weeks, and 2 additional participants withdrew within the first 4 weeks. All 7 participants who withdrew from the study were taking antidepressants. The drop-out reasons that we were able to collect included: participants (1) feeling that their symptoms were too severe to keep participating ($n = 1$), (2) not feeling comfortable talking to people ($n = 1$), (3) feeling too busy to participate ($n = 1$), (4) feeling recovered with no need to participate ($n = 1$). The other three dropped-out participants were unable to be contacted and did not provide the reason. The analyses presented below were based on the data collected from the remaining 35 participants. No significant differences in age ($t = 1.1$, $p = 0.279$), and the length of experiencing a depressive disorder ($t = 0.269$, $p = 0.79$) were detected between participants accepting an antidepressant or not. There were two male participants in the former group ($n = 22$) and one in the latter group ($n = 13$).

Engagement with the program was mainly measured by the retention rate, and the completion rate of two major training modules: the 7 coaching sessions and the 60 recovery journals. Of the 42 participants, 35 completed the week 12 assessment, with a retention rate of 83.33%. The median (upper quartile-lower quartile) of the remaining 35 participants who completed 60 recovery journals and 7 coaching sessions was 56 (59–46) and 6 (7–4) times, respectively. Two participants requested to have the coaching by texting instead of voice calls, including one participant changed all coaching sessions to text messages and accepted 3 sessions in total, and another participant used text messaging for 3 of the 7 sessions she accepted. While the default recommended form of coaching was still voice guidance, we offered this flexibility to stay consistent with the PROCAT model principle of providing personalized service to meet consumer needs. Thus, these coaching sessions delivered by texting were also considered as counting toward completion of full-time coaching. There was no statistical difference in the completion rate of 7 coaching sessions ($Z = -0.704$, $p = 0.482$) or 60 recovery journals ($Z = -1.01$, $p = 0.312$) between participants who took an antidepressant and those who did not.

All 35 participants completed the satisfaction questionnaire after the intervention. The average score of satisfaction on current recovery status was 8.74 ($SD = 1.42$). Perceived achievement of personal recovery goal after intervention was 8.26 on average ($SD = 1.81$). Perceived contributions of the training to recovery achievement scored 7.91 on average ($SD = 1.59$).

In terms of perceived helpfulness of different modules in the intervention, the average ± standard deviation or median (upper quartile-lower quartile) of the overall score (range 0–100) of each module was ranked from low to high as follows: regular assessment 72.74 ± 19.62, recovery lessons 77.6 ± 16.26, recovery journal 79 (64–95), recommended mindfulness tools 82 (60–97), personal support from coach such as reminders, provision of customized resources and feedbacks 89 (81.5–100), and 7 coaching sessions 97 (82–100). Except for the evaluation of the mindfulness module ($p = 0.031$), there was no statistical difference between participants who were accepting an antidepressant and those who were not. Table 2 provides the detailed descriptive statistics of perceived helpfulness of each module.

The overall uMARS score was 4.23 ± 0.44, ranging from 1–5. The mean ± standard deviation or median (upper quartile-lower quartile) of each subscale was arranged from low to high as follows: subscale Engagement 3.78 ± 0.62, subscale Aesthetics 4.33 (4.00–4.67), subscale Information quality 4.5 (4.00–4.75), and subscale Functionality 4.5 (4.00–4.75). In addition, the median of the subjective quality subscale was 3.75 (3.25–4.2-) points. No significant difference in total score or each subscale was observed between participants accepting am antidepressant or not. Table 2 provides the detailed descriptive statistics of subjective quality and perceived impact.

Qualitative user feedback

Three themes were identified with regard to the acceptability and usability of the training, including (1) An efficient access to professional help, with 3 subthemes; (2) A personalized source of social support, with 4 subthemes; and (3) A facilitator of cognitive and behavioral change, with 6 subthemes. Quotations from participants were translated into English and are presented below to demonstrate the identified themes and subthemes.

Key theme 1: An efficient access to professional help

Convenient and private access. The majority of participants reported that this web-based form of learning and coaching was convenient and provided more privacy than face-to-face methods. The remote delivery was perceived as more relaxing, comfortable, acceptable and private than going to the hospital or clinic. Considering the lack of accessible resources, participants reflected that it is difficult to find a psychologist by one's own, and this form of self-help was easier to reach. In addition, it was usually difficult for participants to talk to people around them, but participants found it easier to express themselves remotely. For instance:

> This online form was very convenient. It's difficult to get an appointment in hospital and you can't say too much in the clinic… Talking through a telephone is more relaxing than

Table 2. Scores of perceived helpfulness of different modules and uMARS.

	Participants not accepting antidepressant (n = 13)			Participants accepting antidepressant (n = 22)			
	Upper quartile	Median	Lower quartile	Upper quartile	Median	Lower quartile	Z/t (p)
Perceived helpfulness of different modules							
Recovery lessons	96.00	82.00	75.00	83.00	80.00	62.00	1.332 (0.192)[a]
Recovery journals	95.00	77.00	70.00	89.00	80.00	61.00	−0.445 (0.656)
Coaching sessions	100.00	100.00	86.00	100.00	89.00	78.00	−1.494 (0.135)
Regular assessments	100.00	81.00	62.00	80.00	65.00	60.00	1.811 (0.079)[a]
Mindfulness	97.00	87.00	83.00	95.00	68.00	40.00	−2.16 (0.031)*
Personalized support	100.00	92.00	87.00	94.00	86.00	76.00	−1.636 (0.102)
Scores of uMARS							
Engagement	4.40	3.80	3.60	4.20	3.80	3.00	−1.071 (0.292)[a]
Functionality	4.75	4.25	4.00	4.75	4.50	4.25	−0.467 (0.64)
Aesthetics	5.00	4.67	4.00	4.67	4.17	3.67	−1.34 (0.18)
Information	4.75	4.75	4.50	4.75	4.50	4.00	−1.15 (0.25)
Overall score	4.58	4.37	3.90	4.51	4.17	3.84	−1.005 (0.322)[a]
Subjective quality	4.25	4.00	3.50	4.00	3.50	3.00	1.377 (0.169)

[a]These data conform to the normal distribution, and t-test is used. Other data do not conform to the normal distribution, and Mann–Whitney U test is used.
*p < 0.05. **p < 0.01.

face-to-face. When waiting in the hospital you will have concerns about privacy, but online is more comfortable. In general, patients don't want to let others know (about the disease). So, a remote form is more acceptable and more private. (NA03)

It's better compared to seeing psychotherapists… It's more self-help, not that difficult to participate, and easier to access. I felt more in control. (AA15)

It's difficult to talk to people around about emotional, psychological things. I feel this form of taking online courses not only protected my feelings, but also perfectly targeted at my problems. (NA05)

Systematic and targeted content. The systematic nature of program content was often mentioned by participants. Even though massive amounts of information from the Internet are only a click away, participants reported that the information was often scattered, inappropriate, easy to forget, and difficult to grasp and apply to their own lives. The content in this training was perceived as relevant, more systematic and practical, and provided targeted solutions to the problems related to depression. For instance:

It is very important for content to be logical and systematic, rather than scattered resources online, which are easy to forget… It's more conducive to cognitive and emotional improvement. (NA13)

During my last episode, I searched for information and adjusted all by myself. Now I have more targeted resources to look for. It's pretty convenient to learn this way… The lessons were more professional than what I searched by myself, more practical, and actually let me know how to do, how to drive myself out of difficulties. It's more grounded. (NA03)

It provided a lot of scientific perspectives and methods. I learned some new knowledge, which I didn't know before. It's very helpful for the difficulties I encounter in daily life. (NA10)

Efficient and acceptable settings. The setting of the training was considered appropriate and conducive to efficient learning. The daily updated learning materials, reminders and companionship enabled participants to remind themselves, and take the initiative to act and think, to form good habits, and to study and explore more deeply. Gratitude journals also encouraged participants to discover the good sides of life. Participants reported that the simplified summary card along with each lesson also made it easier to review the knowledge efficiently. For instance:

It really worked for me to keep in touch with positive energy every day, to check in, and to remind myself not to be depressed. (NA03)

The training had a great impact on me. It's a constant reminder for me to form good habits, strive and overcome difficulties, and to remember the desire to cure depression. (NA09)

I'm glad that I took action to practice and learned something from the training… I've read Defen Zhang's [a well-known self-help book writer in China] book before, but there was no actual effect. Without this training, I would not have explored this deeply. (NA08)

I like the gratitude journal a lot. It allowed me to retrospect and think about my life of the day, find the beauty of life and make myself happier. The feedback question is also a good way to review the knowledge. (AA08)

The summary cards were a refined form of lessons. Too many words will be boring, and depressed people wouldn't be able to read through. So, the combination of detailed and simplified versions made it more convenient to review the knowledge. (AA02)

Key theme 2: A personalized source of social support

Comfort and warmth. Biweekly coaching sessions were considered acceptable and necessary. Regular communication between the coach and participants appeared to make participants feel safe and that the relationship was genuine. Participants perceived the coach as comforting and as a necessary component of the intervention. For instance:

I liked talking with coach. It's quite relaxing, and would not feel like a burden. (AA03)

Coaching sessions are very necessary. Regular communications made me feel more secure. Interaction between people is more authentic than simply learning from text. The setting of time and frequency (of coaching sessions) were also acceptable. (AA01)

(I have changed) from being like a crying baby to being today's mature and calm person, I contribute it to the comfort from coach… Training with a voice is much warmer. (AA06)

Inspiration of deeper exploration. In the process of coaching, the real-time discussion with coach inspired deeper exploration on participants' distress and self. For instance, many participants felt that the discussion facilitated the application of knowledge, promoted self-exploration, and provoked new perspectives of thinking. The process of real-time communication triggered more in-depth thinking and was more helpful than simplified knowledge accumulation. For instance:

The coaching sessions were really nice. It helped to summarize and sort out thoughts and methods, some of which were what I have not think of. It helped to alleviate confusion in mind, provide methods, enlightened myself, and avoided continuous entanglement and self-trapping. It's very happy and pleasant to chat with the coach. (NA06)

Regular coaching is also a good way to review the lessons, and can harvest new perspective provided by the coach. (AA08)

The training improved my level of professional knowledge, but the communication with the coach was more helpful. The process of real-time interaction can bring out more thoughts from a deeper level. (AA04)

Empathy and understanding. Participants believed that the feedback and empathy they received from the coach was helpful. In the face of the public's prejudice and stigma on mental illness, the coach was perceived as being able to actually listen to the participants' distress, understand the reasons behind it, and provide corresponding emotional support and professional advice. Especially for participants who lack social support, and were not listened or understood for a long time, it was a very important supplementary method of social support. For instance:

People around me just couldn't understand why I had these thoughts, like my family just think it was affectation… But my coach can listen to me, help me to relax and responded appropriately, let me know that these were normal and provided corresponding advice… Coaching sessions were very

necessary. Words are auxiliary, but communication can play a vital role. People are all eager to be heard. It's really nice to have the coach help discover problems and provide suggestions. (NA03)

I gained a lot, especially on each day of coaching sessions… Let me know the root cause of my fear. It was very clear and systematic … and realized that I could be understood in training. (AA15)

Empowerment and encouragement. Some participants believed that the existence of coach empowered them to make changes. The existence of coach not only reminded and nudged participants to take action as a supporter, but also guided participants to explore and practice from a more reasonable and positive perspective, and produced more confidence and courage to make changes. For instance:

(The training) increased my motivation to change, with the coach accompanied my growth… It feels good to have someone to talk with … have someone who keeps supervise and remind you to change. (AA03)

(The training) made me want to be a better person, like the coach… Learning is very important and broadens my horizon… I am very lucky to see the power of women. I hope I can shine too. Grateful. (NA09)

(Coaching sessions) empowered me a lot … Sometimes, to make difficult changes, you may just need someone who can rationally and positively analyze problems … need the strength from others to give you the confidence and encouragement. (NA08)

Key theme 3: A facilitator of cognitive and behavioral change

Increase awareness. After the training, participants believed that their understanding of depression had increased. For instance, some participants were inclined to avoid or escape from their distress before, but after the training, participants were able to develop a more scientific perception, possessed the ability to face it with a positive attitude, and established various methods to get better. For instance:

I learned a lot about depression, and know that many people have it. In the past, I would feel repulsive, ashamed and avoid it, which cost me much more time in the end. Now I will face it proactively. (NA08)

This three month of training gave me a lot of mental help. The most obvious feeling is that it is a systematic and gradual process. From the beginning, it allowed me to

correctly face depression, then use specific methods and tools to manage emotions, guide my behaviors, awake self-awareness. After the improvement of my condition, it also helped me to rediscover myself, increase happiness and deal with intimate relationship. (AA09)

Improve emotional management skills. Through the training, most participants have increased their ability to manage their emotions. For instance, participants reported being more acceptable emotional changes, being more proactive and effective in managing emotions, being able to peacefully coexist with depression, and being more capable of reducing the impact of negative emotions on daily life. For instance:

Now I will normalize the fluctuation of my mood. It's okay. It will get better after a period of time. Even the worst-case scenario happened, I know I can seek for other help. (NA02)

I often failed at self-regulation before, even wanted to give up. The lessons I learned here gave me more confidence and motivation. I am very touched, and learned to take more initiative to master my emotions. After participating this training, the effect of self-regulation was more obvious. (AA03)

In terms of emotional regulation, I can timely signify it when something is wrong with my mood… I'll try to think from another perspective, accept and treat it calmly… I know that I can try some new things when feeling depressed, and when it's getting too strong, I can get away from the environment, and seek help from families and friends, and talk, etc. (NA10)

Foster a positive mindset. As one of the core theories applied in this intervention, knowledge on cognitive restructuring was applied during the practice of self-management. For instance, many participants reflected that they were able to detect possible problematic mindsets, and became aware of ways to adjust, were able to analyze things from multiple perspectives, replace unreasonable belief with more objective and rational thinking, and no longer let their current emotion control their thoughts and behavior. For instance:

It helped me to notice what didn't pay attention to. It changed my thoughts and ways of thinking, the perspectives I treating problems and things are different. I know that I have methods to deal with (problems), and have already learned a lot of methods. (NA06)

I learn to analyze and look at things from perspectives of bystanders, and I know that many things depend on how

you look at them, not the thing itself. It helped me to better analyze my emotional changes. (AA16)

I will write down what bothers me now, and think about the reason, analyze whether my thoughts were objective and reasonable, then refute unreasonable thoughts… There is more awareness. (AA11)

(After the training) I became more rational. I felt that I have changed from an emotional child to a mature person who thinks rationally and analyze all aspects of problems from multiple angles. I won't let mood take control of me, or just keep procrastinate whenever feeling unwilling. (NA08)

Improve self-esteem. Low self-esteem was one of the common problems reported by many patients with depression. Contents on this topic were viewed by participants as well targeted and helped to rebuild some participants' self-concept. For example, some participants used to worry a lot about the judgment from others, and after the training, they were able to evaluate themselves more objectively and comprehensively. Some other participants could easily deny themselves, and often fell into an inferiority complex before, but after the training, they were more able to accept imperfections, see their own advantages, and empower themselves. For instance:

Now I will accept my imperfections, and do what I can do at present… I know I need to affirm and recognize myself first, and do not rely my own happiness on the responses of others. My self-value does not come from the recognition of others. (AA03)

In the past I always felt that "I shouldn't be like this", "how could it be…", "I am worthless", and I will self-reproach… I thought that I was just like this, it's meaningless… Now I'm much better. I can see my good aspects and what I possess, what I'm good at work, and improved the sense of existence… I know that people all have their bad times. I will accept myself, allow myself to make mistakes and be imperfect occasionally, and think of more positive methods to solve… Don't compare with others. I know my shortcomings, but at the same time, I can see my advantages and strengths. (NA03)

My first gain is that inferiority feeling is a very common psychological phenomenon, so don't be too nervous when it arises. Face it correctly and prove whether I am really like that. Second, find my present advantages and clarify the direction for improvement. Recognize the excellence of others and find what I can improved at the same time… It seems that I am not so harsh on myself now, and learned to accept the real me and reward myself appropriately. (NA08)

Establish positive behavior patterns. Behavioral activation was also an important theory adopted in this WeChat-based intervention, and promoted positive changes on participants' behavior patterns. For example, some participants learned to detect and proactively break the vicious circle caused by previous negative behavior patterns and gradually established their own personalized behavioral strategies to cope with emotional fluctuations, such as going to the gym, shopping with friends, or practicing meditation. In the process of achieving goals, participants were also learned how to subdivide goals and make plans, how to reduce obstacles, and were able to enjoy the process. For instance:

I tended to focus on negative things before. Now I know that it was related to my negative emotions. Now I will remind myself by reading, exercising, diverting attention and changing the direction of thinking. (AA03)

Now I am aware that I can do things that I am interested in under the condition of depression, like work out at the gym, go shopping with friends, take a walk, etc. The positive meanings of these things can often make ourselves more positive. (AA08)

Mindfulness is helpful. It calms me down… I will use it before sleep or when I am feeling frustrated… I am aware that you can't keep continue the negative behavior pattern because of previous habits… Like getting up in the morning, just take action and give yourself some small goals, and let it become a positive behavior pattern in life. In this way, the status will be much better. It's very inspiring. (NA08)

I will start from the smallest action and lower the threshold… Making plans facilitated me from wanting to do something, to knowing how to do it, then reducing obstacles, and enjoying the process of doing it, rather than paying too much attention to results. This way it's easier to actually do it well. (AA11)

Improve interpersonal relationship. The lessons on interpersonal relationship also helped participants to relieve their interpersonal conflict and intimacy problems. Some participants started to examine their past misunderstandings in interpersonal relationships, and establish their own interpersonal style, which contributed to reduced interpersonal conflicts. In terms of intimate relationships, some participants were able to identify their problematic expectations and established a more sophisticated intimacy model. For instance:

…it also allowed me to re-examine my behavior, to understand and change my attitude towards other people, and my interpersonal relationships were also assuaged. (NA06)

During my episode, my mood would fluctuate a lot, and I would be very sensitive to my relationships with others. I didn't know how to reply, worrying if I overreact, I will frighten others, but I will also feel bad if I say I'm fine… After the lessons, now I learned to reply frankly. I don't need to tell everything, but I can also be very polite. I like it this way. (AA08)

I used to think that love means possession and occupation, should be consistent with each other … should meet my needs, or I would overthink whenever I am not satisfied. Now I know that there are ways to respect each other's independence and integrity, respect each other's space and the need to be alone. And I can take the initiative to improve intimacy. I should make effort to maintain it, and identify my unreasonable expectations. (AA15)

Through the process of the intervention, some participants provided suggestions on the content of the training, such as some typos, more examples, a preference on positive quotes sent along with each weekday's reminders, and a better way of collection that convenient to review the resources. A few participants suggested that the training should provide more experiences of other patients, such as building an online community, but they also hesitated when thinking of the possible negative emotional impact of unstable patients within an online community. Feasible adjustments were quickly implemented during the intervention, and none involved the primary design of main modules.

As anticipated, not all participants embraced all the content and format provided within the program. At the beginning of the training, a few participants worried about not able to persist. For instance:

I am afraid I can't learn anything when not in a good condition. (AA01)

I don't want to do anything when I am in a bad mood. (NA08)

A few participants indeed dropped out, but others were able to complete the training. Some participants also reflected that some content was similar to what they already knew, or that it was not quite relevant to their own concerns for now, but they did not mind reviewing it. For instance, AA08 reflected that:

Today's content was kind of easy to me, since it rarely happened to me. I scanned it and then went to review lessons before.

Some participants felt mindfulness tools unhelpful, noted it was easy to forget about it, or only tried a few times and gave up. For instance, participants NA 12 reflected:

I tried three times, but I felt I was too fidgety and difficult to calm down.

And AA01 indicated a dilemma in feeling motivated to try out components of the intervention:

I didn't use meditation. When I am feeling good, I don't want to use it, when I am not feeling good, it is useless.

Potential effectiveness

Even though this study was not powered to compare the clinical efficacy of the designed intervention, potential changes in clinical outcomes were examined. There were significant improvements on all clinical outcomes comparing between baseline and week 12. As seen in Table 3, there were no significant differences on baseline scores between subgroups of participants accepting antidepressants or not. In week 12, there was a difference between subgroups on PHQ-9 scores ($t = -2.14$, $p = 0.04$). However, the change of PHQ-9 from baseline to week 12 was not significantly different between the subgroups ($t = 0.92$, $p = 0.364$).

Discussion

This study investigated the acceptance and usability of a WeChat-based recovery training for patients with depression in China. The results showed high rates of engagement, and high levels of satisfaction, usability and perceived helpfulness. The training was recognized as an efficient source of professional help, personalized social support, and as a conducive tool for cognition and behavioral change. Below, we discuss possible reasons that might have contributed to these favorable results by combining evidence from previous studies, and providing reference for the design and application of future web-based mental health interventions.

Low engagement and persistence rates have been one of the key challenges faced by web-based interventions.[18,49] Commercially available smartphone apps generally lose about 70% of users within one week of download, and large amount of people stopped using mobile health programs before achieved any clinical effects.[50,51] A systematic review also showed that the acceptance of web-based cognitive behavioral therapy for depression only had an average retention rate of 56% among those who were already willing to start.[52] The reasons contributed to low participation may include poor usability, failure to focus on user-centered design, lack of trust, and concerns about privacy.[18]

Table 3. Descriptive statistics of clinical outcomes.

Items[a]		Full sample Mean (SD)	t (p-value)	Not taking antidepressant Mean (SD)	Taking antidepressant Mean (SD)	t (p-value)
PHQ-9	Baseline	12.51 (6.89)	5.641 (<.001)**	13.15 (6.88)	12.14 (7.03)	−0.417 (0.679)
	Week 12	6.46 (4.31)		8.38 (3.10)	5.32 (4.57)	−2.14 (0.04)*
GAD-7	Baseline	9.09 (5.24)	4.35 (<.001)**	8.85 (5.35)	9.23 (5.30)	0.205 (0.839)
	Week 12	5.09 (3.88)		6.08 (3.12)	4.50 (4.23)	−1.167 (0.252)
SSS	Baseline	42.26 (12.19)	5.051 (<.001)**	43.08 (13.74)	41.77 (11.48)	−0.302 (0.765)
	Week 12	33.31 (10.47)		36.08 (6.79)	31.68 (9.47)	−1.462 (0.153)
Life Impact	Baseline	5.69 (2.45)	4.15 (<.001)**	5.38 (2.26)	5.86 (2.59)	0.554 (0.583)
	Week 12	3.83 (1.82)		4.54 (1.56)	3.41 (1.87)	−1.831 (0.076)
GSES	Baseline	19.57 (5.76)	−3.614 (0.001)**	20.62 (7.309)	18.95 (4.71)	−0.82 (0.418)
	Week 12	24.34 (6.86)		23.69 (5.53)	24.73 (7.64)	0.426 (0.673)

[a]PHQ-9: nine-item Patient Health Questionnaire. GAD-7: seven-item Generalized Anxiety Disorder scale. SSS: Somatic self-rating scale. GSES: General Self-Efficacy Scale.
*p < 0.05, **p < 0.01.

The human support provided as part of the training was considered to have likely contributed to the relatively high retention and engagement rate in this study. Previous research has found that web-based interventions with human support outperform self-guided ones,[53] especially for patients with severe symptoms.[54] Factors like hope, empathy, warmth, collaboration and feedback can facilitate a relational process within web-based mental health interventions.[55] The involvement of professional providers like therapists does not appear to be the key, but rather, it is key that there is a minimum level of interpersonal contact.[37] Regardless if an intervention is guided by professionals or by a minimum level supporter, the remote presence of human support appears to exert positive impact on adherence and higher effect size.[56–59]

A limitation of past research has been a minimal focus on testing interventions in the social context of China. The results of this study added more evidence to the importance of human support in mobile mental health interventions from the perspectives of service users in China. Among the score rankings of perceived helpfulness on each module, the support from coach ranked the highest. The qualitative results also emphasized the positive influence of empathy, understanding and empowerment from the training, and many participants believed that the contact with coach had contributed more to their recovery than the lessons.

Within the current Chinese social environment, the public generally lacks a scientific understanding of mental illness, but often treat it with stigma and discrimination. This lack of scientific understanding of mental illness can make it difficult to get enough emotional support, even lead to interpersonal contact a source of stress.[23] The role of coach in this WeChat-based intervention was considered as a bridge to accessible mental health providers and helped to meet the urgent needs for social support. Human support in this WeChat-based intervention was also successfully applied to promote the implementation of knowledge and skills learned within the program, and to provoke deeper thinking and self-exploration. For instance, the coaching sessions and feedback on each lesson prompted participants to review and apply the knowledge on a regular basis, which stimulated further thinking in the process of retelling and discussion, thus contributing to better learning effects.

Meeting personalized needs has been another key preference mentioned by many studies that can facilitate acceptability and usability.[13,60–63] Previous study showed that more control over the interventions were preferred by users, such as personally relevant, easy-to-understand and culturally appropriate content,[60,64] along with options that the participant can choose from.[65] This study also tried to provide participants with diversified training content, multimedia learning materials, and one-on-one coaching sessions in order to meet personalized needs. How personalization was demonstrated in this training and why it was well accepted are discussed as below.

First, the remote-delivered recovery training combined with guidance of a coach was an efficient supplement to the current limited mental health resources in China, and was perceived as more convenient than going to the hospital.[14] One-on-one coaching was not only designed to urge knowledge accumulation, but also to generate a sense of gain and achievement in daily basis, whereas feeling ignored or forgotten has previously been identified as a key reason for the failure of digital learning.[66] Optional audio- or text-based coaching forms were allowed to alleviate the tension and discomfort some participants experienced toward face-to-face communication. Optional multimedia forms of lessons including text and picture, audio and video, were also provided to meet personal preferences during the study.

Second, the contents were designed to meet personalized needs, which may also promote a higher level of acceptance. According to the principles of PROCAT model, the design of lessons did not only focus on clinical symptoms or only based on one certain psychological intervention method, which commonly seem in many psychological interventions.[31] Instead, this model aims to cover various topics that may be experienced by patients with depression, and adopt multiple theories that relate to personal recovery as comprehensively as possible. Feedback from participants also indicated that the lessons were well targeted, facilitated a better understanding of their problems, and prompted mastery of some self-management skills. Although some participants pointed out that some content was already known or not relevant, they were still willing to read the content as a review or to lay a foundation for the long-term benefit of their mental health. It indicated that the various topics of content were acceptable, and facilitated achievement of personal needs. In addition to diverse training lessons that may cater to different individualized needs, coaches also provide personalized training content in one-on-one communication outside of the lessons. Coaching can support the provision of more targeted learning content and help solve individualized problems. For example, learning content provided for individual issues in asynchronous text messages and synchronous coaching sessions, as well as on-demand learning reminders to monitor and encourage study. The high satisfaction with coaching sessions and personalized support in this study demonstrated the acceptability of the personalized service, which is in consistent with previous studies.

Previous studies have shown that ease of use and functionality are also important factors affecting acceptability and usability,[13] and this was also emphasized in the design of this intervention. Based on previous needs and preferences research, social media like WeChat were considered more acceptable and easier to use than specially designed apps, because users in China typically have already integrated WeChat into their daily life.[14,23] Through frequently used social media, the coach would be easier to contact, send personal reminders, provide feedback, thus it could be more conducive to form supportive relationships. The familiarity could also avoid a sense of abruptness and might prevent the widening of digital divide[68]. From quantitative results, uMARS showed an average score of over 4 in four subscales including information, function, aesthetics and subjective influence. These scores were relatively high compared to other studies using this scale.[69–72] The qualitative results also showed that participants generally considered the form of this training convenient to use. These results indicated that the intervention design in this study had relatively high usability and functionality, which may contribute to a higher acceptability.[67]

Interestingly, as one of the modules provided in this study, the perception of help on mindfulness meditation were lower among participants who were currently taking antidepressant compared to those who were not taking antidepressant. Some participants reflected that their depressive symptoms made it difficult to calm down or concentrate when practicing mindfulness-based practice. The mindfulness meditation component was not as widely praised as expected. Mindfulness meditation are some of the few mature digital interventions available in the current Chinese market,[22] and have also been recognized by a large number of academic studies as effective in alleviating symptoms and preventing recurrence.[65,66] Qualitative data collected in this study included reflections that symptoms of depression may affect participants' the motivation to take actions, and that they may have felt more fidgety and found it more difficult to calm down when practicing. Previous studies also suggest that symptoms of depression or schizophrenia may influence motivation for engagement.[13,18] Although the baseline evaluation of this study showed that there was no significant difference between the two groups of patients on symptoms, it is possible that patients taking an antidepressant experienced more symptoms or side effects from medication, which may result in participants finding it difficult to calm down or concentrate during mindfulness meditation practice. More research is needed to verify this speculation. Additionally, as self-help tools, the recommended mindfulness platforms lacked specific supervision or guidance from professionals during practice, which may also result in misunderstanding and limited engagement.[67] More research is needed to understand the role of mindfulness as a mobile health tool in Chinese patients with depression. This result further demonstrated that there is no single way to meet the needs of all patients, but if a set of interventions is provided as a package, the intervention may be more capable to satisfy as many different needs as possible, with a higher engagement and effectiveness.

Combining the qualitative reflection and the preliminary evaluation of the clinical effectiveness, this WeChat-based intervention also demonstrated a high potential to support

individuals in their recovery from depression. At the end of the intervention period, participants were generally satisfied with the current recovery status, and many believed that this WeChat-based intervention had greatly contributed to their recovery progress. From the results of self-rated scales, a *p* value of 0.04 was observed in the week 12 final assessment between two subgroups, with a slightly better improvement of AA participants, which might be contributed by the effectiveness of antidepressant. However, the before/after difference on the scale were similar without statistical significance, which indicate that participants who did not take antidepressant seemed to experienced similar improvement compared to those taking antidepressant and accepting the service at the same time. This primary exploration suggested that the improvement of AA group might be due to the combination of medication and the intervention, while NA group primarily due to the intervention. However, these results are preliminary and need further clinical trials with a larger sample size to verify effectiveness.

Limitations

This study is not without limitations. First, there may be bias in the results due to participants' characteristics. Although the sample size was sufficient for an acceptability and usability study, the participants were mainly young adult women, thus the results may not generalize to populations that are elderly, children, adolescents or men. The participants were mainly recruited from one large provincial general hospital, and the demographic characteristics may be relatively narrowed. However, due to the imperfect hierarchical health system in China, large hospitals are still the first choice for most patients, thus it was still relatively representative. Patients who were willing to participate in scientific research may already have stronger motivation to change, and tend to have higher possibility of improvement, so the result of this study might not be representative to patients who lack motivation. The reasons for drop-out of seven participants indicated that these results might not be generalized to patients who are not able to engage, for reasons such as more, severe symptoms, lack of time, perceiving no subjective need for recovery, or other reasons. Second, there may be bias resulting from the use of self-rating scales. Since all the scales and interviews were self-assessment and retrospective, there may be some recall bias. The uMARS was designed mainly for apps. We adapted this scale for this WeChat mini-program considering the significant similarity between these two kinds of platforms, but more research on the suitability of uMARS in evaluating WeChat mini-programs is recommended. Third, while personalization was a key principle in this service model, there is inherent difficulty in striking the balance between standardization and personalization. Flexibility in the implementation of a personalized service results in more variations compared to a service with strictly designed form or content. For instance, not all participants selected or were willing to use the same recommended mindfulness tools or willing to use video calls as the delivery form of coaching sessions, which might cause difference on the results. How this flexibility or personalization might influence the acceptability or usability in this service needs further research. Forth, considering that there is no control group, the preliminary effect exploration section cannot confirm the effectiveness of the intervention, therefore the clinical outcomes should be interpreted with caution.

Conclusions

Overall, this study demonstrated that this WeChat-based recovery training for depression guided by the PROCAT model was acceptable to patients with depression. It has the potential to promote personal recovery of depression, as an efficient access to professional resources, a source of personalized social support, and a facilitator to the establishment of self-management strategies on both cognitive and behavioral aspects. Human support, personalization, and ease of use were considered as key factors for the higher acceptability and usability in this WeChat-based intervention. This study provided more evidence on web-based mental health interventions for Chinese populations. Randomized controlled studies with a larger sample size, on different demographic groups, such as teenagers or older adults, different mental disorders such as bipolar disorder or schizophrenia, are needed to further understand the effectiveness and implementation of this service.

ORCID iD: Haishan Wu https://orcid.org/0000-0002-6571-7024

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