

Thematic and sentiment analysis of replies to depression help seeking related posts on Sina Weibo

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Abstract. Depression is the most prevalent mental disorder globally, but traditional sources of depression help seeking such as psychiatry are laced with social stigma, resulting in a low worldwide depression professional help seeking rate. In recent years, many with depression have turned to the internet and specifically to social media as an alternative medium to seek help for depression, but the effects of online help have been discovered to be ambiguous. The present study aimed to investigate how depression help seeking related posts are responded to on Chinese social media in terms of two dimensions: themes and sentiments. Employing machine learning statistical techniques including topic modeling and sentiment analysis, this paper assessed the themes and sentiments within 8027 responses to 648 depression help seeking related posts created between October 1, 2018 and June 30, 2024. Topic modeling results reported that four prevalent themes underlie replies to depression help seeking related posts: Sad emotional support, Empathizing, Advising professional help, and Sharing. These prevalent themes all reflected supportive attitudes towards depression help seeking related posts through diverse ways. Sentiment analysis, on the other hand, revealed that still, 18.34% of responses held negative sentiments toward depression help seeking related posts. However, the prevalent sentiment in responses was also discovered to be positive, in line with the results of topic modeling. 78.04% of replies were found to hold positive sentiment, 3.63% of replies were found to hold neutral sentiment, and the mean sentiment score of responses was also positive. The findings of the present study provide insight into how depression help seeking is reacted to in China's social media landscape, indicating possible factors that may hinder the effects of seeking help for depression on social media and suggesting the potential need for systems to foster a more supportive online environment towards depression help seeking on Chinese social media.

Keywords: Depression, Help seeking, Social media, Sentiment, Machine learning.

1. Introduction

1.1. Depression

Depression is the most prevalent mental disorder globally, with adverse effects on individuals' emotional well-being and physical health, as well as disrupting daily activities such as sleep, eating habits, and work performance [1]. As of 2023, it is estimated that approximately 280 million people in the world suffer from depression, corresponding to 3.8% of the global population [2]. In China, approximately 54 million are estimated to suffer from depression, equivalent to 4.2% of the population, which is higher than the global average [3]. Depression is the leading cause of ill health and is responsible for 4.3% of

the global disease burden as the leading cause of disability [4-6]. As a pervasive societal issue, depression necessitates comprehensive and strategic interventions to address its widespread impact effectively.

1.2. Depression Help Seeking

While depression is a globally prevalent issue, only a small proportion of patients seek help for the disorder. In the United States, just 35% of individuals experiencing mood disorders, including depression, seek professional assistance such as consulting a medical doctor within the first year following the onset of symptoms [7]. Comparatively, the rate of professional help seeking is even lower in China, at 6% [7]. In a Chinese population, 23.1% of the participants who self-reported having depression symptoms did not seek help for depression either through unprofessional (e.g., friends, parents, or teachers) or professional (e.g., medicine, therapy) means [8]. One reason for this low global depression help seeking rate is the perceived social stigma towards traditional means of treatment for depression. In an Australian adult population, 17% of participants believed that they would be negatively reacted by psychiatrists if they sought help for depression through psychiatry, and 46% of respondents believed that others would think condescendingly of them if they saw a psychiatrist [9]. Both perceived and self-stigma towards depression help seeking predicted reduced likelihood for a patient to seek help for depression from professionals [9]. In recent years, people have turned to alternative means to seek help for depression, including the internet. By 2019, the Internet has become the second most frequent source of help-seeking for depression considering both professional and unprofessional methods of help-seeking in a Chinese population, with 14.3% of participants reporting depression symptoms seeking help online [8].

Specifically, social media has emerged as an intermedium for not only spreading mental health knowledge such as for depression, but also a space for patients to connect, share their circumstances, and obtain information [10,11]. Depression help seeking related social media content, therefore, constitutes posts relating to spreading depression knowledge, connecting with other patients, sharing personal experiences, and obtaining information. However, the effects of using the internet and social media as a channel for seeking help for mental disorders such as depression have been found to be ambiguous [12]. Notably, a randomized controlled trial of an online social media forum-based support channel for individuals with psychiatric disabilities revealed that those with higher usage of the online channel in writing and reading posts reported higher levels of distress compared to those with a lower usage rate [13]. Furthermore, in a systematic review of online peer support for young people with mental health problems, just two out of the six studies investigated reported significant positive outcomes for online help [14]. In other words, the six studies reviewed yielded divergent conclusions about the effects of online help. Thus, in view of the ambiguous effects of online help seeking for mental disorders such as depression, it is important to explore potential factors that hinder its effectiveness.

Low-quality responses and negative or stigmatized reactions to online help seeking constitute possible reasons that prevent the effectiveness of seeking help for depression online through social media. Notably, a study found that in the responses to questions containing the keyword “depression” in a Chinese forum social media platform Zhihu, only 33.21% and 16.79% of replies were rated as higher quality in terms of professionalism and integrity respectively [15]. Another study similarly reported that through qualitative analysis of 20,129 hot posts containing the keyword “depression” on the Chinese social media microblogging platform Sina Weibo, it was found that although there was a downtrend in stigma towards depression, 2.18% of posts still held stigma towards the disorder [16]. However, although previous literature investigated social media content related to the concept of depression broadly, their emphasis was not specifically on how depression help seeking related content is responded to on Chinese social media. This paper aims to fill this gap by exploring how such content is reacted to on Chinese social media, which could aid the explanation of both the positive and negative effects of seeking help for depression in an internet setting [17].

Previously, some studies have been conducted in the West to investigate how depression help-seeking is responded to on social media. A study performed a qualitative thematic analysis on people’s

responses to depression help seeking related posts on two Swedish online forums, aiming to capture the tone and intentions of reactions to help seeking online [17]. Through the examination of 1475 replies from 72 threads, the paper identified through human analysis six themes in the responses towards depression help-seeking: Giving Tips, Teaching, Coaching, Consoling, Sharing One's Own Experiences, and Bullying. Responses under the "Bullying" theme were identified to be negative and malicious but only accounted for a relatively small proportion of 4.75% of replies. However, the study holds two methodological limitations. First, human thematic analysis of a large quantity of writing is less suitable compared to machine learning techniques for instance in systematic reviews, as manual analysis is more time-consuming and encompasses a lower processing power [18]. Second, while the paper aimed to examine the tone of replies to depression help seeking related posts, the study did not directly perform analysis on the tone of responses. Therefore, this study seeks to advance the existing body of research by leveraging machine learning techniques for thematic analysis, enabling the examination of an extensive dataset comprising thousands of responses. Additionally, the study aims to provide a direct assessment of the tone present in responses to depression help-seeking content on Chinese social media through the application of machine learning-based sentiment analysis.

1.3. Sina Weibo

Weibo (Sina Corporation), is a social media microblogging platform in China similar to X (previously known as Twitter). Founded in 2009, Weibo today has grown to be one of the most used social media platforms in China with almost 260 million daily active users posting images and short blogs such as personal experiences and viewpoints of up to 140 Chinese characters per post [19]. Prevalent social concerns and sentiments in China are often mirrored by public attitudes expressed on Weibo, and thus Weibo content acts as a suitable and representative sample for analyzing online reactions to depression help-seeking related content [20]. Weibo users can follow others, accrue followers, and disseminate or receive information on social events. This encompasses posting and reposting content on their homepages as well as broadcasting personal posts to their audience. Furthermore, users can augment their posts by appending photographs, videos, universal resource locators (URLs), and emojis [20]. Each Weibo post can be engaged with and responded to in a comment section that emulates a threaded discussion forum, where the post serves as the focal point of the dialogue.

1.4. The Present Study

Using responses to depression help seeking related posts on Sina Weibo, this paper aims to address the aforementioned gaps in previous literature and to examine how the Chinese public responds to depression help seeking related content on social media. In particular, we wanted to examine two dimensions of the public's online responses: themes and sentiments. Our specific research questions were: 1) Identify themes in replies to Sina Weibo posts related to seeking help for depression and examine if negative themes exist. 2) Assess whether responses to Sina Weibo posts related to seeking help for depression hold a generally negative sentimental reaction.

2. Methods

2.1. Data Collection

Initially, this study crawled social media posts via the results of the Sina Weibo advanced search function under the keyword "depression help seeking" (抑郁症寻求帮助) to obtain posts related to depression help seeking. Next, the search results were further filtered to only reveal posts that were marked by the site as being "hot" posts, which are posts that have received a high amount of attention in terms of replies, likes, and shares [16]. This is to ensure that the obtained posts about depression help-seeking received a substantial amount of replies which can be collected for analysis. Finally, the comments (responses) to these depression help seeking hot posts were crawled and collected for analysis. Overall, 8191 responses to 648 depression help-seeking related hot post threads from October 1, 2018 to June 30, 2024 were crawled from Sina Weibo in this initial phase.

Subsequently, the dataset underwent a thorough cleaning and preprocessing procedure to facilitate analysis. Initially, punctuation was removed from each Weibo post, after which the text was segmented into semantically meaningful phrases. This segmentation was accomplished utilizing the Jieba library in Python, which is adept at tokenizing Chinese text. Next, stop-words, which are frequent but meaningless words that would skew topic modeling results, were removed following the data-preprocessing procedure of a previous study employing similar thematic and sentiment analysis techniques [21]. Stop-words included in the list `stopwords_zh` were removed, which is an accumulation of six Chinese stopwords lists (baidu stopwords, fergiemcdowall stopwords, fixes stopwords, geonet stopwords, gh stopwords, and ranksnl stopwords). Additionally, semantically meaningless English phrases as well as numbers indicated in the Appendix were removed. In the end, after data cleaning which deleted 164 responses that only included punctuations and stop words, 8027 responses to Sina Weibo depression help-seeking related posts were obtained for analysis in this study.

2.2. Ethical Considerations

Sina Weibo's public data were collected as the only source of data for analysis in this study. As such, all posts and profiles that are set to be private by Sina Weibo users are protected and are not used as the source of data for the present paper. Thus, the study meets the guideline to waive informed consent and similar guidelines [22]. Also, we further removed individual profiles and information related to the identity of the users in the results of the paper to protect the privacy of the subjects.

2.3. Analysis

2.3.1. Theme Extraction Topic Modelling

A Latent Dirichlet Allocation (LDA) model was implemented to perform topic modeling and theme extraction within the collected responses to depression help-seeking related Sina Weibo posts. LDA is an unsupervised machine learning statistical analysis technique capable of identifying hidden themes that underlie a large corpus of text, which is accomplished through classifying texts into clusters of keywords based on computed probability of keyword co-occurrence, where each cluster of keywords constitutes a different theme [23]. The LDA model is proficient in topic modeling and theme extraction [24], and its applicability for topic modeling of Sina Weibo content was confirmed by a previous study through its effective extraction of themes related to the psychological disorder of dementia on Weibo [21].

To implement the LDA model for this study, a series of methodological steps were undertaken. Initially, the optimal number of themes to be extracted was determined. This was achieved by calculating the coherence score of the LDA model across a range of topics (k) from 1 to 30. The coherence score evaluates the semantic similarity of sentences within each extracted topic, with a higher score indicating a more accurate and meaningful topic extraction [25]. Accordingly, the optimal number of topics was identified based on the topic number that achieved the highest coherence score. Second, LDA topic modeling was performed to extract the selected number of topics, which was implemented using the Python "tomopy" LDA package. Third, topic labeling was completed manually considering the top 30 keywords of each theme extracted following the labeling procedure of previous literature which performed LDA topic modeling on public responses to a disease on Sina Weibo [26]. Finally, the results of topic modeling were visualized using another Python package "pyLDAvis," which displays the distribution of topics.

2.3.2. Sentiment Analysis

The SnowNLP sentiment analysis machine learning model was used in this study to assess the sentiment of the replies to posts relating to seeking help for depression. The SnowNLP model have been validated in its capability for sentiment analysis in a variety of topics, including analyzing investor sentiment toward the Chinese stock market [27]. Also, a previous study employed the SnowNLP model to analyze

the sentiment of Sina Weibo posts [28]. The SnowNLP model includes a trained sentiment dictionary and a Bayesian model which is used to perform sentiment analysis.

After a corpus of text is inputted into the SnowNLP model, a sentiment score will be returned in the range from 0 to 1 inclusive, denoting emotion from negative to positive. Specifically, the guidelines for evaluating the sentiment score for emotion is as follows: a score of 0 denotes maximum negative sentiment; a score of 1 denotes maximum positive sentiment; a score of 0.5 denotes neutral sentiment; any score below 0.5 denotes negative sentiment; any score above 0.5 denotes positive sentiment. Table 1 below displays example phrases from the analysis with their associated sentiment scores from the SnowNLP model.

Table 1. Sample sentiments associated with text from SnowNLP model

Text (Chinese)	Text (English)	Sentiment	Positive/Neutral/Negative
恶心	Disgusting	0.11	Negative
猜猜	Guess guess	0.5	Neutral
让我抱抱你	Let me give you a hug	0.75	Positive

3. Results

3.1. Topic Modeling

After calculating the coherence score for theme extraction in the LDA model from 1 to 30 themes, it was derived that the highest coherence score was associated when 4 themes were extracted.

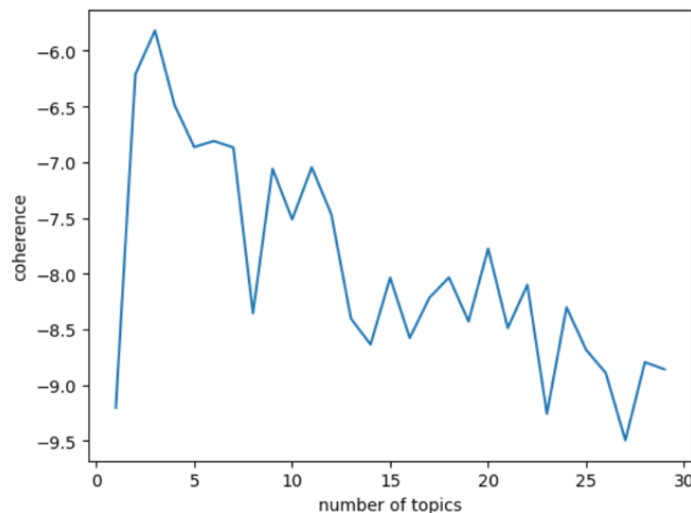


Figure 1. Coherence score for topics extracted from 1 to 30.

Following the tabular presentation format of keyword results from LDA topic modeling as demonstrated by previous literature [26], Table 2 delineates the four topics extracted, each associated with 10 representative keywords chosen from the top 30 most frequent keywords for each topic (a native Chinese-speaking researcher translated the words into English). The table further provides an elaborate explanation for each topic under the 'Topic Description' column.

Table 2. Themes extracted in replies to depression help-seeking related posts and top 30 associated representative keywords

Topic	Topic Description	Replies (N = 8027), n (%)	10 representative keywords selected from the top 30 keywords (English)	10 representative keywords selected from the top 30 keywords (Chinese)
Sad emotional support	The response expresses sadness towards the post and provides support	1970 (24.54%)	candles, husky, grief, hug, patient, sadness, don't want to, gratitude, share	蜡烛,二哈,允悲,抱抱,患者,患,悲伤,不想,感谢,分享
Empathizing	The responder can personally relate with having depression	1822 (22.70%)	true, feel like, I'm all the same, now, I know, friend, death, scared, diagnosed, emotions	真的,觉得,全中,现在,知道,朋友,死,害怕,确诊,情绪
Advising professional help	Advising seeking help from professionals such as doctors and psychiatrists	1720 (21.43%)	doctor, hospital, help, find, hope, psychiatry, need, suicide, treatment, seeking	医生,医院,帮助,找,希望,心理咨询,需要,自杀,治疗,寻求
Sharing	Sharing the depression help seeking related content with others	2515 (31.11%)	repost, Weibo, microphone, want, for sure, I feel, like it, follow, support, understanding	转发,微博,话筒,想,一定,感觉,喜欢,关注,加油,理解

Figure 2 visualizes the distribution of the themes extracted as well as the top 30 associated salient keywords. The themes displayed are labeled from 0 to 3, with 0 being the first-row topic in Table 1 and 3 being the last-row topic in Table 3.

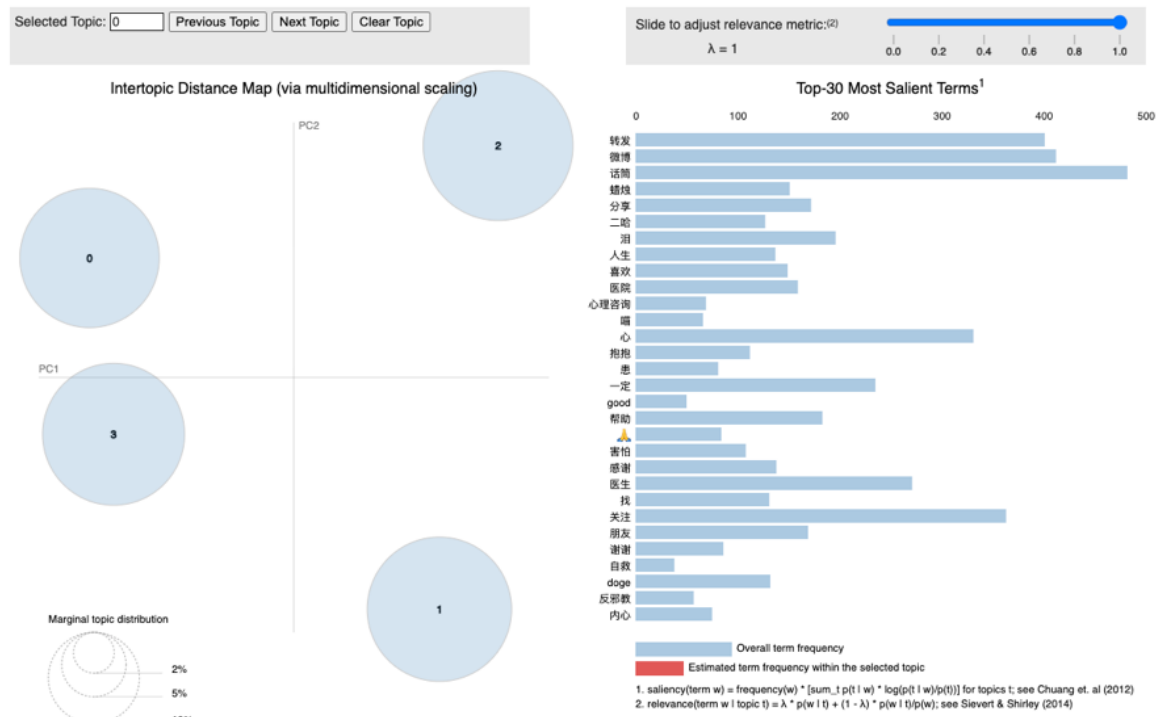


Figure 2. Theme distribution visualization

3.2. Sentiment Analysis

Results from the sentiment analyses are presented in Table 3. The analysis revealed that most replies to depression help-seeking related posts held a positive sentiment, with 6264 (78.04%) of posts under the positive category with sentiment scores larger than 0.5. On the other hand, 1472 (18.34%) of replies held a negative sentiment with a score of less than 0.5. Finally, 291 (3.63%) replies held a neutral sentiment with a score of 0.5.

Table 3. Response sentiment classification

Negative Sentiment Posts	Neutral Sentiment Posts	Positive Sentiment Posts
1472 (18.34%)	291 (3.63%)	6264 (78.04%)

Overall, the mean sentiment of all replies is 0.73, which reflects a positive average sentiment.

4. Discussion

4.1. Principal Findings

This paper aimed to investigate how depression help seeking related posts on the Chinese social media platform Sina Weibo were responded to. Specifically, topic modeling and sentiment analysis were performed on responses to identify the themes and tone of replies.

Thematic analysis extracted four themes that underlie responses: Sad emotional support, Empathizing, Advising professional help, and Sharing. The number of themes extracted is roughly in line with previous studies, where six themes were extracted in responses to depression help seeking related posts on two Swedish forums [17]. In essence, all of the themes extracted represented positive ways that the Chinese public responded to and supported depression help seeking related posts online, with no theme representing bad intention towards said posts. While sadness was expressed in the “Sad emotional support” theme, its intention was support and not malicious. This finding that prevalent

themes of responses to depression help seeking related content on social media are positive also roughly mirrors previous literature which revealed that less than 5% of responses to depression help seeking related posts on two Swedish forums were malicious and a Chinese study similarly reported that less than 3% of depression related posts on Sina Weibo were stigmatized towards the disorder [17,16]. As such, it can be summarized that prevalent themes in responses to depression help seeking related posts on Weibo are positive and not ill-intended.

Sentiment analysis revealed similar findings, where over 80% of responses were categorized as either holding positive or neutral sentiments towards depression help seeking related posts. However, 18.34% of responses were still discovered to hold negative sentiments towards said posts, representing a proportion that cannot be neglected. Negative sentiment and potential stigma, while not being the dominant sentiment, still exist within Weibo towards depression help seeking related posts. This negative tonality in nearly 20% of replies might serve as a possible factor that hinders the effectiveness of seeking help for depression on Chinese social media such as Sina Weibo, contributing to the ambiguous effects of online help seeking for depression.

4.2. Implications

The findings of the present study hold various implications. First, this paper addresses the gap in previous literature where responses to depression help seeking related content were not explored on Chinese social media. By addressing this gap through thematic and sentiment analysis of said responses, this study contributes to a better understanding of how depression help seeking related content is responded to on the Chinese social media Sina Weibo, providing possible explanations for the positive and negative effects of seeking help for depression in an online Chinese environment. Second, the present study revealed that while prevalent majority themes in said responses indicated positive intentions in responses towards depression help seeking related posts, nearly 20% of responses still held negative sentiment. China's online social media space such as Sina Weibo is still not clear of negative reactions to depression help seeking although general reactions are positive, indicating the need for further promotion of supportive attitudes towards depression help seeking in China's online space. Filtering systems to remove potentially malicious responses might also need to be further implemented. Third, the finding that both positive and negative reactions to depression help seeking related content on Sina Weibo serves as a possible explanation for the ambiguous effects of seeking help for depression online through social media. This mixture of both supportive and unsupportive responses may mean that while certain help-seekers are responded to positively, others are not, thus resulting in divergent effects.

4.3. Strengths, Limitations, and Future Directions

The methodology of this study boasts several strengths. First, this paper collected a relatively large sample size of over 8000 responses that enables statistically significant thematic analysis, where previous literature indicated that just a sample size of 132 was required to extract four themes with a population theme prevalence of 5% [29]. Second, compared to questionnaire studies to investigate public reactions, obtaining data directly from user-generated social media data warrants less social desirability and recall bias, improving the credibility of the findings [30]. Third, the present study employed machine learning LDA topic modeling to perform thematic analysis rather than traditional forms of manual classification, which is a more suitable methodology for analysis in the current large dataset of over 8000 responses with higher time efficiency and processing power [18].

However, the present study also holds several limitations that warrant discussion. First, this study only investigated responses to depression help seeking related posts on a single Chinese social media site Sina Weibo. While Weibo content often reflects general social sentiment in China [20], the generalizability of the findings to other Chinese social media platforms may still be under question. Future research could expand on the present study by investigating responses to depression help seeking related posts on other Chinese social media or online sites. Second, thematic analysis in this study using LDA topic modeling only extracted relevant keywords for each theme. Future studies could expand and go deeper in terms of thematic analysis of replies to depression help seeking related content on social

media by incorporating other methods of analysis to extract relevant phrases or key characteristics of themes beyond just keywords, which would provide deeper insight into said responses. Third, this paper only considered two dimensions of sentiment in the responses to depression help seeking related posts – positive and negative. In actuality, sentiments in replies may be more complex and multi-dimensional, and thus the investigation of more diverse sentiments could yield more detailed findings. Future literature could expand on this study by considering analyzing a more diverse range of sentiments such as stigma and anger in said responses. Fourth, the keywords extracted for each theme in this study through the LDA model may not all be completely correlated with their respective themes. Future research could employ different topic modeling techniques to cross-validate the themes extracted in this study.

5. Conclusion

The present study aimed to investigate the themes and sentiments within replies to depression help seeking related posts on Sina Weibo. Results revealed that while prevalent themes and sentiments towards said posts were positive and supportive, negative sentiment still exists in a proportion of nearly 20% of responses that cannot be neglected. To cultivate a more supportive and positive online environment for those seeking help with depression in China, additional efforts are necessary to create a safe space where individuals can access support, obtain information, and connect with others facing similar challenges.

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Appendix

List of English phrases and numbers removed from posts

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