



The Mitigating Effects of Instant Messaging Applications for Older Adults During COVID-19 Pandemic

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Abstract. The mental health of older adults is greatly affected by the pandemic due to the anxiety towards Covid-19 and the reduction in social connectedness. This study focuses on the protective role of Instant Messaging Applications in mitigating the negative effects of Covid-19 anxiety on social connectedness and mental health of older adults in Hong Kong. Questionnaires were distributed through the Elderly Centre to collect data. A total sample of 182 older adults aged between 60 and 93 was obtained. Coronavirus Anxiety Scale (CAS), Social Connectedness Scale-Revised (SCS-R), Positive Mental Health (PMH-9) and Patient Health Questionnaire (PHQ-4) were adopted in the study. The results showed that COVID-19 anxiety is significantly related to social connection ($t=-9.42, p<.001$) while the interaction of COVID-19 anxiety and usage of instant messaging applications does not have a significant effect on social connections ($t=-1.17, p=.24$). Those with higher levels of COVID-19 anxiety have poor social connection. COVID-19 anxiety is not significantly related to mental health ($t=-1.07, p=.29$) while social connection is significantly related to it ($t=14.52, p<.001$). However, the interaction of COVID-19 anxiety and the usage of Instant Messaging Applications have a significant effect on mental health. Those with higher levels of social connection have better mental health. The COVID-19 anxiety is significantly and negatively related to mental health for older adults with high usage of Instant Messaging Applications ($t=-2.24, p=.03$) while the relationship between the two variables is not significant for older adults with low and medium usage of Instant Messaging Applications ($t=0.89, p=.38$; $t=-1.07, p=.29$). The results suggest that the usage of Instant Messaging Applications

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would intensify the negative effect of COVID-19 Anxiety on mental health. Receiving more news and information about the pandemic may exaggerate the anxiety of older adults and lead to deterioration in mental health.

Keywords: Instant Messaging Applications, COVID-19 Anxiety, Social Connectedness, Mental Health, Older Adults.

1 Introduction

The COVID-19 pandemic has brought profound changes to the way we live. These changes seem to have led to a surge of pandemic-related psychological distress including fear, anxiety, perceived threat, and stress. For example, previous studies from the mainland have suggested that more than one-quarter of the general population experienced moderate to severe levels of stress and/or anxiety-related symptoms in response to COVID-19 (Qiu et al., 2020; Wang et al., 2020). The stay-at-home regulation and other social distancing measures are negatively affecting individuals' mental health, including higher levels of depressive and anxiety symptoms, insomnia, and stress (Marroquín et al., 2020; Tull et al., 2020). Both quarantine and social distancing have been shown to be associated with various psychological stressors, such as frustration, boredom or inadequate information, which can have negative, sometimes long-lasting effects on mental health (Brooks et al., 2020; Long et al., 2022). The syndrome of COVID-19 anxiety also leads to post-traumatic stress, general stress, anxiety, health anxiety, and suicidal ideation. (Nikčević & Spada, 2020). Under the pandemic, older adults may face difficulties in social life which lead to a decrease in social connectedness and mental health due to the anxiety towards COVID-19.

Social connection is a state of feeling close to other people (O'Rourke & Sidani, 2017). This includes the feeling cared about by others and caring about others, as well as a feeling of belonging to a group or community. It involves feeling loved, cared for,

and valued, and forms the basis of interpersonal relationships (Eisenberger & Cole, 2012). Under the context of the pandemic, older adults may have anxiety about participating in physical activities which limited their interpersonal relationships and social connectedness due to the fear of getting infected (Zuo et al., 2021). The continuous extension of social evacuation and blockade orders reduced their social, leisure, entertainment, and sports activities in the outside world. Limited social connection influences the mental health transitions of older adults, which in turn reduces their social involvement or enhances their withdrawal from social life, leading to further declines in mental health (Schwartz & Litwin, 2017). Some studies reveal that depressive and anxiety disorders are associated with reduced social participation, poor social support, as well as increased feelings of loneliness and isolation (Douglas et al., 2017; Hodgetts et al., 2017), which in turn exacerbate risk for suicidal ideation, self-harm, suicide, and death. (Almeida et al., 2012). Therefore, the social connection can affect the mental health of older adults.

During the pandemic, the usage of instant messaging applications has increased significantly. The development of smartphones has revolutionized the way in which individuals communicate with each other by inserting numerous user-friendly features such as emoticons and voice and video chat with other users (Derks et al., 2008). Applications provided via smartphones, such as WhatsApp and SnapChat, have contributed to the rapid growth of the new method in text messaging, which allows users to send real-time text messages to an individual or groups of friends with the same application, free of charge (Zhang & Fjermestad, 2008). WhatsApp was the most popular mobile instant messaging (MIM) application with 2 billion monthly active users, followed by Facebook Messenger (1.3 billion) and WeChat (1.2 billion) (Statista, 2022). WhatsApp was the most popular instant messaging application in Hong Kong, followed by Telegram and WeChat (Similarweb, 2022). During the short period of 14th to 24th of March, 2020, messaging rates on Facebook, Messenger, WhatsApp, and Instagram increased by 70%, and the rate of utilization of local SNS (such as WeChat and Weibo) increased by 58% in the mainland (Perez, 2020). There is another study

showed that the number of messages increases massively from March to April 2019 to the lockdown period from March to April 2020 (Seufert et al., 2022). Some older adults may reduce the effect of COVID-19 anxiety by using instant messaging applications.

The availability of instant messaging applications may help isolated older adults interact with other people by exchanging messages, either with their family or other people. Social network site (SNS) users who publicly posted, and had a high frequency of usage, a longer length of time as a member, and a high number of online social networks tended to have higher social connectedness (Findlay & Nies, 2017). The SNS offers continuous opportunities to connect and interact with others, regardless of the time of day or geographic location (Naslund et al., 2020). This is especially important for facilitating social interaction among individuals with mental disorders who have difficulties interacting in face-to-face settings, for example, impaired social functioning is a common deficit in schizophrenia spectrum disorders, and social media may facilitate communication and interaction with others for these individuals (Torales et al., 2020). Furthermore, SNS use is associated with lower levels of loneliness and greater feelings of belongingness (Seabrook et al., 2016). Instant messaging applications share similar characteristics with social media applications. Therefore, it is expected that the usage of instant messaging applications may also facilitate social connectedness positively. Older adults who are isolated due to the pandemic may be able to improve social connection by lowering the sense of loneliness and raising the sense of belonging with family members and friends through instant messaging applications.

The positive social components of SNS provide a protective role against depression and anxiety. Higher levels of self-esteem and life satisfaction brought by the use of SNS may aid in attenuating depressive symptoms (Seabrook et al., 2016). Kraut et al. (2002) found that frequent general Internet use did not increase depression over time, and, in another study, communication activities on the Internet were shown to be associated with lower levels of depressive symptoms (Morgan & Cotten, 2003). Furthermore,

computer-mediated communication, such as email and instant messaging allows users to express and interpret emotion in a similar way to face-to-face interaction (Derks et al., 2008). As instant messaging applications share similar characteristics with social media applications and the internet, it is expected that the usage of instant messaging applications may also facilitate mental health positively. Based on the above literature review, the following hypotheses have been made:

1. Older adults with higher levels of COVID-19 anxiety have lower levels of social connections and mental health.
2. Older adults with higher levels of social connections have higher levels of mental health.
3. The usage of instant messaging applications is a moderator to the relationship between COVID-19 anxiety and social connections.
4. The usage of instant messaging applications is a moderator to the relationship between COVID-19 anxiety and mental health.

2 Methods

A survey with the paper-based questionnaire and a consent form on the front page was employed for data collection to achieve the research objective and examine the above hypotheses. The self-administered survey was distributed from January 2023 to March 2023. Participants were invited to complete a questionnaire in 15-20 minutes. A total of 181 samples were collected through Neighbourhood Elderly Centres in Hong Kong. There were 85 male (47%) participants and 96 female (53%) participants who completed the questionnaire. All respondents (N=181) were aged between 60 to 93. The mean age of the participants was 67.9 years old with a standard deviation of 5.99. Among all older adult respondents (N=181), there were 31 respondents (17.1%) who have a primary education level or below, while 33 of them (18.2%) were within a level of secondary one to three. Nearly half of the respondents had an educational level between Secondary 4 to 7 which included 86 participants (47.5%). Moreover, there are

16 participants (8.8%) had a Higher Diploma and 11 participants (6.1%) had a Bachelor's Degree. Lastly, 4 participants (2.2%) had a Master's Degree.

2.1 Measurement

Coronavirus Anxiety Scale (CAS), Social Connectedness Scale-Revised (SCS-R), Positive Mental Health (PMH-9) and Patient Health Questionnaire (PHQ-4) were adopted in the study.

The Coronavirus Anxiety Scale (CAS) developed by Lee (2020) was adopted in this study. The scale assesses symptoms of anxiety and dysfunctional thinking according to DSM-5 criteria. It is a brief mental health screening to identify possible dysfunctional anxiety related to the COVID-19 crisis (Akkuzu et al., 2020). The scale has 7 items and each item measures the response to a different physiologically based fear or anxiety related to thoughts or information about the coronavirus. It is a 4-point scale (0 = not applicable to me and 3 = very applicable to me). The level of anxiety was measured by averaging the participants' scores (ranging from 0 to 3). The higher the average score, the greater the anxiety of the individual regarding COVID-19. The Cronbach's Alpha of this scale was 0.89, which means this scale had good reliability.

The Social Connectedness Scale-Revised (SCS-R) is a 20-item scale used in the study to assess the extent to which persons feel connected to others in their surrounding social area. It is a Likert scale with 1 being strongly disagreed to 6 strongly agreeing. The SCS-R consists of 20 original items (10 positive items and 10 negative items). The negatively worded items are reverse scored and summed together with the positively worded items to create a scale score with a possible range from 20 to 120. An item mean score with a possible range from 1 to 6 can also be calculated by dividing the total scale score by 20 (or the number of scale items). Higher scores on the SCS-R reflect a

stronger sense of social connectedness (Lee et al., 2001). The Cronbach's Alpha of this scale was 0.92, which means this scale had excellent reliability.

Positive Mental Health (PMH-9) and Patient Health Questionnaire (PHQ-4) were used in this study to assess the positive mental health of older adults in Hong Kong (Lukat et al., 2016). The Positive Mental Health Scale is a unidimensional scale consisting of nine self-reported items to be rated on a four-point Likert scale ranging from "not applicable" (1) to "applicable" (4). The Patient Health Questionnaire (PHQ-4) is a brief four-item PHQ-4 self-report questionnaire that assesses participants' mental health using the last two weeks as a reference frame. It consists of a two-item depression (PHQ-2) and a two-item anxiety scale (GAD-2), both rated on a four-point Likert scale ranging from "never" (1) to "almost every day" (4). In both scales, higher scores reflect a healthier mental health status. The Cronbach's Alpha of these two scales were 0.93 and 0.81 respectively, which means these scales had good reliability. Scores of these two scales were combined and calculated to form a mean score to measure the overall mental health of respondents. Moreover, the frequency of using instant messaging applications per day was used to measure the usage of instant messaging applications.

3 Results

The mean score of the Coronavirus Anxiety Scale (CAS) was 1.03 (SD=0.864) in a range of 0-3. It was a relatively low score which represents the low level of COVID-19 anxiety among participants. The mean score of the Social Connectedness Scale-Revised (SCS-R) was 4.33 (SD=0.870) in a range of 1-6 which represents a high level of social connectedness of participants. The mean score of the Positive Mental Health scale (PMH-9) was 2.31 (SD=0.652) while the mean score of the Patient Health Questionnaire (PHQ-4) was 2.52 (SD=0.646) in the range of 0-3. Both mean scores are considered as high in the two scales which means participants had a relatively healthy mental status in general.

The macro “PROCESS” for SPSS was used to test the hypothesized mediated moderation model of this study. The COVID-19 anxiety was considered as an independent variable, mental health was a dependent variable and social connectedness was a mediator. The usage of instant messaging applications was added as a moderator of the model that affects the relationship between COVID-19 anxiety and social connectedness as well as the relationship between COVID-19 anxiety and mental health. The results showed that COVID-19 anxiety is significantly related to social connection ($t=-9.42, p<.001$) while the interaction of COVID-19 anxiety and usage of instant messaging applications does not have a significant effect on social connection ($t=-1.17, p=.24$). Those with higher levels of COVID-19 anxiety have poor social connection. COVID-19 anxiety is not significantly related to mental health ($t=-1.07, p=.29$) while social connection is significantly related to it ($t=14.52, p<.001$).

However, the interaction of COVID-19 anxiety and the usage of Instant Messaging Applications have a significant effect on mental health (see Figure 1). Those with higher levels of social connection have better mental health. COVID-19 anxiety is significantly and negatively related to mental health for older adults with high usage of Instant Messaging Applications ($t=-2.24, p=.03$) while the relationship between the two variables is not significant for older adults with low and medium usage of Instant Messaging Applications ($t=0.89, p=.38; t=-1.07, p=.29$).

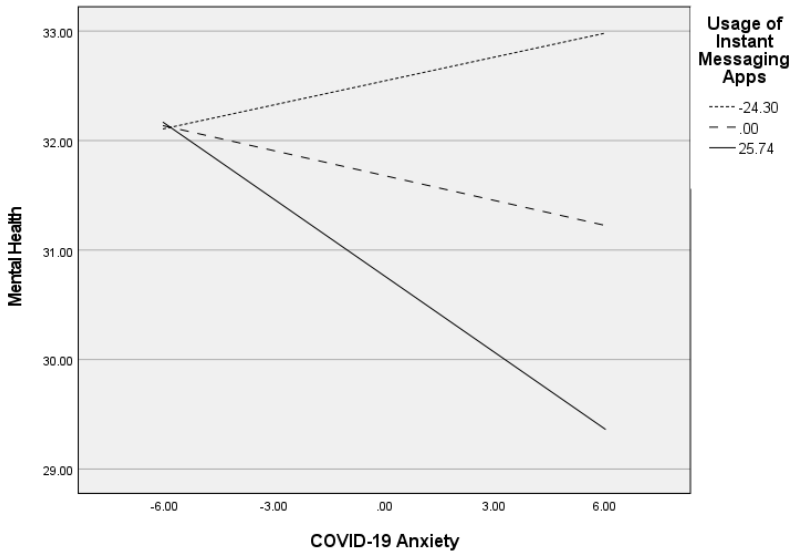


Fig 1. Graph analysis result of usage of instant messaging applications as moderators to the relationship between COVID-19 anxiety and mental health

4 Conclusion and discussion

The results confirm the hypothesis that older adults with higher levels of COVID-19 anxiety have lower levels of social connection. The results are consistent with the previous study which highlighted the importance of tackling COVID-19 anxiety among older adults to promote social connection and reduce feelings of isolation (Zuo et al., 2021). This study also revealed a significant positive relationship between social connectedness and mental health, suggesting that higher levels of social connectedness can have a positive impact on mental health. It reinforces the importance of promoting social connection among older adults, especially during the COVID-19 pandemic. It confirmed the hypothesis and previous studies about the influence of social connection on mental health transitions of older adults, which in turn enhances their social involvement, leading to further improvements in mental health (Schwartz et al., 2017).

Meanwhile, the study showed the effect of using instant messaging applications on mental health is negative ($t=-2.65$, $p=.01$). This suggests that the use of such technologies may have an adverse impact on mental health, particularly for those experiencing higher levels of COVID-19 anxiety. The results are different from the hypotheses that the usage of Instant Messaging Applications would mitigate the negative effects of COVID-19 anxiety. The usage of Instant Messaging applications does not influence social connections, but it will intensify the negative effect of COVID-19 Anxiety on mental health. Receiving more news and information about the pandemic may exaggerate the anxiety of older adults and lead to deterioration in mental health. Using instant messaging applications may not replace in-person communication among older adults. Instead, these applications may cause addictions which worsen the mental health status of older adults. One of the reasons is the development of smartphone checking habits among older adults. Communication on instant messaging applications will replace valuable daily social interactions with family and friends and lead to a negative impact on an individual's mental health (Bessière et al., 2008). The result from this study filled the research gap of the previous studies to clarify the role of the usage of instant messaging applications on the relationship between COVID-19 anxiety, social connections and mental health. The results can help to arouse public awareness and contribute to further studies about the effects of using those applications on older adults.

Last but not least, the study showed the indirect effect of COVID-19 anxiety on mental health through the strong effect on the social connection of older adults, older adults with higher COVID-19 anxiety would have a lower level of social connection which results in a lower level of mental health. Older adults can learn more coping skills to deal with anxiety and stress over their lifetime, which may help them better manage COVID-19 anxiety. Additionally, social support and connectedness play a more significant role in determining mental health outcomes among older adults during the COVID-19 pandemic.

The findings of the study have important implications for interventions aimed at improving social connectedness and mental health among older adults during the COVID-19 pandemic. While, the study underscores the potential negative impact of instant messaging applications on social connections and mental health among older adults, particularly during times of heightened anxiety and stress such as the COVID-19 pandemic. As such, it is important to encourage appropriate levels of usage of such technologies among older adults to promote social connections and mental health. Future interventions may include organizing health talks or information sessions to provide advice and guidance to older adults on reducing their usage of instant messaging applications and on the benefits of other social activities. This could help to promote healthy habits and behaviours among older adults and support their mental health and well-being during the COVID-19 pandemic and beyond.

There are several limitations to this study. Firstly, under the limited time and resources, this study adopted convenience sampling, which may reduce the representativeness as the respondents come from a neighbourhood elderly centre that may have high levels of social support, share similar experiences or backgrounds and induce sampling bias. Moreover, the data collection is conducted at the end of the pandemic wave in Hong Kong. The significant improvements in the living environment may lower the stress and anxiety of respondents and lessen the impact of the pandemic on the respondents. Therefore, it is suggested to conduct a future study with stratified and random sampling to include participants from every age group distribution to enhance the representativeness of the research. Future research could also explore ways to reduce the length of questionnaires or provide additional support to participants to ensure that they are able to complete the survey accurately and without undue burden.

References

- Akkuzu, H., Yumuşak, F., Karaman, G., Ladikli, N., Türkkın, Z., & Bahadır, E. (2020). The reliability and validity of Turkish version of Coronavirus Anxiety Scale. *Cyprus Turkish Journal of Psychiatry and Psychology*, 2(2), 63-67. <https://doi.org/10.35365/ctjpp.20.2.09>
- Almeida, O. P., Draper, B., Snowdon, J., Lautenschlager, N. T., Pirkis, J., Byrne, G., ... Pfaff, J. J. (2012). Factors associated with suicidal thoughts in a large community study of older adults. *British Journal of Psychiatry*, 201(6), 466-472. <https://doi.org/10.1192/bjp.bp.112.110130>
- Bessière, K., Kiesler, S., Kraut, R., & Boneva, B. S. (2008). Effects of internet use and social resources on changes in depression. *Information, Communication & Society*, 11(1), 47-70. <https://doi.org/10.1080/13691180701858851>
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *The Lancet*, 395(10227), 912-920. [https://doi.org/https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/https://doi.org/10.1016/S0140-6736(20)30460-8)
- Derks, D., Fischer, A. H., & Bos, A. E. R. (2008). The role of emotion in computer-mediated communication: A review. *Computers in Human Behavior*, 24, 766-785. <https://doi.org/10.1016/j.chb.2007.04.004>
- Douglas, H. E., Georgiou, A., & Westbrook, J. I. (2017). Social participation as an indicator of successful aging: an overview of concepts and their associations with health. *Australian Health Review*, 41(4). <https://doi.org/10.1071/AH16038>
- Eisenberger, N. I., & Cole, S. W. (2012). Social neuroscience and health: Neurophysiological mechanisms linking social ties with physical health. *Nature Neuroscience*, 15, 669-674. <https://doi.org/10.1038/nn.3086>
- Findlay, A. H., & Nies, M. A. (2017). Understanding social networking use for social connectedness among rural older adults. *Healthy Aging Research*, 6, e12.
- Hodgetts, S., Gallagher, P., Stow, D., Ferrier, I. N., & O'Brien, J. T. (2017). The impact and measurement of social dysfunction in late-life depression: An evaluation of current

- methods with a focus on wearable technology. *International Journal of Geriatric Psychiatry*, 32, 247-255. <https://doi.org/10.1002/gps.4632>
- Kraut, R., Kiesler, S., Boneva, B., Cummings, J., Helgeson, V., & Crawford, A. (2002). Internet paradox revisited. *Journal of Social Issues*, 58(1), 49-74. <https://doi.org/10.1111/1540-4560.00248>
- Lee, R. M., Draper, M., & Lee, S. (2001). Social connectedness, dysfunctional interpersonal behaviors, and psychological distress: Testing a mediator model. *Journal of Counseling Psychology*, 48, 310-318. <https://doi.org/10.1037/0022-0167.48.3.310>
- Lee, S. A. (2020). Coronavirus Anxiety Scale: A brief mental health screener for COVID-19 related anxiety. *Death Studies*, 44(7), 393-401. <https://doi.org/10.1080/07481187.2020.1748481>
- Long, E., Patterson, S., Maxwell, K., Blake, C., Bosó Pérez, R., Lewis, R., ... Mitchell, K. R. (2022). COVID-19 pandemic and its impact on social relationships and health. *Journal of Epidemiology and Community Health*, 76(2), 128-132. <https://doi.org/10.1136/jech-2021-216690>
- Lukat, J., Margraf, J., Lutz, R., van der Veld, W. M., & Becker, E. S. (2016). Psychometric properties of the Positive Mental Health Scale (PMH-scale). *BMC Psychology*, 4.
- Marroquín, B., Vine, V., & Morgan, R. (2020). Mental health during the COVID-19 pandemic: Effects of stay-at-home policies, social distancing behavior, and social resources. *Psychiatry Res*, 293, 113419. <https://doi.org/10.1016/j.psychres.2020.113419>
- Morgan, C. V., & Cotten, S. R. (2003). The Relationship between internet activities and depressive symptoms in a sample of college freshmen. *Cyberpsychology & behavior : the impact of the Internet, multimedia and virtual reality on behavior and society*, 6(2), 133-142.
- Naslund, J. A., Bondre, A., Torous, J., & Aschbrenner, K. A. (2020). Social media and mental health: Benefits, risks, and opportunities for research and practice. *Journal of Technology in Behavioral Science*, 5(3), 245-257. <https://doi.org/10.1007/s41347-020-00134-x>
- Nikčević, A. V., & Spada, M. M. (2020). The COVID-19 anxiety syndrome scale: Development and psychometric properties. *Psychiatry Research*, 292.

<https://doi.org/10.1016/j.psychres.2020.113322>

- O'Rourke, H. M., & Sidani, S. (2017). Definition, determinants, and outcomes of social connectedness for older adults: A scoping review. *Journal of gerontological nursing*, 43(7), 43-52. <https://doi.org/10.3928/00989134-20170223-03>
- Perez, S. (2020, March 27). *WhatsApp has seen a 40% increase in usage due to COVID-19 pandemic*. TechCrunch. <https://techcrunch.com/2020/03/26/report-whatsapp-has-seen-a-40-increase-in-usage-due-to-covid-19-pandemic/>
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xi, B., & Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: Implications and policy recommendations. *General Psychiatry*, 33(2), e100213. <https://doi.org/10.1136/gpsych-2020-100213>
- Schwartz, E., & Litwin, H. (2017). The reciprocal relationship between social connectedness and mental health among older European adults: A SHARE-Based analysis. *The Journals of Gerontology: Series B*, 74(4), 694-702. <https://doi.org/10.1093/geronb/gbx131>
- Seabrook, E. M., Kern, M. L., & Rickard, N. S. (2016). Social networking sites, depression, and anxiety: A systematic review. *JMIR Ment Health*, 3(4), e50. <https://doi.org/10.2196/mental.5842>
- Seufert, A., Poignée, F., Hossfeld, T., & Seufert, M. (2022). Pandemic in the digital age: Analyzing WhatsApp communication behavior before, during, and after the COVID-19 lockdown. *Humanities and Social Sciences Communications*, 9, 140. <https://doi.org/10.1057/s41599-022-01161-0>
- Similarweb. (2022). *Top Apps Ranking*. Similarweb. Retrieved 18 April from <https://www.similarweb.com/apps/top/google/store-rank/hk/communication/top-free/>
- Statista. (2022). *Most popular messaging apps 2022*. Statista. Retrieved 15 April from <https://www.statista.com/statistics/258749/most-popular-global-mobile-messenger-apps/>
- Torales, J., O'Higgins, M., Castaldelli-Maia, J. M., & Ventriglio, A. (2020). The outbreak of COVID-19 coronavirus and its impact on global mental health. *International Journal of Social Psychiatry*, 66, 317-320. <https://doi.org/10.1177/0020764020915212>
- Tull, M. T., Edmonds, K. A., Scamaldo, K. M., Richmond, J. R., Rose, J. P., & Gratz, K. L. (2020).

- Psychological outcomes associated with Stay-at-Home Orders and the perceived impact of COVID-19 on daily life. *Psychiatry Res.*, 289, 113098. <https://doi.org/10.1016/j.psychres.2020.113098>
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the general population in China. *International journal of environmental research and public health*, 17(5), 1729. <https://www.mdpi.com/1660-4601/17/5/1729>
- Zhang, S., & Fjermestad, J. (2008). Instant messaging: Observations from two small e-commerce businesses. *Journal of Enterprise Information Management*, 21(2), 179-197. <https://doi.org/10.1108/17410390810851417>
- Zuo, Y., Ma, Y., Zhang, M., Wu, X., & Ren, Z. (2021). The impact of sharing physical activity experience on social network sites on residents' social connectedness: a cross-sectional survey during COVID-19 social quarantine. *Globalization and Health*, 17(1), 10. <https://doi.org/10.1186/s12992-021-00661-z>

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