

in Pakistan. This is especially important in the context of results from Table IV with a majority (29%) of the content that is common between the two platforms being misinformation, compared to only 12% being information.

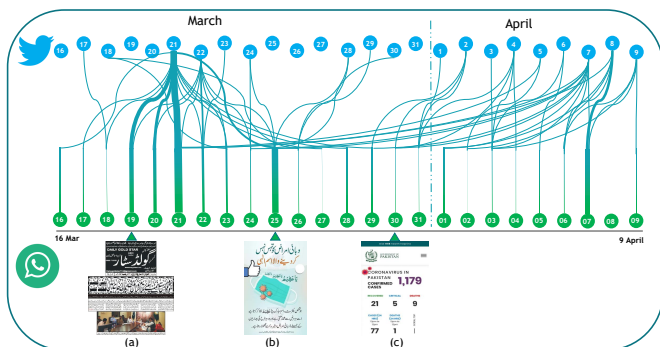


Figure 9: COVID images' temporal flow across WhatsApp and Twitter (a line's thickness depicts the number of images flowing across). *Some Observations:* a) a news snippet originates from WhatsApp on 19th March and is seen on Twitter on 21st; b) religious supplication to fight COVID is observed on WhatsApp 2 days earlier than on Twitter; c) official stats of COVID patients seen on 30th March on WhatsApp earlier than on Twitter.

VIII. CONCLUSIONS

In this paper, we have provided the first detailed analysis of Pakistani WhatsApp public groups, focusing on the COVID-19 discourse. We have analyzed WhatsApp text and image messages collected for more than 6 weeks from 227 public WhatsApp groups to shed light on the salient misinformation dissemination trends and to share insights on how Pakistani social media users are experiencing and responding to the COVID-19 pandemic. Our work is unique as this is the first work to not only study misinformation trends on WhatsApp but also find a relation between WhatsApp and Twitter. Our analyses showed that while it is true that the majority of shared information is not misinformation, misinformation seems to have a longer lifespan on WhatsApp compared to other types of COVID messages (the lifetime of misinformation is roughly 4 times that of correct information). On Twitter the inverse was seen, as COVID misinformation tended to disappear from Twitter 3 times faster than information. This can potentially be attributed to the open nature of Twitter, and how a vast number of users can publicly negate such tweets. While observing user behavior, we found 8 images that could be attributed to organized disinformation, other than that, we did not find any evidence of disinformation within images. Whereas more work is required in detecting disinformation via text messages. We conclude by saying that our dataset has only scratched the surface of how user interactions happen on WhatsApp. More work needs to be performed to understand user behavior, and new ways need to be proposed to detect misinformation in such closed networks.

REFERENCES

[1] "Two Billion Users—Connecting the World Privately," dated: February 12 2020. [Online]. Available: <https://tinyurl.com/ybwq4hpa>

[2] G. Resende, P. F. Melo, H. Sousa, J. Messias, M. Vasconcelos, J. M. Almeida, and F. Benevenuto, "(Mis)Information Dissemination in WhatsApp: Gathering, Analyzing and Countermeasures," in *WWW '19*, 2019.

[3] G. Resende, P. Melo, J. C. S. Reis, M. Vasconcelos, J. M. Almeida, and F. Benevenuto, "Analyzing Textual (Mis)Information Shared in WhatsApp Groups," in *Proceedings of the 10th ACM Conference on Web Science*, 2019.

[4] N. Newman, R. Fletcher, A. Kalogeropoulos, and R. K. Nielsen, "Reuters Institute Digital News Report 2019," Reuters Institute for the Study of Journalism, 2019.

[5] "WHO Director-General's media briefing on COVID-19," dated: March 11 2020. [Online]. Available: <https://tinyurl.com/WHO-DG-OpeningRemarks11March20>

[6] A. Boadale, "Facebook's whatsapp flooded with fake news in brazil election," 2018. [Online]. Available: <https://www.reuters.com/article/us-brazil-election-whatsapp-explainer>

[7] B. Perrigo, "How Volunteers for India's Ruling Party Are Using WhatsApp to Fuel Fake News Ahead of Elections," 2019. [Online]. Available: <https://time.com/5512032/whatsapp-india-election-2019/>

[8] V. Goel, "In India, Facebook's WhatsApp Plays Central Role in Elections," May 2018. [Online]. Available: <https://www.nytimes.com/2018/05/14/technology/whatsapp-india-elections.html>

[9] C. Lokniti, "How widespread is WhatsApp's usage in India?" 2018. [Online]. Available: <https://www.livemint.com/Technology/O6DDLmIibCCV5luEG9XUjWL/How-widespread-is-WhatsApps-usage-in-India.html>

[10] K. Garimella and G. Tyson, "Whatsapp, doc? a first look at whatsapp public group data," in *Twelfth International AAAI Conference on Web and Social Media*, 2018.

[11] R. Evangelista and F. Bruno, "Whatsapp and political instability in brazil: targeted messages and political radicalisation," *Internet Policy Review*, vol. 8, no. 4, pp. 1–23, 2019.

[12] G. Resende, P. Melo, H. Sousa, J. Messias, M. Vasconcelos, J. Almeida, and F. Benevenuto, "(mis) information dissemination in whatsapp: Gathering, analyzing and countermeasures," in *The World Wide Web Conference*, 2019, pp. 818–828.

[13] A. Yadav, A. Garg, A. Aglawe, A. Agarwal, and V. Srivastava, "Understanding the political inclination of whatsapp chats," in *Proceedings of the 7th ACM IKDD CoDS and 25th COMAD*, 2020, pp. 361–362.

[14] K. Garimella and D. Eckles, "Images and Misinformation in Political Groups: Evidence from WhatsApp in India," *arXiv preprint arXiv:2005.09784*, 2020.

[15] P. de Freitas Melo, C. C. Vieira, K. Garimella, P. O. S. V. de Melo, and F. Benevenuto, "Can WhatsApp Counter Misinformation by Limiting Message Forwarding?" 2019.

[16] A. Maros, J. Almeida, F. Benevenuto, and M. Vasconcelos, "Analyzing the use of audio messages in whatsapp groups."

[17] N. Purnell, "Facebook's whatsapp battles coronavirus misinformation," April 2020. [Online]. Available: <https://www.wsj.com/articles/facebook-whatsapp-battles-coronavirus-misinformation-11586256870>

[18] F. Jin, W. Wang, L. Zhao, E. Dougherty, Y. Cao, C.-T. Lu, and N. Ramakrishnan, "Misinformation propagation in the age of twitter," *Computer*, no. 12, pp. 90–94, 2014.

[19] I. C.-H. Fung, C. H. Duke, K. C. Finch, K. R. Snook, P.-L. Tseng, A. C. Hernandez, M. Gambhir, K.-W. Fu, and Z. T. H. Tse, "Ebola virus disease and social media: a systematic review," *American journal of infection control*, vol. 44, no. 12, pp. 1660–1671, 2016.

[20] K. Sharma, S. Seo, C. Meng, S. Rambhatla, A. Dua, and Y. Liu, "Coronavirus on social media: Analyzing misinformation in twitter conversations," *arXiv preprint arXiv:2003.12309*, 2020.

[21] L. Singh, S. Bansal, L. Bode, C. Budak, G. Chi, K. Kawintiranon, C. Padden, R. Vanarsdall, E. Vraga, and Y. Wang, "A first look at covid-19 information and misinformation sharing on twitter," *arXiv preprint arXiv:2003.13907*, 2020.

[22] R. Kouzy, J. Abi Jaoude, A. Kraitem, M. B. El Alam, B. Karam, E. Adib, J. Zarka, C. Traboulsi, E. W. Akl, and K. Baddour, "Coronavirus goes viral: Quantifying the covid-19 misinformation epidemic on twitter," *Cureus*, vol. 12, no. 3, 2020.

[23] M. Cinelli, W. Quattrocchi, A. Galeazzi, C. M. Valensise, E. Brugnoti, A. L. Schmidt, P. Zola, F. Zollo, and A. Scala, "The COVID-19 social media infodemic," *arXiv preprint arXiv:2003.05004*, 2020.

[24] S. K. Rashed, J. Frid, and S. Aits, "English dictionaries, gold and silver standard corpora for biomedical natural language processing related to sars-cov-2 and covid-19," 2020.

[25] S. Vosoughi, D. Roy, and S. Aral, "The spread of true and false news online," *Science*, vol. 359, no. 6380, pp. 1146–1151, 2018.