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Analysing Misinformation Sharing Amongst College Students in India During COVID-19

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Abstract

Over the last few years, social media has been increasingly used to share excessive amounts of information daily. With the growth of information sharing, unverified or false information (also termed as misinformation) is also being shared, which relates to shared information's quality and effects. Moreover, with the current scenario of social distancing measures and lock downs, social media has gained a lot of mo- mentum amongst the student community in India. College students more actively use social media to exchange information in comparison to others. This study aims to find the reasons of misinformation sharing over social media and investigate the factors that lead to differences in motivations behind misinformation sharing among college students. The findings presented in this study have yet not been reported anywhere in the literature. For this purpose, a well designed Google Form ques- tionnaire containing various questions about demography, motivations, information characteristics and post-pandemic effects of misinformation sharing was distributed among students of various colleges to collect the data. A misinformation sharing index (MSI) is created and utilised in the analysis to find relationships with some selected variables. Results reveal that about 62.4friends somehow share misinformation over social media. The main motivations of sharing misinformation are found to be related to self-expression, information char- acteristics and socialising. The students who spend more time on social media, i.e., social media usage more than 12 times per day, always share misinformation on so- cial media. While the extent of verification and accuracy of information is not ranked higher, male students share or intend to share misinformation more than their counterparts, whereas female students admitted that their friends share relatively higher misinformation than male respondents. The educational differential is also apparent with undergraduate students involved in sharing a greater extent of misinformation, and undergraduate males are more active in misinformation sharing than females. During COVID-19, the amount of misinformation sharing has increased rapidly. Misinformation related to COVID-19 leads people to do unnecessary practices and changes in their lifestyles and affects their mental health and behaviour.

Keywords: COVID-19; Misinformation; Social media; College students; Mental health;

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1. Introduction

The word misinformation was first used in the late 1500s, which adds prefix mis-considered as "wrong" or "mistaken" with information, such as misspelling, mistake and misunderstanding are some examples of similar commonly used words. Misinformation is defined as information that has been shown to be inaccurate. During the COVID-19 pandemic, the information viz questions such as (i) Where did COVID-19 come from?, (2) Does it have a cure?, (3) Will life get back to normal?, and (4) How can we be safe? were amongst the most common searches on social media platforms. The information related to COVID-19 can be a life-saver only when it is true [1]. Wrong information may make things worse and does not help anyone as it spreads fear and suspicion among masses and affects individuals' well-being. Like the spread of a virus, the spread of wrong information over social media platforms may be termed an infodemic [2, 3].

With the unprecedented rise of internet and web services, individuals' social interactions have been transformed into social media platforms. This has led to tremendous amounts of information exchange among users over social media. Higher amounts of information can sometimes create confusion about causation and lead to rumours, mistrust and misinformation. Misinformation can be defined as information that is inaccurate and which can easily circulate through social media quickly. The accuracy of knowledge and information is crucial for individuals to make the right decisions and proper functioning of the society in general. There are a variety of reasons which motivate people to share the information which includes but not limited to differences in education, economic conditions, life satisfaction [4]. Modern social media platforms offer multiple ways of interaction among people like instant messaging, photo sharing, video streaming and new AI-based recommendation systems, making it very easy to connect with people and achieve greater influential powers. Thus it amplifies the chances of spreading misinformation to a larger extent [5][6].

Throughout the global pandemic (COVID-19)[7], the amount of unverified information has significantly grown, creating confusion and misbeliefs among people [2]. A study from China showed that the exposure of COVID-19 related social media information was connected with anxiety and depression in some cases [8]. The abundance of unverified, inaccurate and ambiguous information during COVID-19 led to information overload and caused health anxiety termed as Cyberchondria. Since social media plays a vital role in sharing misinformation, an individual's relationships and behaviour on social media may reveal further insights on motivating factors for misinformation sharing [9]. According to several studies, adults are generally more active on social media than any other age groups, especially school and college students [10]. A survey on students' social media information evaluation found out that almost 60% of total respondents never actually verified the source of information they received [11].

Misinformation is "false information that is spread, regardless of any intent to mislead." The misinformation spread often happens in one's day to day lives. In information literacy, there is a lack of awareness about misinformation. If an individual is sharing unverified or wrong information without knowing it, then s/he is technically spreading misinformation. That's why its called an everyday casual phenomenon. Misinformation is not always about intent; it is a simple term for any wrong information. Misinformation spreads very fast during pandemic because of the heavy flow of information on social media [12, 13], sometimes because of intentionally shared wrong information on global levels[14], this kind of misinformation spread was also reported during the time of global pandemic COVID-19 [15]. Informative and accurate articles on social media about COVID-19 are less likely to be shared over social media rather than misleading articles [3]. Various studies show that young and adults are the most active users of social media [16]. Sharing of the misinformation on social media can be determined by shock, believably, the relevance of the information rather than it's source [17, 18]. Thus it is highly needed to find the determining factors that drive the students to share misinformation in general and during the pandemic time.

With a large proportion of the economically and socially vulnerable population, constrained mental health services, the burden of pre-existing mental illness and limited mental health services, the mental health issues in India are also complex during COVID-19[19]. The college students have relatively higher exposure of information flow over the internet. According to an online study [20], Indian students registered 41% increase in anxiety and fear, 54% increase in anger or frustration, 38% increase in boredom and loneliness. The study also found that mental stage of students was affected by adjusting the life at home. Thus, it is essential to analyse misinformation sharing effects on the mental health of students as well as to identify the causes according to the gender differences and education levels.

Studying the reasons behind misinformation sharing and factors affecting the motivations for it will contribute to examining how information behavior varies amongst different students. It will also help to determine some crucial

patterns like how much misinformation is being shared amongst college students, how much information is cross-checked by the college students on the internet before sharing and how much information is seen on the social media platforms. Finally, examining the effects of misinformation related to COVID-19 on students' day-to-day lives will also provide an insight into their mental health since the information flow is heavily increased after the pandemic's arrival. There are many factors behind the whole event of misinformation sharing. This study aims at investigating and analyzing the misinformation sharing amongst college students in India during and beyond the COVID-19 pandemic. The objectives of this study are as follows:

1. To investigate the reasons behind the misinformation sharing on social media among college students in India.
2. To study if specific information characteristics increase the chances of sharing misinformation amongst college students.
3. To identify the factors that lead to differences in motivations behind sharing misinformation amongst college students.
4. To establish an association between social media exposure and mental health-related issues during COVID-19 amongst college students in India.

In order to achieve aforesaid objectives, firstly the student's perception of misinformation on social media is investigated and further many different factors determining student's perceptions are examined by collecting empirical data. The data analysed for this study is new and collected from parts of Rajasthan and Maharashtra states of India using a snowball sampling technique with a well-designed questionnaire. The survey consisted of fifty-five questions related to the socio-demography, perceptions on misinformation sharing, motivations behind sharing information, characteristics of information shared on social media and consequences of information sharing during the post-pandemic period. The study created a misinformation sharing index (MSI) and performed both descriptive and cross-tabulation statistical analysis of misinformation sharing amongst college students in India. All statistical analyses were carried out using R statistical software.

The manuscript is organised as section 1 gives the introduction and motivation for the problem studied. Section 2 details the methodology of data collection and statistical analysis. Further, section 3 enumerates the findings from data analysis followed by discussion in section 4. Finally a conclusion of the study is given in section 5 of the manuscript.

2. Methodology

2.1. Data

The data was collected with the help of an online questionnaire circulated among various groups of college students. The definition of misinformation and some other scenarios were also described in the questionnaire to give respondents a clear understanding.

The questionnaire was developed with the help of Google Forms. The questionnaire link was sent to college students through emails and WhatsApp. The participating students were stimulated to further share the survey to as many people as possible. The participants were automatically directed to the page of information regarding this study and their informed consent when they received and clicked the link. After they accepted to take the survey, they answered a set of questions which appeared sequentially.

Age, gender, height, weight, educational status, economic status, area of living (urban, rural), time spent on social media and studies and frequency of social media usage were the socio-demographic data used in this study to analyze and distinguish the different motivations and perceptions related to misinformation sharing. The survey consisted of questions divided into five different categories: perception, motivations, information characteristics, possible consequences and post-pandemic effects.

The study was accessible to participants with internet facility and was able to understand English. The data collection was disseminated from October 30, 2020 at 7AM IST to November 10, 2020 at 5PM IST. A total of 360 responses was received. All responses were individually checked, and a sample of 359 students was found to be valid for the analysis.

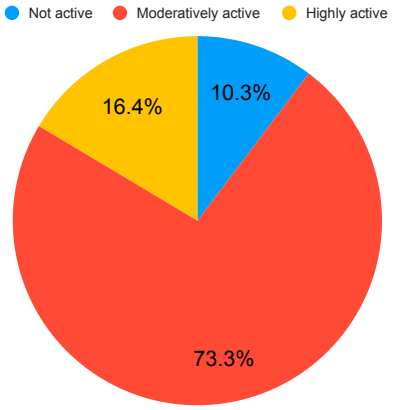


Fig. 1. Responses to question - Are you active on social media?

There were six questions in perception category; five rated on a 5-point Likert scale and one multiple choice question. Motivation category had sixteen questions rated on a 4-point and a 5-point Likert scale. Additionally, there were ten questions in information characteristics rated on a 5-point Likert scale. Possible consequences had six questions (3 questions rated on a 5-point Likert scale and 3 multiple-choice questions). Finally, Post pandemic category had two questions (one multiple choice question and one rated on a 5-point Likert scale).

2.2. Statistical analysis

For data analysis, descriptive statistics and inferential testing such as frequency, mean, standard deviation and percentage were used to estimate the results of the study. Descriptive statistical analysis was applied to get the independent findings among the data, and it was applied to all the questions. Moreover, to get the gender level (male vs. female) and educational level differences (undergraduate vs. graduate) among the data, independent sample t-tests were conducted to compare between two unrelated groups. Further, t-tests and χ^2 test statistical techniques were used to estimate the p-values to determine the significance of differences in various results.

In order to categorize the sixteen reasons behind sharing misinformation, we applied advanced analysis algorithms like PCA (Principal Component Analysis) and LDA (Linear Discriminant Analysis). These two algorithms work on the data using variance. Application of PCA on the 16 motivational questions gave a list of principal components with their contribution to the overall variance. Contribution of top two principal components were PCA1 46.40% (variance = 10.98) and PCA2 12.33% (variance = 2.91). After analysing the contribution of all the questions to these principal components, it was found that all the questions have almost equal variance. Hence it was not practically possible to group these questions based on their contribution to PCA. Similarly, LDA being a supervised dimensionality reduction algorithm, also learns the variance in the data and shows the most important variable while also taking into account the dependent variable. In this data, there are many variables which are candidates to be the dependent variable. Hence, it was not possible to eliminate independent variables based on just one dependent variable.

Correlation expresses the extent to which two variables are related linearly, hence correlation was used to find the similarity in patterns of responses of the question with other questions. This showed the extent (correlation coefficient) to which the questions are similar. Thus correlation was applied to find the association between 16 questions of motivation category. A correlation matrix was created to analyse the correlations among 16 questions related to motivation section. The pair of questions with the largest correlation values were presented into four groups, with the highest correlation coefficients with each other.

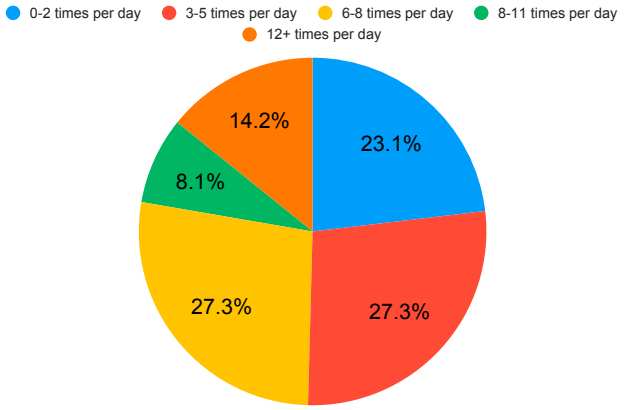


Fig. 2. Responses to question - How frequently do you use social media?

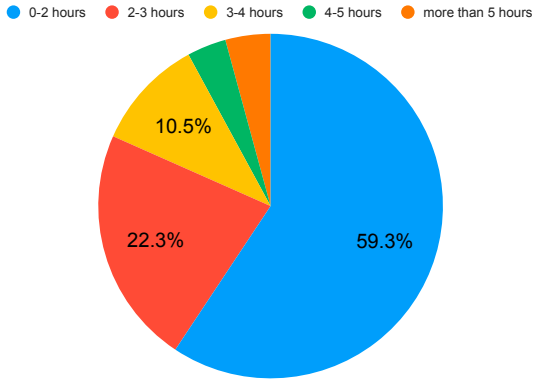


Fig. 3. Responses to question - How long you spend everyday on social media ? (4-5 hours = 3.7 %, more than 5 hours = 4.2%)

3. Findings

The results of 359 respondents data analysed in this study are presented below. Of all respondents, 79.4% were male and 20.6% were female. A majority of respondents were between 18 and 22 years of age, with an average of 21.0 years. Of all responses 74.4% (n=267) were undergraduate students and 25.6% (n=92) graduate students. All the respondents were social media users, and a majority of them were moderately active (n=263, 73.3%) and 16.4% were highly active (Fig. 1). Frequency wise distribution of social media usage can be seen in Fig. 2. Also, 67.4% (n=242) of respondents' parents have accounts on social media. A majority of people used social media for less than 2 hours every day (59.3%), and average usage is 2.38 hours (Fig. 3). Most people belonged to a lower middle class economic status (n=193, 53.8%) ; while 39.8% (n=143) belonged to upper-middle class. Of all respondents, 64.1% are currently living in an urban residence, more than rural (35.9%).

3.1. Perceptions on misinformation sharing

A majority of respondents (n=224, 62.4%) reported that their friends have shared misinformation sometimes on social media platforms (Table 1); the mean was 1.87 (SD = 0.82) on a 4-point scale (with 1 implying "nobody" and 4 implying "everybody"). About 19.5% people agreed that they had shared misinformation in the past on social media platforms. However most respondents (n=289, 80.5%) reported that they never share misinformation.Most of the participants were ignorant of the fact that they have shared misinformation on social media as majority were

Table 1. Students' perceptions on misinformation being shared.

Question	Average	SD	Options	Frequency	Percentage
1. How many of your friends share misinformation on social media?	1.87	0.82	1: No one	135	37.60%
			2: Very few people	150	41.80%
			3: Many people	60	16.70%
			4: Everyone	14	3.90%
2. How much misinformation is shared on social media by you?	1.26	0.59	1: Never share	289	80.50%
			2: Sometimes share	52	14.48%
			3: Regularly share	13	3.62%
			4: Always share	5	1.39%
3. How much misinformation will be shared on social media by you in the future?	1.32	0.64	1: Surely will not share	272	75.77%
			2: Maybe will not share	62	17.27%
			3: Maybe will share	20	5.57%
			4: Surely will share	5	1.40%

*SD = Standard deviation

of the opinion that their friends share misinformation. The frequency of sharing misinformation is 1.26 (SD=0.59) on a 4-point scale, with one implying they "never share" and four implying they "always share" misinformation. Next question asked respondents about their intention of sharing misinformation in the future, the mean was 1.32 (SD=0.64) on a 4-point scale, where one implies "surely will not share" and four implies "surely will share". Notably, three-fourths of the respondents (n=272, 75.8%) agreed to not sharing misinformation in the future for sure.

3.2. Differentials by socio-demographic attributes

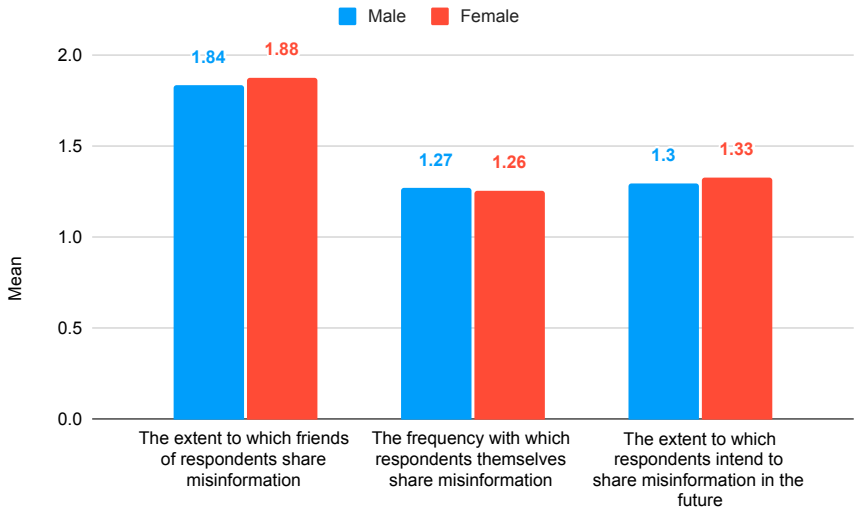
3.2.1. Gender differences

On average female students scored higher on two of the three questions, however both scored almost equal on one of the questions (Figure 4). The differences in scores are statistically significant for two questions : the extent of friends sharing misinformation, M_{Male} = 1.88, SD = 0.844; M_{Female} = 1.84, SD = 0.845 and the amount of misinformation they expect to share in the future, M_{Male} = 1.45, SD = 0.59; M_{Female} = 1.23, SD = 0.60.

While the perception of misinformation is almost equal in both genders as suggested by Figure 4, but some of the reasons in the top five are different for both genders. Table A.6 in appendix shows the top five reasons for each gender. The first-ranked reason for both genders is "Information sharing helps me to get other people's views regarding the information or event", while other reasons differed by gender. The second-ranked reason for male students is "The information seems useful to me or others". The second and third-ranked reasons for female students are "Sharing helps me express my opinions" and "The information seems useful to me or others"; both have equal scores of Mean = 2.47. After applying t-tests on all the questions to study the gender level differences (Table 5), it was found that 9 out of 26 questions with highest significant differences among males and females. Among all the 9 questions males rated towards "strongly agree"(1 as "strongly agree" to 5 as "strongly disagree") than females. The question with the highest difference is "Sharing information is a good way to relieve boredom" with the smallest p-value, which is less than 0.001. This is followed by "The information you are sharing is about a very sensitive topic", "The information is eye-catching and looks good", "Sharing is an internet culture and I share because everyone shares", "I want to look knowledgeable to others by sharing", "The information can be a good topic to start a conversation", "The information is entertaining", "Sharing information looks makes me cool and educated in groups", "I enjoy sharing information with others". Four out of these 9 questions are from information characteristics section and five are from motivation section. In motivation section, three questions are from the self impression category and two are from recreation category. It shows that majority of motivations are based on individual level.

3.2.2. Education level differences

Based on education level factor, graduate students scored higher than undergraduates on all the three questions (Figure 5). The differences in scores are statistically significant for only one question : the extent of friends sharing



[b]0.99

Fig. 4. Gender differences. Note: range of answers is as given: extent of friends sharing misinformation: 1(”nobody”) to 4(”everybody”). Amount of misinformation respondents shared: 1(”never shared”) to 4(”always share”). Extent to share in future: 1(”surely will not share”) to 4(”surely will share”).

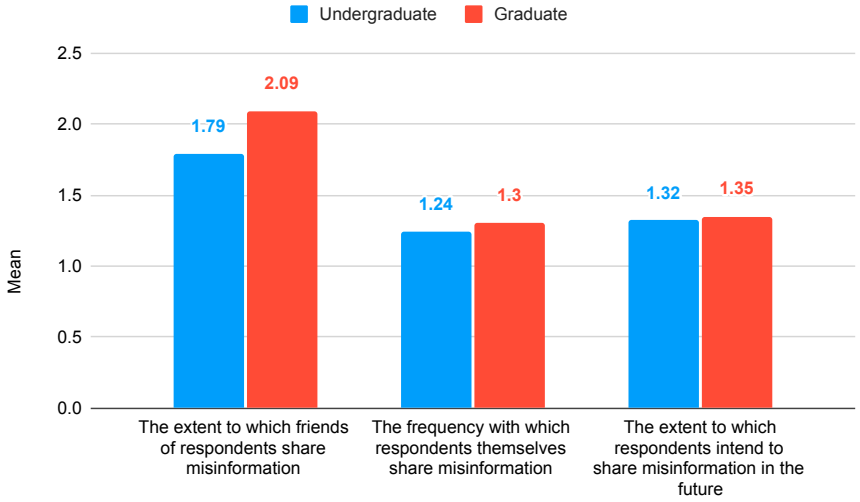


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Fig. 5. Education level differences. Note: range of answers is as given: extent of friends sharing misinformation: 1(”nobody”) to 4(”everybody”). Amount of misinformation respondents shared: 1(”never shared”) to 4(”always share”). Extent to share in future: 1(”surely will not share”) to 4(”surely will share”).

misinformation, with $M_{Undergraduate}$ = 1.79, SD = 1.043; $M_{Graduate}$ = 2.09, SD = 1.042 . This implies that graduate students feel that they have seen their friends share misinformation on social media more than undergraduates. Notably, graduate students constitute 25.6% of the total respondents. The difference in average scores in the other two questions is small.

For both undergraduate students and graduates, the top five reasons for sharing misinformation consist of four individual motivations and one reason related to information characteristics. The reason is related to information characteristics: ”The information seems useful to me or others” ranked first for graduates and second for undergraduates. The top reason for undergraduates is ”Information sharing helps me to get other people’s views regarding the

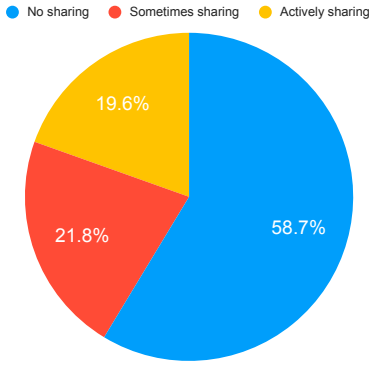

Fig. 6. Percentage distribution of MSI amongst the respondents.

information or event". This implies that individual motivations play a more substantial role in deciding to share misinformation with others. After analysing the results with applied t-tests according to educational level differences (Table 5), it was found that 4 out of 26 questions with the highest educational level difference in which under graduates gave higher ratings(1 as "strongly agree" to 5 as "strongly disagree") in all the four questions. "Sharing helps me to get more related information" has largest difference in t-tests with p value = 0.012, after this "Sharing helps to keep me updated on the latest happenings around me." has second largest significance with p-value = 0.018. Other two questions are "Information sharing helps me to get other people's views regarding the information or event." and "The information is related to your beliefs.". It can be seen that three out of these four questions are individual motivation related questions and only one question is related to information characteristics; this shows that undergraduate students often share misinformation because they want to be socially active and want to interact with other people with the help of the information they get.

3.3. Reasons and consequences of misinformation sharing

Respondents used a 5-point scale (1 as "strongly agree" to 5 as "strongly disagree") to indicate the extent to which they agreed that each of the 26 sentences were similar to their reasons for misinformation sharing on social media. The top five reasons for misinformation sharing consist of four individual motivations and one reason related to information characteristics. The top individual motivations are: "Information sharing helps you get other people's views regarding the information or event", "Sharing helps you express your opinions", "You enjoy sharing information with others", and "Sharing information makes you feel good". The only reason associated with information characteristics in the top five reasons is: "The information seems useful to you or others", is the second topmost reason for misinformation sharing with Mean = 2.44 (SD = 1.15).

Majority of respondents (n=268, 74.7%) indicated that the consequences of spreading the misinformation would result in bad societal conditions and 22% (n=79) of respondents opted for poor emotional consequences. During the pandemic, most respondents (66.4%, n=237) reported that misinformation sharing over social media related to COVID-19 leads to anxiety and trust issues among people (M=2.1). Also, 18.8% (n=67) of respondents admitted that misinformation during COVID-19 lead to unnecessary actions and habits among people. After sharing any misinformation 48.4% of respondents sometimes get the feedback while 26.6% respondents always get the feedback of the wrong information they have shared with someone.

3.4. Development of Misinformation Sharing Index

A new variable named Misinformation Sharing Index (MSI) was recorded as the sum of the original two variables as listed in Table 2. A total score of MSI takes the values of either 0, 1 or 11. Within this, participant's misinformation sharing was categorized as 'no sharing' for zero, 'moderate misinformation sharing' for one and 'actively misinformation sharing' for eleven. The percentage distribution of each category is depicted in Fig. 6. After using Pearson's

Table 2. Original variables used for calculating MSI

Variable	Options - score
1. Do you think the information that you spread is misinformation?	No - 0 Yes - 1
2. How much of the information you share is misinformation according to you?	Less than 10% - 0 More than 10% - 10

Table 3. Groups of questions according to correlation values between questions

Group	Questions
1. Recreation	1. I enjoy sharing information with others. 2. Sharing information makes me feel good. 3. Sharing information is a good way to relieve boredom. 4. I like chatting around with that information.
2. Awareness	1. Sharing helps me to get more related information. 2. Sharing helps to keep me updated on the latest happenings around me. 3. Information sharing helps me get other people's views regarding the information or event. 4. Sharing helps me save and remember useful information.
3. Self Impression	1. I want to look knowledgeable to others by sharing. 2. I want to be influential by sharing. 3. Sharing information looks me cool and educated in groups. 4. Sharing is an internet culture and I share because everyone shares.
4. Social Expression	1. Information sharing helps me to keep in touch with friends. 2. Sharing helps me to interact with people and break the silence. 3. Sharing helps me to enhance my interpersonal relations with others. 4. Sharing helps me express my opinions.

Chi-squared test the results of MSI variable with some selected variables are presented in Table 4 with corresponding p-values. Table 4 also shows students' percentage distribution according to the bivariate relationships between a set of questions and the outcome variable MSI. Results reveal that about 80.3% of males actively share misinformation on the social media platforms. Amongst the students who always share misinformation, 25.4% of them are highly active on social media and 69.0% are moderately active on social media. More than two-third (i.e. 68.1%) of students who never share misinformation spend less than 2 hours on social media. About 38.9% of students who never share misinformation are strongly agreed that misinformation related to COVID-19 leads to anxiety and trust issues among people. Students who always share misinformation over social media, 53.5% of them gets feedback sometimes, and 26.8% of them get feedback regularly if they share any kind of misinformation. Majority of students (82.0%) who never share misinformation thinks that bad societal consequences could be the major consequence of spreading misinformation. One-third (33.3%) of students who never share misinformation strongly disagree that they share any information to impress people or look cool. While, only 9.9% of students who always share misinformation reported that they share any information to impress people and look cool.

4. Discussion

Misinformation sharing is a common phenomenon among college students; nearly 63.0% of students have seen their friends share misinformation over social media to some extent. According to our data collection method, we assume that some respondents might have biased towards the motion of not sharing misinformation by themselves; still, almost 20.0% of students reported that they had shared misinformation. About 27.0% of the students admitted

Table 4. Misinformation Sharing Index bivariate analysis results

Variable	Category	No sharing	Sometimes sharing	Always sharing	Total*	p-value
Which gender do you associate with yourself?	Female	23.8	12.8	18.3	31.5	0.10730
	Male	76.2	87.2	81.7	44.1	
Are you active on social media?	Not active	13.7	5.1	5.6	21.6	0.02107
	Moderately active	73.4	76.9	69.0	41.3	
	Highly active	12.8	17.9	25.4	54.2	
How frequently do you use social media?	0-2 times per day	26.1	23.1	15.5	34.5	0.05215
	3-5 times per day	31.3	23.1	19.7	32.6	
	6-8 times per day	26.5	25.6	31.0	42.8	
	8-11 times per day	5.6	10.2	12.7	58.6	
	12+ times per day	10.4	17.9	21.1	56.9	
How long do you spend everyday on social media?	0-2 hours	68.1	55.8	35.7	32.2	0.00135
	2-3 hours	17.1	24.7	37.1	55.5	
	3-4 hours	9.0	10.4	14.3	48.6	
	4-5 hours	2.8	5.2	4.3	53.8	
	> 5 hours	2.8	3.9	8.6	60.0	
Do misinformation related to COVID-19 leads to anxiety and trust issues among people?	Strongly agree	38.9	37.2	23.9	36.0	0.02637
	Somewhat agree	34.1	28.2	25.4	55.5	
	Neutral	19.4	20.5	29.6	47.4	
	Somewhat disagree	4.7	6.4	12.7	58.3	
	Strongly disagree	2.8	7.7	8.4	66.7	
What could be the consequences of spreading misinformation according to you?	Bad Societal consequences	82.0	64.1	64.8	35.7	0.00038
	Bad Emotional consequences	16.6	26.9	32.4	55.7	
	Bad Family related consequences	1.4	9.0	2.8	75.0	
How often you get the feedback if you shared any misinformation?	Never	28.4	24.4	14.1	32.6	0.03296
	Sometimes	47.9	46.2	53.5	42.3	
	Regularly	12.8	21.8	26.8	57.1	
	Always	10.9	7.7	5.6	30.3	
Self Impression Group (As given in Table 3)	Strongly agree	1.9	3.8	0.0	42.9	0.01749
	Somewhat agree	5.7	10.3	9.9	55.6	
	Neutral	24.3	37.2	36.6	51.9	
	Somewhat disagree	34.8	19.2	35.2	35.4	
	Strongly disagree	33.3	29.5	18.3	34.0	

*Total = Sometimes + Always sharing
All the values are in %

Table 5. Results of t-tests on differences based on socio-demographic attributes

Reasons		Gender			Education		
	Mean	Male	Female	t-test	UG	Graduate	t-test
1. Sharing information makes me feel good.	2.62	2.58	2.78	1.49 *	2.63	2.59	-0.30
2. I enjoy sharing information with others.	2.61	2.55	2.84	1.67 **	2.61	2.59	-0.19
3. Sharing information is a good way to relieve boredom.	3.13	3.01	3.59	3.41 ****	3.07	3.32	1.60 *
4. I like chatting around with that information.	3.19	3.15	3.32	1.24	3.21	3.12	-0.65
5. Sharing is an internet culture and I share because everyone shares.	3.92	3.84	4.26	2.66 ***	3.89	4.02	0.92
6. Sharing helps me to interact with people and break the silence.	3.00	2.96	3.15	1.02	2.95	3.14	1.29 *
7. Information sharing helps me to keep in touch with friends.	2.96	2.93	3.07	1.01	2.91	3.08	1.03
8. Sharing information looks me cool and educated in groups.	3.68	3.65	3.91	1.90 **	3.67	3.73	0.37
9. Sharing helps to keep me updated on the latest happenings around me.	2.68	2.67	2.74	0.49	2.60	2.91	2.10 **
10. Sharing helps me get more related information.	2.65	2.62	2.76	0.87	2.56	2.89	2.26 **
11. Information sharing helps me to get other people's views regarding the information or event.	2.41	2.42	2.35	-0.48	2.34	2.62	2.00 **
12. Sharing helps me save and remember useful information.	2.62	2.61	2.66	-0.82	2.57	2.77	1.42 *
13. Sharing helps me express my opinions.	2.49	2.50	2.47	-0.17	2.47	2.55	0.59
14. Sharing helps me enhance my interpersonal relations with others.	2.99	2.98	3.03	0.29	2.99	2.99	-0.02
15. I want to be influential by sharing.	3.51	3.46	3.72	1.63 *	3.51	3.53	0.21
16. I want to look knowledgeable to others by sharing.	3.64	3.56	3.93	2.27 **	3.68	3.52	-1.06
17. The information can be a good topic to start a conversation.	2.63	2.55	2.90	2.15 **	2.59	2.74	0.99
18. The information you are sharing is about a very sensitive topic.	3.17	3.07	3.55	3.27 ****	3.12.	3.29	1.21
19. The information is eye-catching and looks good.	3.06	2.98	3.38	2.73 ***	3.01	3.23	1.63 *
20. The information is entertaining.	3.05	2.98	3.30	2.02 **	3.00	3.20	1.38 *
21. The information is related to your beliefs.	2.98	2.96	3.07	0.75	2.92	3.16	1.84 **
22. The information seems useful to me or others.	2.45	2.44	2.47	0.23	2.43	2.49	0.42
23. The information comes from my close friends or family or relatives.	3.10	3.10	3.09	-0.02	3.09	3.12	0.21
24. The information has a high number of likes or shares on social media platform.	3.32	3.27	3.26	1.32 *	3.30	3.38	0.56
25. The information is shared by a well-known and trusted person or by a highly influential person.	2.83	2.85	2.77	-0.49	2.79	2.95	1.01
26. I share information if it looks frightening.	3.57	3.54	3.69	0.95	3.58	3.55	-0.18

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

All the questions with p-values less than 0.001 are most significant and marked as "****" and other questions are marked according to p-values mentioned above.

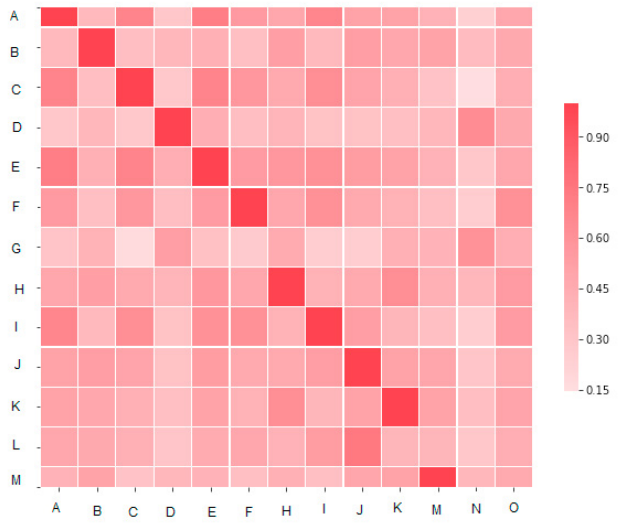

Fig. 7. Correlation heat map of all correlations above threshold of 0.5 . Note: Labels (A-O) represent individual questions as given in Table A.7 in appendix.

that the information they shared over social media might be wrong information. The female students admitted that their friends share relatively higher misinformation than male respondents. For graduate and undergraduate respondents, males and females share misinformation almost similarly in the graduate category, and males share misinformation more frequently than the female respondents in undergraduate category (male 35.0%, female 18.0%).

Undergraduate students share more misinformation than graduate students, and undergraduate males are more active in misinformation sharing than females. Bi-variate analysis results showed that the students who spend more time on social media, i.e., social media usage more than 12 times per day, always share misinformation on social media. Students who always shared misinformation on social media agreed that misinformation related to COVID-19 leads to anxiety and trust issues.

After calculating the correlation matrix, a heat map was drawn based on correlation values where at least one of the value in a row (except the question itself) is greater than the threshold (0.50) in Fig. 7. The shade of the red colour represents the relation of questions with each other. Darker the shade, higher are the correlation values, which means higher is the extent of relation. A list of pairs of questions with the highest correlations was calculated by analysing the heat map and then started grouping the correlation values' questions. Findings of all the 16 questions revealed four groups of questions with the highest correlations among each other (Table 3). The first category of similar questions mainly includes the questions related to recreation (sharing is enjoyable; sharing feels good; sharing relieves boredom; individuals love chatting around). The second category consists of questions about awareness or acknowledgement (sharing helps to get more related information; sharing keeps us updated on the latest happenings around; sharing helps us to get other people's views regarding the information or event; sharing helps us to save and remember useful information). Since instantaneous sharing of information in order to create awareness may also result in misinformation sharing [21]. The third group have the questions related to self-impression, ("I want to look knowledgeable to others by sharing", "I want to be influential by sharing", "Sharing information looks me cool and educated in groups", "Sharing is an internet culture and I share because everyone shares"). Finally, the fourth group consisted of the questions about social expression("Information sharing helps me to keep in touch with friends", "Sharing helps me to interact with people and break the silence", "Sharing helps me enhance my interpersonal relations with others", "Sharing helps me express my opinions").

The reason behind misinformation sharing mainly comprises of individual motivations rather than information characteristics. Out of the top five contributing factors of misinformation sharing, only one is from the information characteristics and rest four are from the individual motivations like getting opinions, enjoyment and self-expression (see, Table A.6). The importance of motivation is also being recognised increasingly in broader information behaviour literature [22], and this study also suggests that these non-cognitive factors (e.g. socialisation and self-expression)

play a significant role in misinformation sharing. According to this study males share (and intend to share) more misinformation when compared to female respondents. This finding is consistent with other studies which found that females are more careful and critical about the quality of the information they are sharing [23]. Females evaluate more indications and tend to use a more comprehensive approach when processing any sorts of information [24]. However, further research is needed to analyze that this gender difference is significant or not. Studies have shown that females tend to share more information on social media compared to male. Females have more intentions of communication on the internet, according to reports [25]. Top five reasons for sharing information is almost equal among males and females. However, males ranked higher in terms of the amount of misinformation they shared. Reasons differ slightly when the top five reasons for undergraduate and graduate students are compared (Table 5). Topmost reason for information sharing among graduates is "The information seems useful to me or others" and "Information sharing helps me to get other people's views regarding the information or event" for undergraduate students. This indicates that graduate individuals share the information if it is useful while undergraduates typically share information to see people's reactions or get the idea about the information from other people. It is observed that the majority of top reasons are from individual motivations like self-impression, socialisation, recreation. One-third of the time, the students feel like cross-checking the information they get in touch with over the social media. A study also suggests that online trust issues are negatively associated with checking the authenticity of information while social media fatigue, self-expression and online trust are positively associated with sharing misinformation intentionally [26]. Moreover, the respondents thought that they often do not get notified that they shared the wrong information.

This study involves human respondents, so the behaviour of actual human being in real life scenario and on a survey form can differ when it comes to some negative aspects of their behaviour such as misinformation sharing. It can be considered as a potential limitation of this study. This study uses a non-probability sampling technique with a smaller amount of data; hence, it can not represent all college students in India. It can be improvised by analysing the relationships on a relatively more considerable amount of data and using probability samples to get better validations.

5. Conclusion

This observational study found that college students and their friends share misinformation over social media platforms, and there is a significant gender level difference between undergraduate and graduate students. Majority of the students who share misinformation are moderately active on social media. It was observed that there is a close association between social media exposure and mental stress levels of a college student, especially during the COVID-19 pandemic time. Therefore, psycho-social support for college students' mental health and well-being during the COVID outbreak and beyond is essential and should be taken up at every college level. The main reasons for sharing misinformation were based on individual motivations rather than information characteristics.

An excessive amount of information made it difficult for students to distinguish between misinformation and correct information. Therefore, fake news detection is crucial and necessary, especially in the global pandemic (COVID-19), wherein college students heavily use the internet. Additionally, it was concluded that the spread of misinformation could be reduced if individuals carefully evaluate the credibility or the proof of the information before sharing it over social media platforms. Finally, information literacy programs need to be developed and organised at the community level and the priority areas of government policies in India's rural and urban areas. There is a need to create integrated abilities among college students in order to understand how information is produced and valued especially during the pandemic when the entire world is connected only through the social media. The authors plan to conduct more in-depth and advanced analysis and modelling of the impact of misinformation spread over social media on students during COVID-19 pandemic.

For future studies, the authors plan to conduct more in-depth and advanced analysis and modelling of impact of misinformation spread over social media on students during pandemic.

References

[1] Jane Galvão. Covid-19: the deadly threat of misinformation. *The Lancet Infectious Diseases*, 2020.

[2] Zapan Barua, Sajib Barua, Salma Aktar, Najma Kabir, and Mingze Li. Effects of misinformation on covid-19 individual responses and recommendations for resilience of disastrous consequences of misinformation. *Progress in Disaster Science*, 8:100119, 2020.
[3] Justyna Obiała, Karolina Obiała, Małgorzata Mańczak, Jakub Owoc, and Robert Olszewski. Covid-19 misinformation: Accuracy of articles about coronavirus prevention mostly shared on social media. *Health Policy and Technology*, 2020.
[4] Stephan Lewandowsky, Ullrich KH Ecker, and John Cook. Beyond misinformation: Understanding and coping with the "post-truth" era. *Journal of applied research in memory and cognition*, 6(4):353–369, 2017.
[5] Dominic Spohr. Fake news and ideological polarization: Filter bubbles and selective exposure on social media. *Business Information Review*, 34(3):150–160, 2017.
[6] Oded Nov, Mor Naaman, and Chen Ye. Analysis of participation in an online photo-sharing community: A multidimensional perspective. *Journal of the American Society for Information Science and Technology*, 61(3):555–566, 2010.
[7] Priyanka Harjule, Azizur Rahman, and Basant Agarwal. A cross-sectional study of anxiety, stress, perception and mental health towards online learning of school children in india during covid-19. *Journal of Interdisciplinary Mathematics*, 24(2):411–424, 2021.
[8] Junling Gao, Pinpin Zheng, Yingnan Jia, Hao Chen, Yimeng Mao, Suhong Chen, Yi Wang, Hua Fu, and Junming Dai. Mental health problems and social media exposure during covid-19 outbreak. *Plos one*, 15(4):e0231924, 2020.
[9] Shalini Talwar, Amandeep Dhir, Puneet Kaur, Nida Zafar, and Melfi Alrasheedy. Why do people share fake news? associations between the dark side of social media use and fake news sharing behavior. *Journal of Retailing and Consumer Services*, 51:72 – 82, 2019.
[10] Maeve Duggan, Nicole B Ellison, Cliff Lampe, Amanda Lenhart, and Mary Madden. Social media update 2014. *Pew research center*, 19:1–2, 2015.
[11] Kyung-Sun Kim and Sei-Ching Joanna Sin. Use of social media in different contexts of information seeking: Effects of sex and problemsolving style. *Information Research: An International Electronic Journal*, 20(1):n1, 2015.
[12] Hunt Allcott and Matthew Gentzkow. Social media and fake news in the 2016 election. *Journal of economic perspectives*, 31(2):211–36, 2017.
[13] Kai Shu, Amy Sliva, Suhang Wang, Jiliang Tang, and Huan Liu. Fake news detection on social media: A data mining perspective. *ACM SIGKDD explorations newsletter*, 19(1):22–36, 2017.
[14] Amber Benham, Eli Edwards, Ben Fractenberg, Laura Gordon-Murnane, Cynthia Hetherington, Deborah A Liptak, Meg Smith, Craig Thompson, and Anne P Mintz. *Web of deceit: Misinformation and manipulation in the age of social media*. Information Today, Inc., 2012.
[15] Jane Galvão. Covid-19: the deadly threat of misinformation. *The Lancet Infectious Diseases*, 2020.
[16] Sally Harridge-March, Áine Dunne, Margaret-Anne Lawlor, and Jennifer Rowley. Young people's use of online social networking sites–a uses and gratifications perspective. *Journal of Research in interactive Marketing*, 2010.
[17] Xinran Chen, Sei-Ching Joanna Sin, Yin-Leng Theng, and Chei Sian Lee. Why students share misinformation on social media: Motivation, gender, and study-level differences. *The journal of academic librarianship*, 41(5):583–592, 2015.
[18] Y Linlin Huang, Kate Starbird, Mania Orand, Stephanie A Stanek, and Heather T Pedersen. Connected through crisis: Emotional proximity and the spread of misinformation online. In *Proceedings of the 18th ACM conference on computer supported cooperative work & social computing*, pages 969–980, 2015.
[19] Priyanka Harjule, Vinita Tiwari, and Anupam Kumar. Mathematical models to predict covid-19 outbreak : An interim review. *Journal of Interdisciplinary Mathematics*, 24(2):259–284, 2021.
[20] Nandini. College students' mental health worst-hit by covid lockdown: Study https://www.hindustantimes.com/education/college-students-mental-health-worst-hit-by-covid-lockdown-study/story-GpvxKCtOHm6T2YMBPtcuzH.html. *Hindustan Times*, Aug 2020.
[21] Jari Salo, Amandeep Dhir, Shalini Talwar, Dilraj Singh, and Gurnam Virk. Sharing of fake news on social media: Application of the honeycomb framework and the third-person effect hypothesis. *Journal of Retailing and Consumer Services*, 57(Marraskuu):1–11, 2020.
[22] Diane Nahl and Dania Bilal. *Information and emotion: The emergent affective paradigm in information behavior research and theory*. Information Today, Inc., 2007.
[23] Sook Lim and Nahyun Kwon. Gender differences in information behavior concerning wikipedia, an unorthodox information source? *Library & information science research*, 32(3):212–220, 2010.
[24] Joan Meyers-Levy and Durairaj Maheswaran. Exploring differences in males' and females' processing strategies. *Journal of consumer research*, 18(1):63–70, 1991.
[25] Shelly Rodgers and Mary Ann Harris. Gender and e-commerce: An exploratory study. *Journal of advertising research*, 43(3):322–329, 2003.
[26] Shalini Talwar, Amandeep Dhir, Puneet Kaur, Nida Zafar, and Melfi Alrasheedy. Why do people share fake news? associations between the dark side of social media use and fake news sharing behavior. *Journal of Retailing and Consumer Services*, 51:72–82, 2019.

Appendix A. Appendix

The labeling of the questions is mentioned in Table A.7 which is used in the correlation heat map in Fig. 7. Table A.6 shows the top five motivations for information sharing according to gender level (Male vs. Female) and study level (Undergraduate vs. Graduate).

Table A.6. Top 5 reasons of misinformation sharing by gender and education level

Rank	Male	Female	Rank	Undergraduate	Graduate
1	Information sharing helps me to get other people's views regarding the information or event. (M=2.42)	Information sharing helps me to get other people's views regarding the information or event. (M=2.35)	1	Information sharing helps me to get other people's views regarding the information or event. (M=2.33)	The information seems useful to me or others. (M = 2.49)
2	The information seems useful to me or others. (M = 2.44)	Sharing helps me express my opinions. (M = 2.47)	2	The information seems useful to me or others. (M = 2.43)	Sharing helps me express my opinions. (M = 2.55)
3	Sharing helps me express my opinions. (M = 2.50)	The information seems useful to me or others. (M = 2.47)	3	Sharing helps me express my opinions. (M = 2.47)	You enjoy sharing information with others. (M=2.59)
4	You enjoy sharing information with others. (M=2.55)	Sharing helps me save and remember useful information. (M = 2.66)	4	Sharing helps me save and remember useful information. (M = 2.56)	Sharing information makes you feel good. (M=2.59)
5	The information can be a good topic to start a conversation. (M = 2.55)	Sharing helps to keep me updated on the latest happenings around me. (M = 2.74)	5	Sharing helps me get more related information. (M = 2.56)	Information sharing helps me to get other people's views regarding the information or event. (M=2.61)

Table A.7. Questions representing labels in Figure 7

Label	Question
A	Sharing helps me to get more related information.
B	Sharing information is a good way to relieve boredom.
C	Information sharing helps me to get other people's views regarding the information or event.
D	I want to be influential by sharing.
E	Sharing helps to keep me updated on the latest happenings around me.
F	Sharing helps me express my opinions.
G	Sharing information looks me cool and educated in groups.
H	Information sharing helps me to keep in touch with friends.
I	Sharing helps me save and remember useful information.
J	I enjoy sharing information with others.
K	Sharing helps me to interact with people and break the silence.
L	Sharing information makes you feel good.
M	I like chatting around that information.
N	I want to look knowledgeable to others by sharing.
O	Sharing helps me to enhance my interpersonal relations with others.