

# As a pandemic strikes: A study on the impact of mental stress, emotion drifts and activities on community emotional well-being

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## ARTICLE INFO

### Keywords:

Community Mental health  
Emotions  
Emotional drift  
Lockdown  
Psychological impact

## ABSTRACT

The widespread, ongoing COVID-19 pandemic has brought to the fore concerns regarding the psychological well-being of people. Recent research revealed various issues impacting mental health of people. However, a systematic study of the emotional drift of the populace, has been precluded so far. Our investigative research seeks to explore stress factors for different subgroups in India, variation in primary emotions during COVID-19 initial phase, and the emotional impact of activities practiced by people to adjust to the new norms.

We conduct an online questionnaire-based survey that elicits responses from 958 participants. Our analysis establishes significant correlations between pandemic-induced causative factors and stresses in subgroups and micro-community. Unexpected events during the pandemic disturbed community's emotional equilibrium. Lastly, we find specific activities demonstrating an ameliorative impact on the emotional well-being of people. Our analysis emphasizes the need for a pre-planned infrastructure to provide Psychological First Aid (PFA) to foster psychological preparedness.

## 1. Introduction

The worldwide outbreak of CoronaVirus Disease - COVID-19, was first declared a Public Health Emergency of International Concern (PHEIC) on 30 Jan 2020 by the WHO. Soon after, on 11 March 2020, it was declared a pandemic [1]. Since then, researchers in all parts of the world have launched intensive efforts to understand the mechanisms of its spread [2], COVID-19 detection with medical images and biomarkers [3,4], develop and study vaccines against the novel coronavirus [5,6], enforcing safety measures [7], and analyze the impact of the pandemic [8–16] as well as counter-measures taken by governments [17,18], on society.

India's first cases of COVID-19 were reported by January end, 2020. On 24 March 2020, the Government of India enforced a 21-day country-wide lockdown with strict implementation of COVID-19 protocols such as social distancing to arrest the pandemic's onslaught [19]. Aggressive information dissemination through multiple media, warnings through recorded voice messages in phone calls and public announcements further ensured that India's huge population of 1.36 billion<sup>1</sup> was made adequately aware of the protocols. The lockdown was first extended on 14 April 2020 and subsequently extended till 30 May 2020 [19]. A study

by the Indian Council of Medical Research (ICMR) found that the spread of COVID-19 can be reduced by 62 %, as a result of these strong measures [20]. Rajendran *et al.* in his study observed the curbing effect of lockdown and social distancing measures on COVID-19 transmissions [21].

Since the Coronavirus spreads from human to human primarily through respiratory droplets of infected persons, governments across the world enforced partial or complete shutdown of normal outdoor activities and gatherings to curb its rampant onslaught. However, social distancing in human society impacted the mental health of people grievously [17]. According to a report in Lancet, psychological distress and disorder are highly prevalent in isolated people [18]. No wonder that close on the heels of the COVID-19 pandemic, lockdown and social distancing triggered a silent parallel pandemic of community mental health breakdown. In the light of this scenario, we venture to investigate the psychological impact of the pandemic on different subgroups of people in India and micro-communities. The goals of our study are:

- To identify what were the dominant kinds of stresses that bogged down selected sub-groups of people, and what were their underlying causes?

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<sup>1</sup> Demographics of India - Wikipedia.

- To study the variation of primary emotions amid the community, as the pandemic progressed through different sub-phases of the first wave;
- To analyze the positive or negative impact of various activities that people had engaged in to cope with the unusual situation of heightened restrictions, on their emotional and mental well-being.

The remainder of our paper is organized as follows. In [Section 2](#), we present prior studies and bring forth our motivation for conducting the present study in the light of related works and gaps therein. We also formulate our Research Objectives (ROs). In [Section 3](#), we describe the organization of our questionnaire and explain the assessment methods. In [Section 4](#), we focus on our first RO to study mental stress affecting specific segments of society. In [Section 5](#), we present our second RO to analyze the emotional drifts that people underwent during the initial phase of pandemic. [Section 6](#) brings our third RO to center-stage to explore the correlation between emotions and activities practiced by individuals during lockdown to combat stress. In [Section 7](#), we examine all these findings under a common prism to discuss their overall impact, and suggest desirable steps towards greater community preparedness and effective Psychological First Aid (PFA), especially with relation to the initial stages of a pandemic. We conclude our work in [Section 8](#).

## 2. Motivation and research Objectives

Even as the COVID-19 pandemic shocked the world with its lightning spread, researchers initiated earnest studies on its impact on community's physical and mental health. Different studies have been carried out to assess the risks, contain virus spread, and detect infection in people. A study by Rajendran *et al.* revealed that the chances of contracting the virus increased with age and comorbidity in a populated area [21]. To control the spread in aged people, a study by Casaccia *et al.* devised an embedded system which restricted the physical activity maintaining social distancing [22]. Apart from reducing the spread, detecting the infection in people has challenged the clinical resources. Due to the dependency on physical testing, robust methods involving the use of biomedical sensors for virus detection evolved. Hemamalini *et al.* employed Multi-Layer Perceptron (MLP) to detect hidden signatures of the virus from the X-ray images [3]. Banerjee *et al.* worked on the X-ray images using Convolution Neural Network (CNN) to reveal the presence of disease [4].

Though initially the pandemic was observed as a toll on physical health of the community, it slowly emerged into a psychological sequel. The early evidence of psychological stress in India appeared in newspapers, reporting a high incidence of suicide and sleeplessness due to anxiety, anger, and depression [8]. Empirical studies conducted by researchers all over the world have also revealed scientific evidence of psychological setbacks during the initial phase of the pandemic [9,10]. Ironically, the quarantine protocol followed globally for its treatment, added to the already existent psychological challenges. For example, Kathirvel showed that people placed in quarantine as part of treatment suffered *Hikikomori*, that is - social withdrawal after prolonged isolation [23].

The widespread psychological impacts raised an emergent need for the medical fraternity to address not only physical but also mental illnesses. Sadly, lockdown and social distancing protocols made it difficult for affected persons and the medical fraternity to reach out to each other in-person. With mounting casualties and continuing untreated psychological aberrations of the first wave, people in India reeled under a far more devastating second wave that witnessed extensive loss of lives and mental trauma sweeping through the masses. To compound it all, mental health issues were sidelined, as mainstream news focused largely on the COVID-19 afflictions, deaths and recoveries. All these clearly indicate that a systematic study of the initial phases of a pandemic is extremely critical to arrest further damage, as people are caught unaware and unprepared for an ensuing battle against the deadly virus. In this paper, we focus on

conducting a systematic study of the mental stresses, emotions and activities that affected various sections of society in India during the first wave of COVID-19.

Studies conducted in different parts of the globe revealed correlations between various causative factors and mental stresses in people. [Table 1](#) presents a summary of these research studies. We discuss their prominent findings below.

In a study on the Iranian population, Moghanibashi-Mansourieh reported higher anxiety in women, people belonging to the age group 21–40 years, individuals who frequently followed coronavirus news updates, and those who knew someone who had COVID-19 disease [11]. Arafa *et al.* reported an enormous psychological impact in Egypt, among women, people working in non-healthcare sectors, those who watched news excessively, and those lacking emotional support from family [12]. In Italy, a survey by Spinelli *et al.* showed that lack of emotional support during the pandemic worsened parents' and children's mental health significantly [13]. A study by Ni *et al.* revealed probable depression and anxiety in health professionals and community workers in China [14]. A cohort study conducted by Jia *et al.* revealed psychological morbidity to be more common among youth and women, in the UK [24]. Flesia *et al.* reported higher levels of distress in women, people with lower income, and people living with family members in Italy [25].

According to a study by Wang *et al.*, forced staying at home increased the risk of depression in females, people of age above 40 years, and specific subpopulations such as students, teachers, and doctors in China [26]. A study by Shrestha *et al.* revealed the greater risk of distress for healthcare professionals, people of age group > 45 years, females, and students in post-secondary education level in Nepal [27]. To assist students in recovering from the psychological impact, school counselors can be treated as the mental health providers [28]. However, a study by Villares *et al.* reported mental stress in school counselors due to non-counseling duties, emphasizing the importance of defining roles and responsibilities [29]. Another study by Savitz-Romer *et al.* studied the school counselor experiences and revealed ambiguity in their roles [30].

Apart from the above subgroup-based studies, different *meta*-analysis studies reviewed psychological impact on the general population. Bueno-Notivol *et al.* found an increase in the percentage of people with depression during the outbreak indicating an adversely affected mental health of people [15]. Salari *et al.* identified lack of mental health knowledge, impact of social media, economic issues, quarantine, and lack of psychological coping method to be the underlying factors leading to stress, anxiety, and depression in people [16]. Another study by Santabarbara *et al.* identified gender, age, marital status, social distancing, unemployment, financial challenges, educational status, lifestyle of people, and awareness level about COVID-19 as the factors associated with anxiety in people [31]. Apart from the identified factors, the above *meta*-studies established the raised need of interventions to improve citizens' mental well-being.

The findings discussed in the above studies are significant and clearly establish that different populace and specific groups and communities, such as women, youth, and health professionals in all countries faced acute distress at different stages of the COVID-19 crisis.

Nevertheless, we find certain research gaps that need to be addressed. Firstly, the studies did not identify the latent stresses in people arising out of the fundamental stresses in students, professionals and families. Secondly, there are hardly any systematic studies on the *emotional drifts* of the populace as the pandemic progressed after striking. Moreover, scant attention has been paid to understand the ameliorative or deteriorating effects of different activities that people practiced, to combat mental stress. Both these issues need to be investigated in the context of stress factors that significantly impacted different subgroups of people. We have already emphasized the need to systematically study stress factors in the initial stages of a pandemic, to restrain their prolonged impact. Motivated by the above challenges and research gaps, we delineated the following Research Objectives (RO) for our study:

**Table 1**

A summary of research works assessing the psychological impact of COVID-19 on different groups of people located in specific countries.

REFERENCE	AIM	SAMPLE POPULATION	DESIGN	IMPACTED GROUP	FINDINGS	RESEARCH GAP
Moghannibashi-Mansourieh [11] (2020)	Assess the anxiety level during COVID-19 pandemic	10,754 individuals of 31 provinces of Iran	Online Questionnaire-based survey	Female and people of age group 21–40 years	Higher anxiety in women, people who frequently followed pandemic-related news, people belonging to the age group 21–40 years, and in people who had someone in their known to contract COVID-19 disease	Identify latent stress factors, analyze the emotional drift in people.
Arafa <i>et al.</i> [12] (2020)	Assess depression, anxiety, stress, and inadequate sleeping during COVID-19 outbreak	1629 individuals of Egypt	Online Questionnaire based on Depression Anxiety Stress Scale-21 (DASS-21)	Female and Non-healthcare sector professionals	Women, people working in non-healthcare sectors, frequently watching news on COVID-19, and lacking emotional support from family showed severe depression, anxiety, stress and insufficient sleep	Identify latent stress factors, analyze the emotional drift in people.
Jia <i>et al.</i> [24] (2020)	Cohort study on depression, anxiety, and stress in people during COVID-19	3097 individuals of UK aged ≥18 years	Online survey based on Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder Scale (GAD-7), and Perceived Stress Scale (PSS-4)	Youth and females	Analysis of psychological morbidity in association with factors such as age, gender, living alone, positive mood, worry about contracting COVID-19 and perceived loneliness, and risk of COVID-19 revealed increased stress anxiety and depression in young people and women	Identify latent stress factors, analyze the emotional drift in people.
Flesia <i>et al.</i> [25] (2020)	Assess the impact of COVID-19 and government-imposed restrictions on stress levels	2053 adult individuals of Italy	Online survey using Perceived Stress Scale (PSS-10), Coping Orientations to the Problems Experienced (COPE-NVI-25), Brief Self-Control Scale (BSCS), Locus of Control (LOC) Scale, and Big Five Inventory (BFI-10)	Females and people under lower-income class	High stress levels were found in people during pandemic especially in women, those with lower income, and people living with family members. Factors such as emotional stability, self-control, coping style, and locus of control can be used to characterize and identify the distressed people from the population	Identify the impact of different activities on people's emotions.
Wang <i>et al.</i> [26] (2021)	Assess anxiety and depression during COVID-19.	600 individuals of China	Online survey based on Self-Rating Anxiety Scale (SAS) and the Self-Rating Depression Scale (SDS)	Females, People of age group ≥ 40 years, Students, Academicians, and Healthcare professionals	Higher risk of anxiety was found in females and people age ≥ 40 years. Higher risk of depression was deduced in professionals such as students, teachers, and doctors	Identify latent stress factors, analyze the emotional drift in people.
Spinelli <i>et al.</i> [13] (2020)	Analyze the psychological impact of COVID-19 on parents and children	854 parents residing in Italy	Online survey based on Parenting-Stress Index (PSI), Depression Anxiety Stress Scale (DASS), and Strengths and Difficulties Questionnaire (SDQ)	Parents and children	Parents faced individual and dyadic stress due to the quarantine situation which adversely affects their ability to manage work, personal life, and raise children. Children were psychologically impacted by the stress mediated from their parents	Identify latent stress factors.
Shrestha <i>et al.</i> [27] (2020)	Assess psychological impact during COVID-19	410 individuals of Nepal	Online survey based on COVID-19 Peritraumatic Distress Index (CPDI) questionnaire	Healthcare workers, people of age > 40 years, females, and students	Health professionals were at a higher risk to develop stress. People of age group > 45 years, females, students in post-secondary education level were also negatively affected	Analyze the emotional drift in people.
Ni <i>et al.</i> [14] (2020)	Study the impact of social media, anxiety and depression in community-based workers and health workers during COVID-19	1577 community-based adults and 214 healthcare workers residing in China	Online survey based on Generalized Anxiety Disorder-2 and Patient Health Questionnaire-2	Healthcare and community-based workers	Close contact with COVID-19 patients and COVID-19 news on social media was associated with anxiety and depression in community-based workers and healthcare professionals	Identify latent stress factors, analyze the emotional drift in people.

(continued on next page)

**Table 1 (continued)**

REFERENCE	AIM	SAMPLE POPULATION	DESIGN	IMPACTED GROUP	FINDINGS	RESEARCH GAP
Villares <i>et al.</i> [29] (2022)	Analyze the delivery of counseling services by school counselors during first wave of the pandemic	589 school counselors of USA who are members in American School Counselor Association (ASCA)	Online survey based on School Counselor Activity Rating Scale (SCARS) and Counselor Burnout Inventory (CBI) through SurveyMonkey	School counselors	Mental stress due to non-counseling activities in school counselors involved in a reactive approach of school counseling in comparison to the ones involved in a comprehensive approach. There is a need to define roles and responsibilities of a school counselor to avoid burnouts	Identify latent stress factors.
Savitz-Romer <i>et al.</i> [30] (2021)	Analyze the experience of school counselors amidst the shift in roles and responsibilities during COVID-19	3000 counselors from urban and rural schools of US	Online survey link shared to individuals	School counselors	Lack of support to enact their roles, limited involvement in school planning, and involvement in non-counseling roles caused stress in school counselors. Efforts should be made to reduce the ambiguity in the roles of counselor to serve the psychological needs of students	Identify latent stress factors.
Bueno-Notivol <i>et al.</i> [15] (2020)	Review of Community-based studies on depression during COVID-19	12 articles reviewed	Meta-analysis study	General population	Percentage of people with depression increased during the outbreak, thereby indicating an adversely affected mental health of people	Analyze the emotional drift in people.
Salari <i>et al.</i> [16] (2020)	Review of studies on stress, anxiety, and depression during COVID-19.	36 articles reviewed	Meta-analysis study	General population	Stress, anxiety, and depression were prevalent in people	Analyze the emotional drift in people.
Santabarbara <i>et al.</i> [31] (2021)	Review of studies on anxiety in people during COVID-19	43 studies reviewed	Meta-analysis study	General population	Factors associated with anxiety included gender, age, marital status, social distancing, unemployment, financial challenges, educational status, awareness level about COVID-19, and lifestyle of people	Identify latent stress factors, identify the impact of different activities on people's emotions.

**Research Objective-1 (RO-1):** Assess to what extent did the onset of the pandemic and subsequent lockdown inflict mental stress upon target segments of the society?

**Research Objective-2 (RO-2):** How did the onset and gradual progress of the pandemic, the imposition of lockdown and its subsequent extensions, affect the emotions and emotional drift of people?

**Research Objective-3 (RO-3):** Was there any relation between the emotional well-being of people and the activities they engaged in to stay healthy during the lockdown?

We began our investigation by issuing an online questionnaire that

was designed to assess the triggers and impact of mental stress, gauge the emotional drifts of people as the pandemic rushed forward, and identify effective ameliorative activities. Our study assumes significance for administering timely and targeted PFA to different sections of the population at the onset of a pandemic. Such timely assuage of mental stresses can boost the morale of citizens and enhance preparedness to face the multi-headed challenges of an ongoing pandemic.

**Table 2**

Sociodemographic distribution of sample population (Number of respondents: N = 958).

Age group (years)	Number <i>n</i>	Proportion of sample population %	Gender	DEMOGRAPHICS		Occupation	Number <i>n</i>	Proportion of sample population %
				Number <i>n</i>	Proportion of sample population %			
<=25	711	74.22	Female	263	27.45	Service	208	21.71
26-30	100	10.44	Male	695	72.55	Student	658	68.68
31-40	95	9.92	Marital Status		Business		28	2.92
41-50	12	1.25	Married	170	17.75	Retired	15	1.57
>50	40	4.18	Unmarried	778	81.21	Unemployed	23	2.40
			Missing values	10	1.04	Others	25	2.61
						Missing values	1	0.10

### 3. Questionnaire and assessment methods

**Structure:** Guided by our ROs listed in the previous section, we carefully designed a questionnaire for collecting responses from the public through a mix of 3-point Likert scale, multiple-choice and open-ended questions. The questionnaire is organized in four sections. The first section garners demographic information which is reproduced in Table 2. The respondent is led through the remaining sections pertaining to our stated research objectives. The second section of the questionnaire pertains to RO-1 and contains tailor-made questions for each subgroup (*i*) students, (*ii*) employed/self-employed persons, and (*iii*) families, to assess their mental stress. To frame the questions for each subgroup in this section, we referred to different news articles to obtain an indication of the emerging concerns. From these articles, we identified the different concerns induced by the pandemic such as shift of academic activities to online mode [32], work-from-home [33], economic losses [34], home confinement [35]. Keeping these issues in consideration, we carefully culled out the questions for each sub-group.

In the third section pertaining to RO-2, we pose questions seeking information about the primary emotions that people experienced during the study period. The fourth section, keeping RO-3 in view, inquires about the activities that people had engaged in to maintain their mental wellness. The study period included initial episodes from the advent of the COVID-19 pandemic in India in Jan'20, through lockdown imposition from 24 March 2020, till its extension from 14 April 2020 onward.

Before circulating among the public, we conducted a convenience-based pilot test of the questionnaire by inviting 8 people to scrutinize it. Based on their feedback, we reframed some questions. The online questionnaire was activated on 30 April 2020 and circulated widely through emails, social media, and WhatsApp. Additionally, we shared the informed consent with the participants explaining the nature of our research and confidentiality of their responses. The response collection was carried out till 12 October 2020. A total of 958 people voluntarily participated in the survey.

**Assessment Methods:** For statistical analysis and assessment, we used Python 3 and IBM SPSS 26 software. We preprocessed the data to reduce the dimensionality of the feature space comprising all Likert-scale items, verify scale construction, assess the quality of questions, and carry out statistical hypothesis testing.

1. **Factor analysis:** To reduce dimensionality and retain the most important information captured by the responses to the set of Likert items, the data is pre-processed with Principal Component Analysis (PCA) with varimax rotation. We test the Kaiser-Meyer-Olkin (KMO) measure against the acceptable limit of 0.5 to assess the adequacy of the sampled data for factor analysis and strength of the association among Likert items. Further, Bartlett's test of sphericity with a significance value  $p < 0.05$  confirms that correlation matrix of the Likert items is not an identity matrix. A non-identity correlation matrix indicates sufficient correlation between the variances of the categorical responses and is ideal for conducting PCA. We report the results of Bartlett's test with chi-square  $\chi^2_{df}$  where  $df$  is the degree of freedom and significance value  $p$ . Finally, we ensure the following: (*i*) the components extracted satisfied Kaiser's criterion of having eigenvalues exceeding 1, (*ii*) the eigenvalues were appearing before the point of inflexion, in the scree plot [36].

2. **Internal consistency reliability analysis:** Internal consistency refers to the extent to which questions of a questionnaire measure the same concept. We perform internal consistency reliability analysis to ensure unidimensionality and reliability of the Likert items under each Principal Component extracted under RO-1. A set of Likert items is reliable if its evaluated Cronbach's alpha  $\alpha$  is at least 0.6. It is considered mediocre for the range 0.7 to 0.8, good for 0.8 to 0.9, and very good for 0.9 to 1.0 [37].

3. **Non-Parametric tests:** Non parametric tests are mathematical techniques for statistical hypothesis testing that make no prior assumptions about the underlying population. We employ different non-parametric tests to deal with our non-normal distributed data.

To compare the median of two groups of independent samples, we apply Mann-Whitney  $U$  test. We report the  $U$  test statistic of this test, which is the total of the differences between ranks in the sample. To analyze the statistically significant differences in paired samples, we apply the non-parametric Wilcoxon signed-rank test. Additionally, we report the significant results of each test with  $Z$ : the standardized test statistic,  $p$ -value: the significance level of the observed change, and  $r$ : the magnitude of the significant change in the samples.

In subsequent sections, we will elaborate upon the questions, and their responses and present the results of statistical analyses.

### 4. Research Objective-1: Assessment of mental stress among sub-groups

#### 4.1. Target Sub-groups

We identified three sub-groups for conducting our study:

- a. **Students:** They form a subgroup connected by their common goal of acquiring knowledge and skills to fulfill their aspirations, become worthy citizens and pursue their desired careers. They became vulnerable to the vagaries of the pandemic and lockdown conditions when the online mode replaced all normal processes of education.
- b. **Employed or self-employed people:** Members of this subgroup are either employees of some organization or own their business. Most are breadwinners or contribute to the family income. They form the economic backbone of the larger community and have to bear a high degree of responsibility towards themselves, family and society at large. This sub-group faced unique challenges during the pandemic, as the economic situation nose-dived.
- c. **Families:** A family is a micro-community whose members usually live together as a fundamental support system in which individuals flourish [38]. A family provides a wholesome emotional support to its members by creating a balanced atmosphere where they share their joys and sorrows. But this basic fabric of society was fundamentally affected due to the pandemic. While in some cases, members were severed from family as they were struck at a remote place, in other cases friction arose due to all members being confined within a limited space at home. Moreover, families were constantly exposed to local and media-reported news about the Coronavirus and its ruthless attack, thus engulfing all members in a cloud of uncertainty and negativity.

#### 4.2. Questions

For the first two sub-groups, the questions generally are of the form: "To what extent did you face stress due to (Stress Factor)?". Participants were asked to respond on a 3-point Likert scale:

1. Manageable stress
2. High stress
3. Overburdening stress

The Stress Factors for the three subgroups are as follows:

#### a. Subgroup-1 Students:

- i. Tackling increased assignment load due to online studies.
- ii. Not being able to interact freely with teachers and peers during or after class.
- iii. Facing financial burden due to internet expenses and maintaining digital resources.

- iv. *Being unable to meet friends.*
- v. *Being unable to engage in outdoor activities/games.*
- vi. *Having to manage studies alongside household work.*
- b. *Subgroup-2 Employed or self-employed:*
  - i. *Having to manage office work/business operations from home.*
  - ii. *Having to manage household responsibilities with office/business-related work.*
  - iii. *Facing financial challenges due to salary cuts/ having to pay employees.*
  - iv. *Fearing job loss/business losses.*
- c. *Subgroup-3 Families:*
  - i. *'As compared with pre-lockdown, to what extent are you facing stress due to domestic abuse?': 1 (None at all), 2 (Somewhat increased), and 3 (Serious).*
  - ii. *'Keeping family members updated through news is important, but do you get tense?': 1 (Not a problem), 2 (Tensed), and 3 (Very much Tensed).*
  - iii. *'To what extent do you feel stressed due to a family member or yourself being stuck at a place far away from home?': 1 (Manageable stress), 2 (High Stress), and 3 (Overburdening Stress).*

In addition to the above Likert-scale questions, we posed two dichotomous questions with Yes and No answer options, to create two comparison groups:

- di. *'Is home confinement resulting in unusual fights among members of your family?'.*
- dii. *'Is your family facing stress due to any member facing job loss triggered by the pandemic?'.*

#### 4.3. Response analysis

**Graphics:** Table 3 summarizes the number of valid responses under each category in column *iii*, the median and mode categories in column *iv* and the factor loadings along the major Principal Components (PC), in column *v*.

We analyze any significant impact ( $p < 0.05$ ) of the two factors that the dichotomous question investigated, namely *job-loss* and *family in-fights*, on various dominant stresses that PCA revealed for each subgroup (*Student, Employed/Self-employed, Families*). Table 4 lists the summary of the Mann-Whitney *U* test conducted on various dominant stresses revealed by PCA across categories in dichotomous questions under RO-1. The column *Question* lists the two dichotomous questions. Column *Response categories* present the frequency of responses in each category Yes and No. In column *Significant Impact on Stress factor*, we list the stresses which obtained significant results across the comparison groups Yes and No. Column *Mean rank in response category* presents the mean rank  $mr_{yes}$  ( $mr_{no}$ ) for category Yes (No). We report the test statistics *U*, *Z*, *p*, and *r* in the last four columns.

Fig. 1 presents the pie chart of the distribution of dominant stress factors identified for each of the sub-groups. Any individual's overall response for a Principal Component is given by the medium of his/her responses for the Likert items aligned with that component.

**General results of Pre-tests and Post-tests for Factor Analysis:** The KMO pre-test conducted for all sub-groups yielded KMO measures  $> 0.5$ . This established their sampling adequacy for conducting factor analysis. Further, we conducted the Bartlett's test of sphericity which yielded a *p-value*  $< 0.001$  for each sub-group, thereby indicating sufficient correlation between the variances of the categorical responses. Based on these indicators, we conducted PCA with varimax rotation for the Likert items' responses under each sub-group.

After conducting PCA, the internal reliability post-tests conducted on the Likert items under the Principal Components extracted for each sub-group yielded Cronbach's  $\alpha > 0.6$ . This reflects the strong coupling of items that aligned with their respective Principal Components.

##### 4.3.1 Principal Components for Subgroup-1 Students (KMO =

$0.676, \chi^2_{15} = 729.318, p < 0.001$ ): We obtained two principal components *PC\_1a* and *PC\_2a*, with eigenvalues fulfilling Kaiser's criterion of being greater than unity. Both the components in combination explained 52.5 % of the total variance in responses. Then, we conducted reliability analysis on the Likert items along the two obtained principal components.

A. *PC\_1a - Online-Induced Stress (Eigen-value = 2.372)*: We observe in Table 3 under column (v), that stress factors *i, ii, iii, and vi* are well-aligned with *PC\_1a*, all having factor loadings  $> 0.4$  and Cronbach's  $\alpha$  equal to 0.60. It is apparent that they occurred due to the burden of having to deal with the outside world through online mode. Online teaching inundated students with assignments with limited active help from teachers and peers. Households had to bear the financial burden of maintaining high bandwidth digital resources. Students had to handle the extra work-pressure along with household jobs. *PC\_1a* can thus be interpreted as *Online-Induced Stress*.

**Response Distribution:** The pie chart in Fig. 1(a), reveals that a majority 56.17 % of students reported High to Overburdening *Online-Induced Stress*. The mode and median response is class 2 (*High stress*). Thus, we can observe that the majority of the population of the students' subgroup category faced high *Online-Induced Stress*.

**Influence of job loss on Online-Induced Stress:** Results of the Mann Whitney *U* test in Table 4, row 2 demonstrate a significant difference in *Online-Induced Stress* between students who experienced the unfortunate event of some family member losing a job from those who did not ( $mr_{yes} > mr_{no}$ ). This shows that the tension of adapting to the online mode of academics was further heightened by the job-loss situation.

B. *PC\_2a - Constrained Outreach Stress (Eigen-value = 1.209)*: Table 3 shows that *PC\_2a* aligned itself well with stress factors *iv* and *v*, with both factor loadings exceeding 0.4 and Cronbach's  $\alpha$  equal to 0.68 indicating relatedness. Both these stress-inducing factors aggravate when there is a lack of significant physical interactions through outdoor games and by meeting friends. Such interactions are known to be vital for the mental well-being of young citizens [39]. We named *PC\_2a* as *Constrained Outreach Stress*.

**Response Distribution:** The pie chart in Fig. 1(b) shows that an overwhelming 70.22 % of students felt High to Overburdening *Constrained Outreach stress*. The mode and median response is class 2 (*High stress*). Thus, we can observe that the majority of the students faced high *Constrained Outreach Stress*. This indicated that most students were highly stressed because they were not able to do outdoor activities and meet their friends.

**Influence of family in-fights on Constrained Outreach Stress:** Results of Mann Whitney *U* test in Table 4, row 1 demonstrates a significant difference in *Constrained Outreach Stress* between students who experienced unusual fights in family members due to home confinement from those who did not ( $mr_{yes} > mr_{no}$ ). This indicates that an oppressive situation at home aggravated stress due to lack of physical engagements through outdoor activities and social contacts.

#### 4.3.2 Principal Components for Subgroup-2 Employed or self-employed

(KMO = 0.583,  $\chi^2_6 = 166.533, p < 0.001$ ): We obtained two principal components *PC\_1b* and *PC\_2b* with eigenvalues satisfying Kaiser's criterion. Together, both the components explained 77.4 % of the total variance in responses. Thereafter, we conducted reliability analysis on the Likert items along the obtained principal components.

A. *PC\_1b – Economic Insecurity Stress (Eigen-value = 2.014)*: In Table 3, under column (v), we observe that the stress factors *iii* and *iv* for the employed/self-employed subgroup are well-aligned with *PC\_1b*, having factor loadings  $> 0.4$ . Their reliability analysis reports a Cronbach's  $\alpha$  of 0.75 which indicates their close coupling. Looking at these stress factors, we observe that financial threats such as stalled

**Table 3**

Descriptive Indices and Principal Components of Likert scale for sub-groups Students, Employed/Self-employed and Families.

RO	Stress Factors	(iii) Number of valid Responses under each category			(iv) Descriptive Statistic		(v) Factor Analysis: Principal Components (PC)		
		1	2	3	Median Category	Mode Category	Factor Loadings > 0.4 on Principal Component-1	Factor Loadings > 0.4 on Principal Component-2	
RO-1. a	<b>Subgroup-1 Students</b>						PC_1a	PC_2a	
	i. Increased assignment load in online studies.	171	280	202	2	2	0.675	—	
	ii. Not being able to interact freely with teachers and peers during or after class.	405	195	47	1	1	0.613	—	
	iii. Financial burden due to internet expenses and maintaining digital resources.	486	105	55	1	1	—	—	
	iv. Being unable to meet friends.	255	221	172	2	1	0.731	0.891	
	v. Being unable to engage in outdoor activities/games.	254	214	176	2	1	—	0.879	
	vi. Having to manage studies alongside household work.	301	241	106	2	1	0.681	—	
RO-1. b	<b>Subgroup-2 Employed/Self-employed</b>						PC_1b	PC_2b	
	i. Manage office work from home.	143	29	16	1	1	—	0.851	
	ii. Manage household responsibilities with office work.	114	56	18	1	1	—	0.851	
	iii. Delayed increments or cut-down salaries.	132	42	13	1	1	0.885	—	
	iv. Fear of losing a job.	120	46	20	1	1	0.891	—	
RO-1. c	<b>Subgroup-3 Families</b>						PC_1c		
	i. As compared with pre-lockdown, to what extent are you facing stress due to domestic abuse?	796	92	8	1	1	0.720	—	
	ii. Keeping family members updated through news is important, but do you get tense?	340	462	136	2	2	0.845		
	iii. To what extent do you feel stressed due to a family member or yourself being stuck at a place far away from home?	8	17	11	2	2	0.782	—	

**Table 4**

Summary of Mann-Whitney U test on different stress factors for dichotomous questions under RO-1.

(i) Question	(ii) Response categories		(iii) Significant Impact on Stress factor	(iv) Mean rank in response category		(v) Test Statistics			
	Yes	No		Yes <i>mr<sub>yes</sub></i>	No <i>mr<sub>no</sub></i>	U	Z	p	r
di. Is home confinement resulting in unusual fights among your family?	116	827	Constrained Outreach Stress	367.43	304.51	44,222	3.773	<0.001	0.15
			Work-Home Balancing Stress	123.79	100.18	3155	2.187	<0.001	0.15
			Family-Reorientation Stress	535.32	444.68	82526.5	4.894	0.02	0.16
dii. Is your family facing stress due to any member facing job loss triggered by the pandemic?	188	740	Online-Induced Stress	395.83	314.61	29,367	3.856	0.02	0.15
			Economic Insecurity Stress	132.75	103.77	2445	2.187	<0.001	0.15
			Family-Reorientation Stress	530.34	426.66	54,734	2.96	0.01	0.1

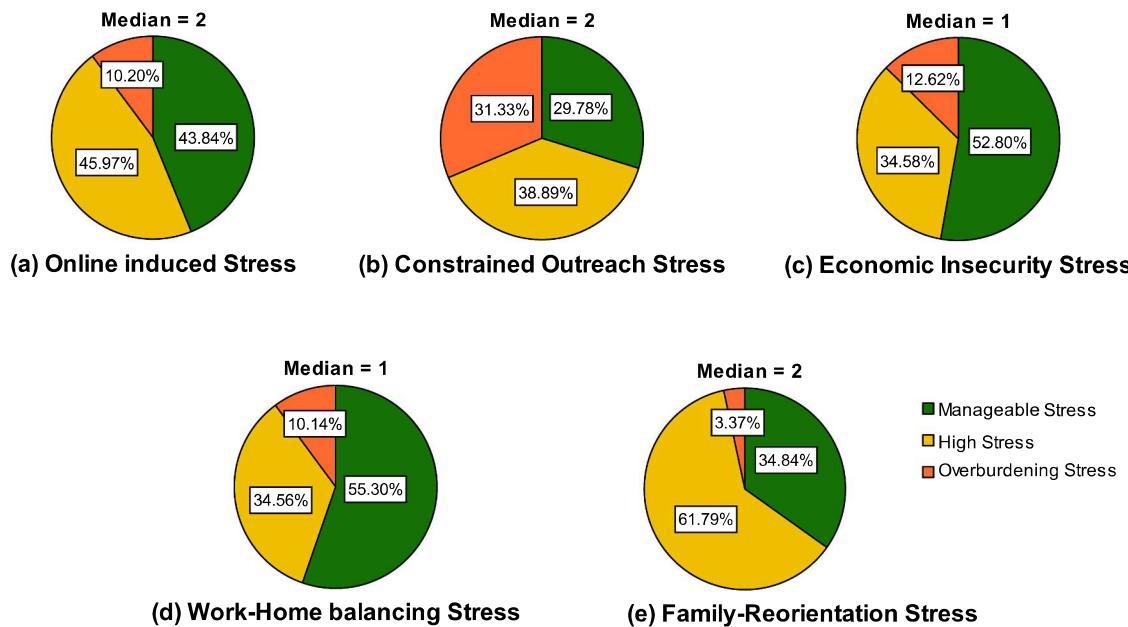
increments or salary cuts as well as stress due to the fear of losing one's job, arise within an unsure and weak economic environment. We name *PC\_1b* as *Economic Insecurity Stress*.

**Response Distribution:** The pie chart in Fig. 1(c) illustrates that 47.2 % of people under this subgroup reported a *High to Overburdening Economic Insecurity Stress*. Both the median and mode are class 1 (*Manageable stress*). Thus, we can observe that the majority of the population of the employed category could manage *Economic insecurity stress*. Still, a significant 47.2 % mentally stressed population is an alarming scenario.

**Influence of a Job loss on Economic Insecurity Stress:** Results of Mann Whitney U test in Table 4, row 2 demonstrate a significant difference in *Economic Insecurity Stress* between employed people whose

families experienced job loss owing to the pandemic from those who did not (*mr<sub>yes</sub> > mr<sub>no</sub>*). From this, we deduce that job loss added to financial stability stress concerning job security, revenue creation, and general monetary condition.

B. *PC\_2b - Work-Home Balancing Stress (Eigen-value = 1.083):* Table 3 under column (v) shows that *PC\_2b* aligned well with the Likert items *i* and *ii*, with both factor loadings > 0.4. These items exhibited Cronbach's  $\alpha$  of 0.66, indicating their unidimensional orientation. Switching work from office to home leads to constraints such as limited resources, space, and help from colleagues, causing stress factor *i*. It also causes conflicts between the office and home responsibilities, being in the same physical space, thereby inducing



**Fig. 1.** 3-point Likert-scale distribution of stresses under various professional classes. (a) Students' *Online-Induced Stress*. (b) Students' *Constrained Outreach Stress*. (c) Employed/self-employed *Economic Insecurity Stress*. (d) Employed/Self-employed *Work-Home Balancing Stress* (e) Families *Family-Reorientation Stress*.

stress factor *ii*. We label *PC\_2b* as *Work-Home Balancing Stress*.

**Response Distribution:** The pie chart in Fig. 1(d) demonstrates 44.7 % of people communicated a *High* to *Overburdening Work-Home Balancing Stress*. Both median and mode are class 1 (*Manageable stress*) - though 55.3 % of the employed/self-employed people were able to cope with *Work-Home Balancing Stress*, a sizable population still suffered.

**Influence of family in-fights on Work-Home Balancing Stress:** An analysis of Mann Whitney *U* test on how home confinement influenced *Work-Home Balancing Stress* is illustrated in Table 4, row 1. It demonstrates a significant difference in *Work-Home Balancing Stress* between employed persons who experienced unusual fights in family members due to home confinement from those who did not ( $mr_{yes} > mr_{no}$ ). As a result, we conclude that family disputes caused by home confinement made it even more difficult for people to strike a balance between their home and office commitments.

**4.3.3 Principal Components for Subgroup-3 Families** ( $KMO = 0.63, \chi^2_3 = 16.485, p < 0.001$ ): We obtained one principal component *PC\_1c*, with eigenvalues fulfilling Kaiser's criterion of being greater than unity. Both the components explained 61.5% of the total variances in responses. Then, we conducted reliability analysis on the Likert items of the obtained principal component.

**A. *PC\_1c* - Family-Reorientation Stress (Eigen-value = 1.845):** From column (v) of Table 3, we observe that all the three stress factors indicated by Likert items *i*, *ii*, and *iii*, are aligned with *PC\_1c*, all having factor loadings  $> 0.4$  and Cronbach's  $\alpha$  equal to 0.68. Inspecting the three Likert items, we observed that stress in families was either due to forced home confinement (factors *i* and *ii*) or due to forced separation from family (factor *iii*). Constrained personal space led to domestic abuse (factor *i*) and a normally lively home atmosphere was vitiated by constant exposure to grim news about the pandemic (factor *ii*). We, therefore, assigned the only principal component for this subgroup as *Family-Reorientation Stress*.

**Response Distribution:** The pie chart in Fig. 1(e) reveals that 65.16 % of respondents faced *High* to *Overburdening Family-Reorientation Stress*. Its median and mode class of 2 (*High Family-Reorientation Stress*) in the overall distribution indicated that the majority of

people were rather seriously impacted by this stress factor.

**Impact of family in-fights on Family-Reorientation Stress:** From the Mann-Whitney *U* test results in Table 4 row 1, we observed significantly higher levels of *Family-Reorientation Stress* in people facing fights among family members in comparison to those who had a calm environment at home ( $mr_{yes} > mr_{no}$ ). From this, we infer that family disputes further aggravated the impact of domestic abuse, continual exposure to unpleasant news, and separation from family.

**Impact of job loss on Family-Reorientation Stress:** From the Mann-Whitney *U* test results in Table 4 row 2, we found higher levels of *Family-Reorientation Stress* in families who bore the brunt of a family-member's job loss, in comparison to families who did not ( $mr_{yes} > mr_{no}$ ). This underscores the fact that economic stability is the foundation upon which a family thrives [40,41]. Any dent in financial security affects family dynamics adversely. Job loss accentuating the stress in families due to frequent news updates about COVID-19 and separated family members due to lockdown.

## 5. Research Objective-2: Emotion drift of populace

### 5.1. Questions

We examined the variation of eight primary emotions of people from the onset of COVID-19 to the lockdown extension in initial phase of pandemic, using pictorial choice questions with multiple choice of emotions:

- What were your emotions when you first heard of the lethal coronavirus?
- How did you feel when you heard the news about the first lockdown in India?
- What did you feel when you heard about the extension of the first lockdown in India?

The above questions seek spontaneous emotional reactions. They are framed in the context of the following episodes:

- Episode-1:** Question *i* pertains to the initial phase from December 2019 to mid-March 2020, when the presence of COVID-19 in India became evident.

2. **Episode-2:** Question *ii* refers to the duration from end-March 2020 to mid-April 2020, when the lockdown was imposed to prevent the spread of the Coronavirus disease caused by SARS-CoV-2.
3. **Episode-3:** Question *iii* related with the duration from end-April 2020 to unlocking in October 2020, when the lockdown was further extended to arrest the surge in infected cases.

The answer options were representative emojis rendered in Graphics Interchange Format (GIF) as shown in Table 5. Emojis facilitated respondents to easily identify and relate the emotion with their current mental state. Many respondents expressed that they enjoyed the process of responding to the questionnaire due to GIF emoji prompts.

## 5.2. Response analysis

The *EmoLex*<sup>2</sup> (Emotion Lexicon) dataset contains affective English words and their scores for Plutchik's emotions [42], namely, *anger*, *disgust*, *fear*, *sadness*, *joy*, *anticipation*, *surprise*, and *trust*. Based on the pictorial emotion choices, we estimated the emotion scores ( $S$ ) of each respondent, for a given episode, by referring to the *EmoLex* dataset. For example, the emotion scores for word *hopeful* are  $S(\text{anticipation}) = 0.703$ ,  $S(\text{joy}) = 0.559$ ,  $S(\text{surprise}) = 0.234$ ,  $S(\text{trust}) = 0.633$ ,  $S(\text{anger}) = 0$ ,  $S(\text{disgust}) = 0$ ,  $S(\text{fear}) = 0$ , and  $S(\text{sadness}) = 0$ . Following this, we create a lookup table containing words corresponding to all the emotion choices and their emotion scores. Next, we extract the emotion words corresponding to a respondent's choice of emoticons for the question of the given episode. From the lookup table, we fetch the emotion scores for each word and sum them up. The overall emotion scores of a respondent are the sum averaged with the count of words.

To examine the change in emotions in progression from *Episode-1* to *Episode-2* to *Episode-3*, we applied the Wilcoxon signed-rank test on the following related samples:

1. *Pair-1:* Emotions across *Episode-1* and *Episode-2*
2. *Pair-2:* Emotions across *Episode-2* and *Episode-3*

Table 6 summarizes the test results for both pairs. The column *Related-samples* mentions the differenced emotion scores for a given pair of episodes. An emotion suffixed with 'k' denotes its presence during *Episode-k*. For example,  $S(\text{anger}1)$  denotes the score of anger during *Episode-1*. The column *Ranks* lists the number  $N_n$  ( $N_p$ ) of negative (positive) differences. The mean ranks  $mr_n$  ( $mr_p$ ) for negative (positive) scores indicates the average of the ranked differences. The test statistics  $Z$  and  $r$  are mentioned in the last two columns respectively. The significance value  $p$  was  $<0.001$  in all cases, so we did not mention it in the table.

Let us analyze the results given in Table 6 and draw inferences on emotional drift for various emotions across the specified three episodes:

**Anger:** Overall, *anger* declined from *Episode-1* to *Episode-2* ( $N_n > N_p$  and  $mr_n > mr_p$ ) demonstrating that the imposition of lockdown generally decreased community hostility due to COVID-19. From *Episode-2* to *Episode-3*, overall *anger* showed an increasing trend, probably resulting from the continued lockdown extensions ( $N_p > N_n$  and  $mr_p > mr_n$ ). It implies that people started to feel the pinch of the extended lockdown.

**Disgust:** Generally, *disgust* decreased from *Episode-1* to *Episode-2* ( $N_n > N_p$  and  $mr_n > mr_p$ ) implying the gradually settling loath in the community with lockdown imposition. From *Episode-2* to *Episode-3* ( $N_p > N_n$  and  $mr_p > mr_n$ ), overall *disgust* demonstrated an increasing trend. It indicates that the community disliked prolonged lockdown.

**Fear:** In general, *fear* dipped from *Episode-1* to *Episode-2* ( $N_n > N_p$  and  $mr_n > mr_p$ ) revealing a reducing sense of fear in the community with lockdown imposition. From *Episode-2* to *Episode-3* ( $N_p > N_n$  and  $mr_p > mr_n$ ), overall *fear* illustrated a rising trend. It hints towards only a short-

term relief in fear provided by lockdown imposition and prolongation scared people.

**Sadness:** Overall, *sadness* subsided from *Episode-1* to *Episode-2* ( $N_n > N_p$  and  $mr_n > mr_p$ ) suggesting that lockdown imposition imbibed hope in the community. From *Episode-2* to *Episode-3* ( $N_p > N_n$  and  $mr_p > mr_n$ ), overall *sadness* showed a gradually increasing trend. It reveals that despair and anxiety grew in the community probably due to prolonged lockdown.

**Joy:** In general, *joy* surged from *Episode-1* to *Episode-2* ( $N_p > N_n$  and  $mr_p > mr_n$ ) reflecting that lockdown brought jubilation to the community. Overall *joy* reflected a declining trend from *Episode-2* to *Episode-3* ( $N_n > N_p$  and  $mr_n > mr_p$ ). It illustrates the gradually growing despondency in the community probably due to lockdown prolongation to contain the worsening situation.

**Anticipation:** Considering overall, *anticipation* increased from *Episode-1* to *Episode-2* ( $N_p > N_n$  and  $mr_p > mr_n$ ) demonstrating that lockdown brought a positive change in the community's outlook expecting good out of the lockdown imposition. Overall *anticipation* presented a declining trend from *Episode-2* to *Episode-3* ( $N_n > N_p$  and  $mr_n > mr_p$ ). It hints towards a negative change that occurred in the community's perspective towards lockdown extension.

**Surprise:** Generally, *surprise* rose from *Episode-1* to *Episode-2* ( $N_p > N_n$  and  $mr_p > mr_n$ ) suggests the shocked state of the community when the lockdown was first established. From *Episode-2* to *Episode-3* ( $N_n > N_p$  and  $mr_n > mr_p$ ), overall *surprise* illustrated a decreasing trend. It reflects that the community started to get accustomed to the pandemic situation.

**Trust:** Altogether, *trust* increased from *Episode-1* to *Episode-2* ( $N_p > N_n$  and  $mr_p > mr_n$ ) demonstrating the reliance of the community in lockdown imposition. Overall *trust* reflected a decreasing trend from *Episode-2* to *Episode-3* ( $N_n > N_p$  and  $mr_n > mr_p$ ). It indicates the creeping skepticism in the community towards lockdown extension.

## 6. Research Objective-3: Impact of activities on mental wellness

### 6.1. Descriptive Question

Restricted outdoor activities during the lockdown necessitated a sudden change in the lifestyle of an entire population making them adopt new practices. To interrogate how the newly initiated activities impact people's mental and emotional well-being, the following open-ended question was put forward: '*Your step to stay mentally healthy during the lockdown?*'.

### 6.2. Response analysis

After examining the answers, we were able to group the activities into one of the following categories:

1. *Profession-related work* such as office work, assignments, etc.
2. *Spending time with friends and family physically or in online mode* such as audio/video chats
3. *Personal development* such as training, internship, learning coding, learning to cook, etc.
4. *Exercise* such as Yoga, meditation, indoor workout etc.
5. *Active social media engagement*
6. *Entertainment and Recreational activities* such as watching TV, online web series, etc.

To investigate RO-3, we analyze the correspondence between emotions recorded under RO-2 and the activity pursuits of people during the lockdown period. For the above categories, we applied a Mann-Whitney U test on the emotion scores recorded for *Episode-3*. We choose this episode rather than *Episode-2* believing that a brief period of lockdown would not cause a substantial change in people's routine. However, prolonged confinement in lockdown extensions do lead to individuals adopting new practices and altering their lifestyle.

<sup>2</sup> <https://www.saifmohammad.com/WebPages/NRC-Emotion-Lexicon.htm>.

**Table 5**

Emotions with their respective emoji GIFs.

S.no.	Emotion	GIF	S.no.	Emotion	GIF	S.no.	Emotion	GIF	S.no.	Emotion	GIF
1	Angry	😡	5	Hopeful	😊	9	Lethargic	😴	13	Energetic	😃
2	Worried	😟	6	Sad	😢	10	Lonely	😿	14	Bored	😴
3	Calm	😌	7	Depressed	😔	11	Excited	😎			
4	Neutral	😐	8	Confused	😕	12	Happy	😄			

**Table 6**Results of Wilcoxon Signed rank test for various emotions across three episodes ( $p < 0.001$ ).

(i) Emotion	(ii) Related-samples	(iii) Counts and Ranks				(iv) Test Statistics	
		Counts		Mean Ranks		Z	r
		Negative $N_n$	Positive $N_p$	Negative $mr_n$	Positive $mr_p$		
1. Anger	$S(\text{anger}2) - S(\text{anger}1)$	229	52	154.66	80.87	-11.48	-0.37
	$S(\text{anger}3) - S(\text{anger}2)$	46	118	73.65	85.95	5.67	0.18
2. Disgust	$S(\text{disgust}2) - S(\text{disgust}1)$	98	71	100.24	63.96	-4.27	-0.14
	$S(\text{disgust}3) - S(\text{disgust}2)$	46	118	73.20	86.13	5.71	0.18
3. Fear	$S(\text{fear}2) - (\text{fear}1)$	513	48	294.51	136.56	-19.35	-0.63
	$S(\text{fear}3) - S(\text{fear}2)$	111	160	137.48	134.98	2.55*	0.08*
4. Sadness	$S(\text{sadness}2) - S(\text{sadness}1)$	490	185	362.30	273.63	-12.58	-0.41
	$S(\text{sadness}3) - S(\text{sadness}2)$	173	360	251.62	274.39	7.78	0.25
5. Joy	$S(\text{joy}2) - S(\text{joy}1)$	171	520	246.78	378.63	14.75	0.48
	$S(\text{joy}3) - S(\text{joy}2)$	400	163	295.93	247.81	-10.11	-0.33
6. Anticipation	$S(\text{anticipation}2) - S(\text{anticipation}1)$	192	373	229.67	310.45	9.28	0.30
	$S(\text{anticipation}3) - S(\text{anticipation}2)$	306	153	244.92	200.16	-7.83	-0.25
7. Surprise	$S(\text{surprise}2) - S(\text{surprise}1)$	157	221	134.00	228.93	7.29	0.24
	$S(\text{surprise}3) - S(\text{surprise}2)$	166	79	135.23	97.31	-6.87	-0.22
8. Trust	$S(\text{trust}2) - S(\text{trust}1)$	205	360	233.78	311.03	8.28	0.27
	$S(\text{trust}3) - S(\text{trust}2)$	301	158	239.55	211.80	-6.82	-0.22

\*  $p = 0.01$ .

**Table 7** presents the statistically significant results of the test. The column *Activities* mentions the categories of the activities for which we obtain significant results. Column *Emotion* lists the emotions which yield significant results in the activity category. Column *Mean rank* mentions  $mr_1$  ( $mr_0$ ) which is the average of the ranks for all observations within group 1 (0). Group 1 shows participation in the activity category, whereas group 0 denotes non-participation. The test statistics  $U$ ,  $Z$ , and  $r$  are mentioned in the last three columns respectively. We do not mention  $p$  value in **Table 7** as the significance values of all the cases were  $< 0.05$ . The test statistics of the cases flagged with asterisk (\*) are at a further lower significance value of  $< 0.01$ .

Interesting patterns of relationships between activities and emotions of the respondents emerge from **Table 7**. Although the effect size in the results show small impact ( $r < 0.1$ ), it provides insight into the sort of influence that activities had on people in lockdown conditions. We infer following about the different categories:

1. **Personal development activity:** People who engaged in personal development activities experienced higher levels of *joy*, *anticipation*, and *trust*. Individuals who indulged in this activity had greater *joy* scores than those who did not engage ( $mr_1 > mr_0$ ). For this activity, we found higher *anticipation* scores in people who were engaged in boosting skills than others ( $mr_1 > mr_0$ ). Also, *trust* scores were higher in those who worked on enhancing their personal skills in contrast to others ( $mr_1 > mr_0$ ). From this, we may conclude that working on personal skills during lockdown had a positive influence on the emotional well-being of the community.

2. **Exercising:** Individuals who exercised were less enraged and disgusted. Those who engaged in this activity exhibited lower levels of *anger* than those who did not ( $mr_0 > mr_1$ ). In comparison to individuals who did not exercise, those who exercised had lower *disgust* scores ( $mr_0 > mr_1$ ). Therefore, we infer that yoga, meditation, and

**Table 7**Results of Mann-Whitney  $U$  test on emotions of *Episode-3* across activity categories ( $p < 0.05$ ).

(i) S. No.	(ii) Emotion	(iii) Activities	(iv) Mean rank		(v) Test Statistics	
			With activity, $mr_1$	Without Activity, $mr_0$	$U$	Z
1.	Joy	Personal Development	496.21	444.23	110,962*	2.85*
2.	Anticipation		493.67	449.60	109,310	2.53
3.	Trust		493.22	450.55	109,017	2.45
4.	Anger	Exercise	469.21	492.85	107,229	-2.02
		Active social media engagement	494.26	469.79	115,429	0.07
5.	Disgust	Exercise	469.21	492.85	107,229	-2.02
		Active social media engagement	494.26	469.79	115,429	0.07
6.	Sadness	Active social media engagement	507.76	460.92	120,560*	2.67*
7.	Fear	Watching spiritual programs	483.17	388.05	20,422*	2.59*

\*  $p < 0.01$ .

- indoor workouts helped the community in taming their hostility and aversion.
3. *Active social media engagement:* People who used social media frequently experienced increased anger, contempt, and unhappiness. We find elevated *anger* scores in individuals engaged in social media ( $mr_1 > mr_0$ ) contrary to non-indulging ones. *Disgust* scores were higher in people involved actively in social media ( $mr_1 > mr_0$ ). Also, people actively using social media had higher *sadness* scores than those who do not ( $mr_1 > mr_0$ ). We deduce that social media exacerbated community's anger, disgust, and sadness indicating the need to tap it in such times.
  4. *Watching spiritual programs:* We learned from their responses of people that a large number of them watched spiritual programs such as Mahabharata and Ramayana. *Fear* levels were higher in individuals who watched these programs than in those who did not. ( $mr_1 > mr_0$ ). As a result, we infer that individuals who were fearful were more likely to turn to spiritual programming for solace.

## 7. Discussion

Let us discuss the dominant patterns that crystallized from our analysis, in the perspective of our preset ROs.

**A. Stress factors induced by the pandemic and lockdown:** The initial phase of a pandemic poses huge challenges before an unprepared society, for adapting to several new norms and lifestyle changes. Our study identified specifically that, students faced *Online-Induced stress* and *Constrained Outreach Stress*, professionals had to cope with *Economics Insecurity Stress* and *Work-Home Balancing Stress*, and families underwent *Family-Reorientation Stress*.

Broadly, the analysis of our findings on RO-1 in section 4 reveals three major causes of all kinds of stresses affecting different subgroups: *unnatural space confinement*, *economic instability*, and *a major switch of working/academics to online mode*. Unnatural and extended home confinement exacerbated conflicts in families, significantly limited the ability to conduct office work smoothly - more so with home responsibilities, and ushered in a fearful home atmosphere with constant exposure to negative news. 70.22 % of students, 44.7 % of professionals, and 65.16 % of families reported distress due to the aggravated family conflicts. Our analysis also shows that an unstable economic atmosphere induced major stresses in individuals and families. People faced unprecedented job losses, which further heightened students' *Online-Induced Stress*, professionals' *Economic Insecurity Stress*, and *Family Reorientation Stress*. Further, a sudden and wide-encompassing switch to the online mode gave birth to a range of stresses amid students and professionals. 56.17 % of students and 44.7 % of employed/self-employed people communicated the pressure faced to quickly adapt to the digital mode amid the forced WFH culture.

It may be observed that the effect size of the results ranging from 0.1 to 0.2 is small for most results - indicating their relatively small impact. Nevertheless, we are exploring the initial phases, when a pandemic's unexpected toll and subsequent lockdowns trigger a domino-effect on communities' mental health well-being. The reported stress factors and their causes should be taken as warning signals of budding issues that can escalate as the pandemic progresses. Our results clearly indicate the need for creating specialized medical and counseling facilities to relieve the above-mentioned stress factors in affected people by providing PFA. Such PFA facilities should be put in place and remain active at all times, so that as new viruses or variants come, the society is poised for tackling possible community stresses effectively.

**Comparison of our findings with existing literature:** Megatsari *et al.* analyzed the anxiety levels due to restricted mobility during the pandemic in different subgroups based on age, gender, education, and employment [46]. The authors do not make any attempt to identify the underlying stress factors related to education and employment. To address this in our work, we take into account specific stress factors relevant to the subgroup and micro-community under study, such as

switching from offline to online mode of academics, balancing workload and home management for working people, and financial load on the family. We also identify the latent stress components for the subgroups and micro-communities constituting these stress factors.

**B. Emotion Drifts in the populace:** Emotional equilibrium and emotional resilience are vital for a community's mental well-being [47,48]. Emotional resilience enables us to recover from adversity and maintain emotional stability. Undoubtedly, the gradual progression of the pandemic and subsequent lockdowns caused discernable swings in the primary emotions of people such as *anger*, *fear*, *disgust*, *joy*, *anticipation*, *surprise* and *trust*, thereby affecting emotional stability and resilience.

On an aggregate level, we deduce from our analysis of RO-2 in section 5, that there was a major shift from negative emotions during the initial striking period of COVID-19, to a preponderance of positive emotions after the first lockdown was declared. It is worth noting that the effect sizes of the reverse drifts in the negative emotions *anger*, *sadness*, and *fear*, as well the forward drifts in the positive emotions *joy*, and *anticipation* are appreciable, ranging between 0.3 and 0.7. This demonstrates that, with moderate to large impact, the government's proactive step of imposing lockdown to combat the pandemic, had a positive impact on the emotional balance of the community. However, we find that positive emotions such as *joy*, *anticipation*, *surprise* and *trust* took a dip with lockdown extension. The impact of this result (average effect size  $r_{av} = 0.2$ ) is comparatively less than the effect size of the former drift, but it does show that people were somewhat impatient with the extension of lockdown. Overall, our analysis reveals that the community underwent discernable emotional disturbances with changing pandemic conditions. This signals to the healthcare sector the urgent need for educating the public on the benefits of lockdown so that they remain mentally strong and well-prepared beforehand.

**Comparison of our findings with existing literature:** A study by Ugbolue *et al.* compared the psychological state prior to pandemic and during its first wave to compare the isolating impact of pandemic [45]. They recorded the responses for only 4 emotional categories- Soothed/Anger, Sadness/Joy, Peaceful/Excited, and Busy/Boredom for prior and during COVID-19 time. However, it must be noted that (i) complex emotions account for a range of primary emotions, (ii) community emotions trends were triggered not only by switchover from normal to onset of the pandemic, but also by subsequent events such as lockdown imposition and a series of lockdown extensions. To address this gap, we expand our choices of emotional feeling categories latently recording the primary emotions. We provide emoticons along with the choice categories to prompt the respondents to select a more related feeling and avoid any incorrect selection. Further, we analyze the forward and reverse drifts in the recorded primary emotions with the pandemic's progression through various phases. This gives a better understanding of how nature's forces as well as government decisions to ward off peril, impact the mental preparedness of communities.

**C. Impact of activities on emotions:** Engaging in activities positively affects the mental health of people [49]. According to our analysis of RO-3 presented in section 6, people were negatively affected by round-the-clock exposure to blaring social media posts, whereas yoga, meditation, working on personal skills, watching spiritual programs, and engaging in recreational activities made them feel positive and empowered. Although the effect size is small ( $r \approx 0.1$ ) for all the activities, this shows the ameliorative effects of such activities on mitigating the emotional disturbance of people. Further, there is a need to contain dramatic projection of events on social media during challenging times.

Eyeing this impact, psychological planners may be devised that includes a range of ameliorative activities. These planners would prompt people to practice productive activities in their daily routine, thereby nourishing their emotional and physical well-being amidst restrictive measures imposed during pandemic.

**Comparison of our findings with existing literature:** Correa *et al.*

conducted a survey to study the relationship between physical activities and emotions, namely happiness, surprise, fear, sadness, and anger during the period of social distancing in the pandemic [43]. Lopez-Bueno *et al.* analyzed the association between physical activities and anxiety during lockdown restrictions in COVID-19 in different age- and gender-based subgroups of the sample population [44]. Both these research works analyzed emotions in relation to only physical activities that the respondents engaged in. They did not account for the fact that, during a deep COVID-19 crisis with restricted space, people engaged in different activities to cope with stress. Thus, they ignored the range of activities to study their impact on emotional well-being. In our work, we address this research gap by considering the impact of activities such as developing personal skills, exercising, active use of social media, recreational activities, and office work. Specifically, we investigate to what extent they had a positive or negative impact on emotional well-being.

In a nutshell, we identified stress factors in different sub-groups leading to disconsolate mental health, observed the emotional drift and impact of different activities taken up by people during confinement. Our findings clearly indicate the lack of psychological preparedness and responsiveness in the community to the unseen future crises. Hence, proper management to enhance the mental health of the populace and arresting the probable prolonged psychological impact becomes necessary.

Within the scope of our work, we focused on analyzing the psychological impact during the initial phase of the pandemic only. Future extension of the work may concentrate on broadening the scope of the analysis to include the peaking and declining periods of the pandemics' phases in different waves. A limitation that we faced due to the enforced social distancing protocol was that this survey could be circulated in online mode only, relying on voluntary respondents. To work around this, studies may employ different methods such as in-field surveys and interviews to investigate psychological aspects of the pandemic with a broad-based strategy. Further, our study employed statistical analyses to illustrate the extent to which different activities had an impact on the emotional state of people during the first phase. To explore the long-term effect of activities taking into consideration other influencing factors, future research work may focus on carrying out a longitudinal study across different waves of a pandemic to quantify and generalize the multi-dimensional relationships between different activities and a community's emotions.

## 8. Conclusion

In conclusion, let us outline the main contributions of our work in the light of the goals of our study as enumerated in Section 1.

1. We conducted an online cross-sectional questionnaire-based study with specific focus on the initial phases of the COVID-19 pandemic in India, to (i) gauge mental stresses that affected the target sub-groups, students, professionals and families, (ii) to gauge community emotional drifts, and (iii) to evaluate the impact of activities emotional well-being of the community, during this phase.
2. Our study filtered out the dominant stress factors in each of the designated sub-groups and their contributing factors. Our study clearly establishes the prevalence of *Online-Induced Stress* and *Constrained Outreach Stress* among students, *Economics Insecurity Stress* and *Work-home Balancing Stress* in professionals, and *Family-Reorientation Stress* in families.
3. Our study confirmed a significant drift towards positive emotions as the situation changed from onset of the pandemic to lockdown imposition and a reverse trend towards negative emotions with subsequent lockdown extensions. Such opposite drifts in emotions of the masses in quick succession indicates an emotional imbalance in the community caused by the onset of pandemic, lockdown imposition, and its prolongation.

4. From a statistical analysis of the correlation between emotions experienced by people and activities they engaged in, we found (i) an ameliorative impact of *Personal Development* by enhancing the positive emotions of *joy*, *anticipation* and *trust* in people (ii) a positive outcome of *Exercise* by reigning in the negative emotions of *anger* and *disgust*, (iii) the deleterious impact of *Active social media engagement* by heightening negative emotions of *anger*, *disgust* and *sadness*, and (iv) coping fear by *Watching spiritual programs*.

The above results assume significance as they give indicators to our medical fraternity to plan for treating broad directions to follow in order to secure the mental well-being and preparedness of people, when first faced with the challenge of an oncoming pandemic. In order to handle the psychological dominos, it is imminent that a reliable infrastructure for dispensing PFA be created. This should include:

1. Directed psychological counseling to treat students to be able to manage their stress induced by the switch to online mode of academics and restricted outdoor activities. For employed/self-employed people, counseling should be targeted to coach them to deal with their work/office responsibilities amid home confinement and economic constraints. Professional guidance on how to balance work-home responsibilities in a collaborative manner would go a long way in creating harmony.
2. Active counseling needs to be dispensed to families to guide family members to cope with separation from family members and/or frequent in-fights due to long term confinement with them. Training would be needed to wean away family members from constant exposure to negative news through mass media.
3. Psychological planners including different ameliorative activities should be circulated to nourish the emotional well-being of people. With the evident emotional imbalances caused by the sudden lockdown restraints, it becomes imperative to not only disseminate reliable information, but also beef up economic relief measures to retain a healthy emotional balance of a community.

## 9. Data availability statement

The datasets generated during and/or analyzed during the current study are not publicly available due to the confidentiality of the personal details assured to the respondents but are available from the corresponding author on reasonable request.

## CRediT authorship contribution statement

**Shampa Chakraverty:** Methodology, Validation, Data curation, Supervision, Writing – review & editing. **Divya Gupta:** Conceptualization, Software, Formal analysis, Investigation, Resources, Writing – original draft, Visualization.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The data that has been used is confidential.

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