

Psychological Impact of COVID-19 Recovery: Suicide Risk Stratification Using the SAFL Digital Tool

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Abstract

Introduction: The psychological aftermath of COVID-19 has emerged as a significant public health concern, with increasing reports of mood disturbances, distress, and suicidality in recovered individuals. Digital tools may aid in timely screening and intervention which is crucial in these population. The study aims to assess suicide risk and effectiveness of the SAFL (Self-Assessment for Life) digital application among these individuals attending a tertiary care hospital, Mysore.

Methodology: This cross-sectional study included 400 adult post-COVID patients who were not critically ill. Sociodemographic and clinical details were recorded. Suicide risk was assessed using the Columbia Suicide Severity Rating Scale (C-SSR) and the SAFL app. Assessments included mood, sleep, and distress using the Numerical Rating Scale (NRS). Pearson correlation was used to validate the SAFL app against C-SSR.

Results: The majority of patients were aged 30–44 years (36%), female (51.5%), and urban residents (68%). Most were educated and above the poverty line. Based on C-SSR, 77.5% were low risk, 12% moderate, and 10.5% high risk for suicide. The SAFL app classified 59.8% as low, 28.8% as moderate, and 11.2% as high risk. A significant positive correlation ($r = 0.78$, $p < 0.05$) was found between both tools. The SAFL app showed excellent performance for high-risk identification (sensitivity 82.2%, specificity 98.6%, accuracy 96.7%) but lower sensitivity (37.7%) in moderate-risk detection.

Conclusion: The SAFL app is a valid and effective digital screening tool for high-risk identification. However, clinical oversight is essential, especially for moderate-risk patients, to ensure comprehensive mental health care.

Keywords: COVID-19, Suicide Risk, Columbia-Suicide Severity Rating Scale (C-SSRS), Self-Assessment for Life (SAFL), Mobile Applications, Digital Screening

1. Introduction

The 2019 COVID-19 pandemic was a threat to public health throughout the world. A virus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was the cause of COVID-19. The WHO first proclaimed a global health emergency on January 31, 2020, due to the severity of this disease and its potential for international spread. On March 11, 2020, they turned this declaration into a pandemic emergency [1].

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Many different organ systems are susceptible to the severe and perhaps fatal consequences of COVID-19. Common clinical indicators include fatigue, dry cough, and fever [2]. Recent studies indicate that neuropsychiatric symptoms are quite common after COVID-19 infection. Alongside increased rates of newly diagnosed mood and anxiety disorders, as well as dementia, patients frequently experience fatigue, cognitive dysfunction, and sleep disturbances. However, it remains unclear how the severity of the initial illness or the time elapsed since infection influences these neuropsychiatric outcomes [3].

Suicide remains one of the most pressing public health concerns. There is substantial evidence indicating that individuals infected with COVID-19 have taken their own lives. According to the National Institute of Mental Health (NIMH), suicide is defined as death resulting from self-inflicted harmful behavior carried out with the intent to die. A suicide attempt involves self-directed, potentially dangerous behavior intended to result in death, though it may not always lead to injury or be fatal. Suicidal ideation refers to the act of thinking about, planning, or considering suicide [4]. The World Health Organization (WHO) notes that suicide rates often rise during pandemics and other crises. A meta-analysis of 54 studies found that during the COVID-19 pandemic, the prevalence of suicidal thoughts (10.81%), suicide attempts (4.68%), and self-harm (9.63%) was significantly higher compared to rates observed in pre-pandemic studies [5].

COVID-19 may cause brain damage through several mechanisms, including direct viral invasion, hypoxia, inflammation, immune activation, and blood-brain barrier disruption, leading to ongoing neuroinflammation and possible neurodegeneration. The cytokine storm is a key contributor to related neuropsychiatric symptoms and suicidality. Additionally, neurotransmitter imbalances, disrupted brain networks, sleep issues, HPA axis dysfunction, and gut-brain axis disturbances may further increase suicide risk, compounded by psychological stress from the pandemic [6].

A higher suicide rate during the COVID-19 pandemic has been attributed to a number of factors, including lockdowns, quarantine, unemployment, social isolation and the sudden changes in lifestyle that go along with it, stigma and discrimination related to having or getting infected with the virus, migration, limited access to religious and community support, infodemic about COVID-19, and mental health issues. People have been catastrophizing and feeling a great deal of fear and anxiety as a result of the current state of uncertainty about the future [7]. Additionally, long-lasting physical symptoms, such as pain and loss of taste and smell, have also been described by some people, which can raise the risk of suicide [8]. Furthermore, there have been claims of a noticeable increase in alcohol consumption and a noticeable spike in domestic violence after the previously mentioned restriction measures were put into place [9]. In addition, the symptoms of mental, neurological, and physical illnesses, together with inflammatory brain damage, may make individuals with post-COVID syndrome more prone to suicidal thoughts and actions. Survivors of COVID-19 who do not have post-COVID syndrome may also be at risk [10].

Preventing suicide during the COVID-19 pandemic requires addressing both existing and pandemic-specific risk factors. Given this context, timely identification of individuals at risk is critical. Traditional suicide risk assessment tools, such as the Columbia Suicide Severity Rating Scale (C-SSRS), are well-established, but the integration of technology-driven solutions, like mobile apps, offers new potential for efficient screening and follow-up. The SAFL (Suicide Assessment and Follow-up Log) app is one such digital tool designed to aid in suicide risk assessment and monitoring.

Hence, the study aims to evaluate suicide risk among individuals with prior COVID-19 infection attending outpatient services at a tertiary care hospital. It also compares the SAFL app with the C-SSRS (screening version) to validate its effectiveness and identifies psychosocial, medical, and demographic factors linked to increased suicide risk. The study highlights important risk factors and assesses the utility of digital tools in early detection and prevention, contributing to improved post-COVID mental health care strategies.

2. Methodology

This was a cross-sectional observational study, with data collection carried out over 18 months, from August 2022 to November 2024, following approval from the institutional ethics committee. The study was conducted in the Department of Psychiatry at a tertiary care teaching hospital. Patients were included if they were over 18 years of age, had a history of COVID-19 infection, and provided informed consent. Critically ill patients and those unwilling to consent were excluded. Sociodemographic information, clinical details of their COVID-19 infection, hospitalization history, and relevant investigations were recorded. Suicide risk was assessed using the Columbia Suicide Severity Rating Scale (C-SSRS, screening version) and was compared with the SAFL (Self-Assessment for Life) app to assess its validity. For illiterate participants, a resident assisted by recording oral responses. Collected data were scored and analyzed to meet the study's primary and secondary objectives.

Objectives of the study

The primary objective of this study was to assess suicide risk among individuals previously infected with SARS-CoV-2 who were attending the outpatient department of a tertiary care hospital. The secondary objectives included validating the SAFL app by comparing its results with the C-SSRS (screening version) and identifying key factors—such as psychosocial, medical, and demographic variables—associated with increased suicide risk in this population

2.1. Sample size calculation and Statistical analysis

As no prior studies were available on suicide risk among COVID-19 patients, a prevalence of 50% was assumed for sample size calculation. With a 5% alpha error and 5% allowable error, the required sample size was calculated to be 400.

Data analysis was done with the help of statistical software Graphpad InStat v3.0. Frequency and percentages was used to portray all categorical data, while mean and standard deviation or median and interquartile range, depending on the distribution, was used to describe any continuous data. After verifying the normalcy assumption, the Independent Sample t-test or Mann Whitney U test was used for continuous measurements. The Chi-square test or Fisher's exact test was used for categorical observations based on the expected frequency. For every comparison, the P-value was deemed significant at the 5% level of significance.

3. Results

The study included 400 adult patients with previously diagnosed COVID-19 infection. The majority of the patients were aged between 30-44 years (144 patients; 36%) with 206 female patients (51.5%). Detailed socio-demographic data has been depicted in **Table 1**.

Table 1 Socio-demographic data of 400 patients

Socio-demographic variable	Observation	Frequency	Percentage
Age distribution	18-29 years	101	25.25
	30-44 years	144	36
	45-49 years	103	25.75
	>60 years	52	13
Gender distribution	Male	194	48.5
	Female	206	51.5
Place of residence	Urban	272	68
	Rural	128	32
Income categorization	Above poverty line	272	68
	Below poverty line	125	31.25
	Status unknown	3	0.75
Level of Education	Master's degree	46	11.5
	Bachelor's Degree	190	47.5
	Pre-university	72	18
	7-10 th grade	60	15
	Below 7 th grade	12	3
	No formal education	20	5
Occupation	Homemaker	107	26.75
	Agriculture	65	16.25

	Student	49	12.25
	Healthcare professional	45	11.25
	IT professional	45	11.25
	Unemployed	36	9
	Business	30	7.5
	Others	23	5.75
Marital status	Married	284	71
	Single	96	24
	Separated/ widowed/ divorcee	20	5
History of addiction to substances	Non alcoholic	262	65
	Alcohol- Weekly	81	21
	Alcohol- Once a month	57	14
	Cannabis use	12	3

3.1. Cause of distress

All the patients were enquired about the cause of distress. Each patient gave multiple causes for the distress post-COVID 19 infections. Most encountered cause of distress was relationship issues/ strained relationship in 49 patients (12.25%) followed by workplace issues in 36 patients (9%). However, in 232 patients (58%) no significant cause could be noted (**Table 2**).

Table 2 Causes of distress during COVID-19 infection

Causes of distress	Frequency	Percentage
Failure/ setbacks at academics or examination/ interview failures	12	3
Financial loss/ property loss	25	6.25
Health issues	27	6.75
Loss of family member/ partner or a near one	32	8
Work place issues/ loss of job	36	9
Relationship issues	49	12.25
Nothing significant	232	58

3.2. Details of past COVID-19 infection

RT-PCR was the most common method of COVID-19 diagnosis, used in 220 patients (55%), while 12 patients (3%) were diagnosed through imaging alone. Both methods were used in 168 patients (42%). Nearly half the patients (49.5%) did not require hospitalization, and 37.25% were admitted for less than two weeks. Quarantine was advised for 2 weeks in 38% and for 2 weeks to 1 month in 38.5%. ICU admission occurred in 38 patients: 21 (5.25%) for less than a week, 14 (3.5%) for 1–2 weeks, and 3 (0.75%) for more than 2 weeks. Oxygen therapy was required in 128 patients (32%), and 15 patients (3.75%) needed ventilator support. Steroids were not administered in 226 patients (56.5%), and in 81 patients (20.25%), steroid use status was unknown.

3.3. C-SSR, SAFL and NRS scale

All the patients included in the study were subjected to C-SSR screening questionnaire. The patients were then categorized to low risk, moderate risk and high risk for suicide based on the scoring (**Figure 1**). Based on the screening scale, it was seen that 310 patients (77.5%) were deemed low risk, 48 patients (12%) were moderate risk while 42 patients (10.5%) were high risk for suicide. Furthermore, a series of questions were directed to assess the suicide risk

among the post-COVID 19 patients using SAFL-application (**Figure 2**). Based on the application, it was seen that 239 patients were low risk, 115 patients were moderate risk while 45 patients were high risk.

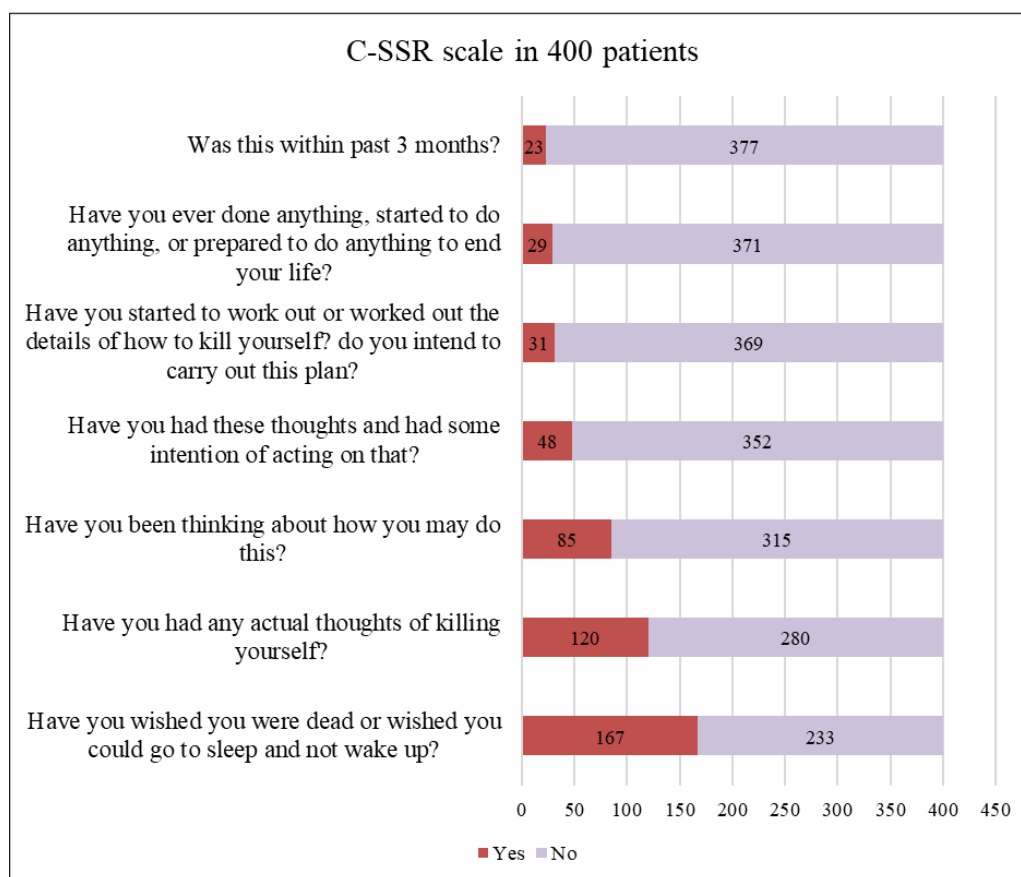


Figure 1 C-SSR scale in 400 patients [C-SSR: Columbia Suicide Severity Rating Scale]

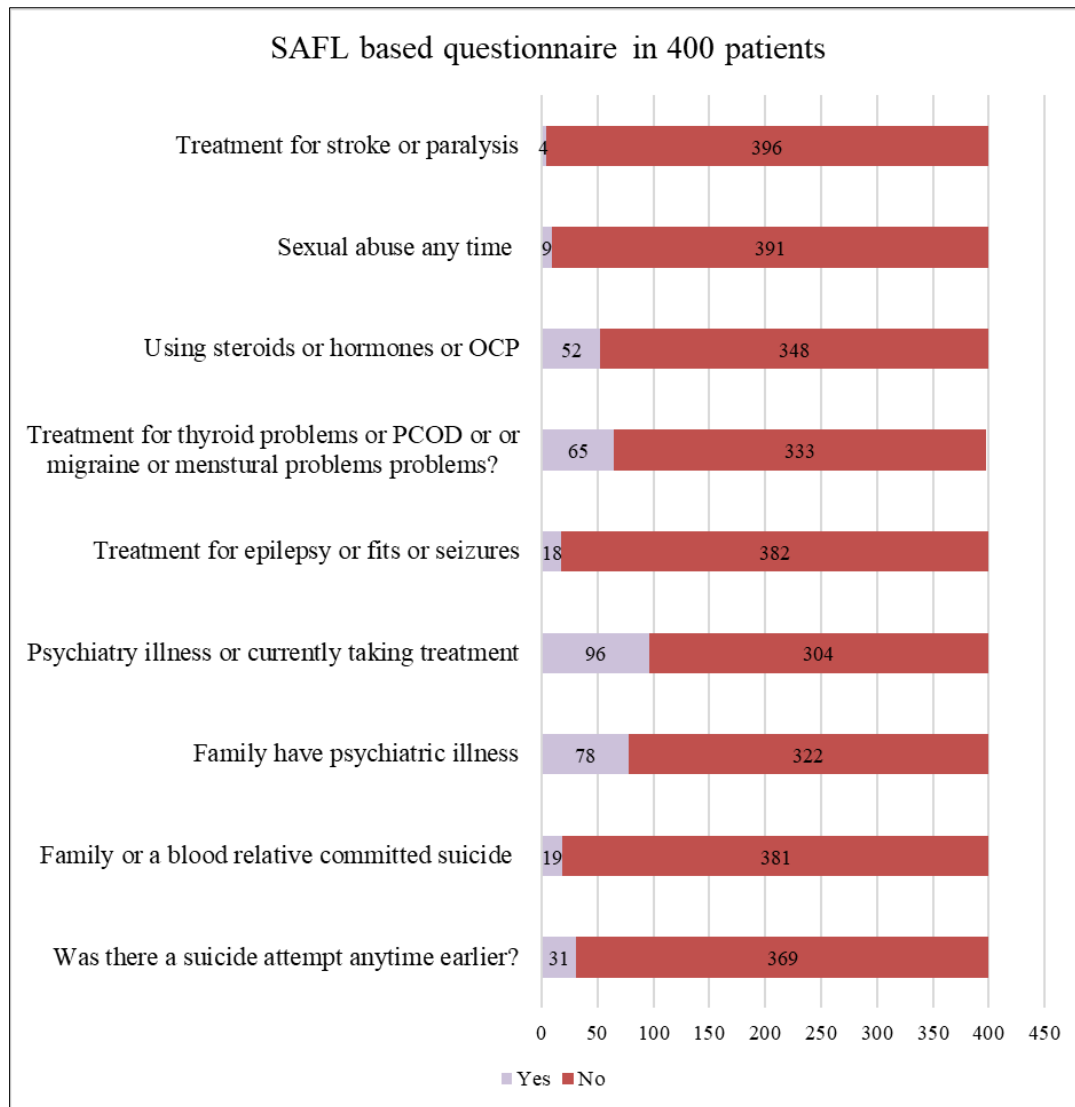


Figure 2 SAFL based questionnaire in 400 patients [SAFL- Self-Assessment for Life]

All the patients were administered a NRS to assess the mood, sleep and level of distress in post-COVID 19 status. A score of 1 indicated a low level of disability while 5 rated the highest. Most participants rated their distress at level 2 (164), indicating mild distress. Mood was predominantly rated at level 4 (177), suggesting low mood levels, while sleep was mostly rated at level 5 (135), indicating poor sleep quality, reflecting mild distress, low mood, and significant sleep disturbances among the participants.

3.4. Correlation and predictivity of SAFL application with C-SSR screening scale

Pearson correlation test revealed a significant positive association between the two scorings with $r=0.78$ and $p<0.05$, indicating higher the C-SSR value-greater the SAFL-score (**Figure 3**).

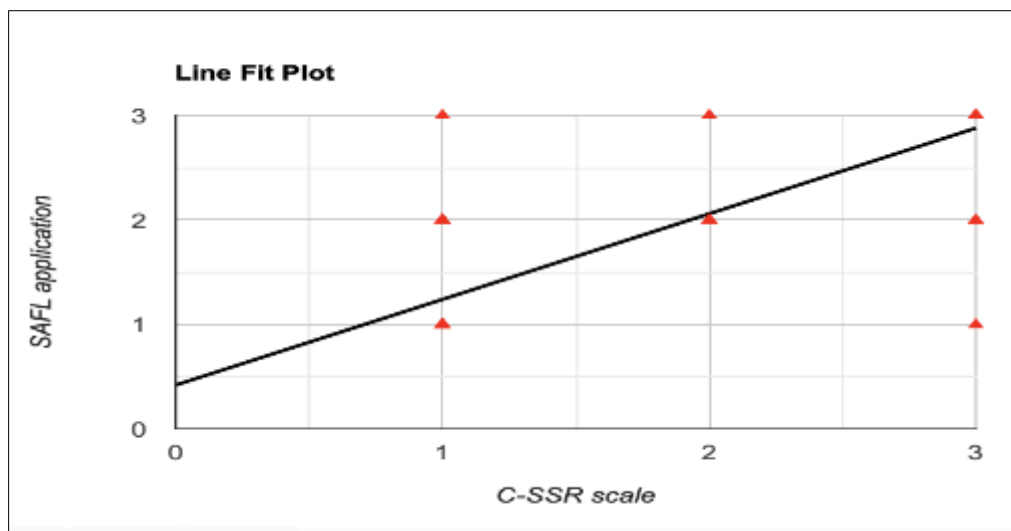


Figure 3 Line-fit plot of C-SSR scale versus SAFL-application

Considering C-SSR screening tool as gold standard, SAFL app demonstrated a strong performance in stratifying suicide risk among post-COVID patients, as reflected in its sensitivity, specificity, predictive values, and overall accuracy across different risk categories (**Table 3**).

Table 3 Risk stratification on SAFL app

Risk stratification on SAFL app	Sensitivity	Specificity	Negative predictive value (NPV)	Positive predictive value (PPV)	Accuracy
For patients deemed "low risk"	77.2% (72.9-81.8% at 95% CI)	98.98% (93.96-99.97% at 95% CI)	55.9% (50.8-61% at 95% CI)	99.58% (97.12-99.94% at 95% CI)	82.1% (77.98-85.8% at 95% CI)
For patients deemed "moderate risk"	37.7% (28.8-47.3% at 95% CI)	98.23% (95.93-99.4% at 95% CI)	79.7% (77.2-81.9% at 95% CI)	89.6% (77.8-95.5% at 95% CI)	80.9% (76.7-84.6% at 95% CI)
For patients deemed "high risk"	82.2% (67.9-92% at 95% CI)	98.6% (96.7-99.5% at 95% CI)	97.6% (95.9-98.8% at 95% CI)	88.1% (95.9-98.8% at 95% CI)	96.7% (94.5-98.2% at 95% CI)

4. Discussion

Understanding the demographic profile of post-COVID patients is essential in evaluating their risk of suicide and developing targeted mental health interventions.

Only 13% of participants in this research were older than 60, with the majority of participants (36%) being between the ages of 30 and 44, followed by those between the ages of 45 and 59 (25.75%) and 18 and 29 (25.25%). This implies that the productive age group has a greater risk of psychological distress and suicide, which is in line with research by Bridge JA et al. (2023) [11], likely due to work, financial, and caregiving stressors, and concerns over long-term health [12].

Although there was a small female majority (51.5%), the gender distribution was about equal. During the epidemic, women had more suicidal thoughts than males, despite men having a greater suicide fatality rate [13] [14].

Educationally, 47.5% were graduates and 11.5% postgraduates, with only 5% uneducated. Though higher education improves mental health awareness, it may also heighten stress. A Brazilian study echoed these concerns among students

[15]. The educated profile of this group supports the use of digital and psychoeducational interventions for suicide prevention.

In this study, 68% of participants were from the above poverty line (APL) group, while 31.25% were below the poverty line (BPL). This is consistent with data from the National Crime Records Bureau that showed a 54% increase in self-employed suicides compared to 2018 [16].

Boshra et al. (2020) [17] and D'Souza et al. (2020) [18] both identified financial anguish brought on by job loss and economic instability during the pandemic as a major risk factor for suicide. Wealthier people may endure severe psychological suffering because of greater perceived losses, fear of losing social standing, and a lack of emotional support, whereas lower-income groups endure economic problems.

Around 32% of the sample was from rural regions, while 68% of the sample was from urban areas. However, according to a 2025 research by Leveau CM et al in Argentina's metropolitan areas had a decreased suicide rate [19]. A greater rate of underdiagnosis in rural areas may be explained by underreporting and restricted access to care, which might account for the disparity in the current data. Although access to healthcare may be greater in urban regions, stresses like loneliness and job uncertainty are also more prevalent there.

Another factor was marital status: 71% were married, 24% were single, and 5% were widowed, divorced, or separated. Marriage may provide social support, but difficult relationships during sickness might make people feel more distressed.

Substance use was another important factor: 34.5% consumed alcohol, with varying frequencies, while cannabis use was rare (3%). Even occasional use can impact mental health, as cannabis and alcohol have been linked to increased suicidal ideation, as noted by Adeyinka DA et al [20]. The pandemic's emotional toll—grief, fear, boredom, and economic uncertainty—likely contributed to substance use, further elevating suicide risk in vulnerable individuals.

Important information on the psychological triggers causing emotional vulnerability and possible suicide risk can be gleaned from the data where 232 individuals (58%) out of the 400 patients evaluated said they had no discernible or substantial external cause of distress. This conclusion is noteworthy because it raises the possibility that internal psychological factors—such as trauma, depression or anxiety—may be more important in explaining post-COVID distress than particular life experiences. It could also indicate that stresses are not being recognized or reported enough because of stigma, denial, or a lack of awareness. Among patients who did report specific causes, relationship issues (12.25%) emerged as the most common identifiable trigger. Workplace issues or job loss (9%) and loss of a loved one (8%) were also significant causes of distress. Similarly, health issues (6.75%) and financial or property losses (6.25%) reflect common pandemic-induced stressors. Pathirathna ML et al in 2022 [21], Almaghrebi AH et al in 2020 [22] also noted a similar trend in results. These findings support existing literature showing that interpersonal conflict and emotional instability are major predictors of suicidal ideation, especially in vulnerable individuals. Pandemic-related stress, isolation, unemployment, and bereavement further worsened these risks—particularly for those with limited coping abilities or pre-existing mental health issues.

This study assessed the effectiveness of the SAFL mobile application in stratifying suicide risk among post-COVID patients by comparing it to the C-SSRS, the gold standard tool. No previous literature was found comparing these two tools, making this investigation unique in applying the SAFL app for suicide risk assessment in this population. Based on the C-SSRS, 77.5% of patients were low risk, 12% moderate, and 10.5% high risk. The SAFL app categorized 59.75% as low, 28.75% moderate, and 11.25% high risk. A strong positive correlation ($r = 0.78$, $p < 0.05$) between the two tools indicates that the SAFL app reliably reflects C-SSR trends, particularly in identifying high-risk individuals. The SAFL app showed high specificity and accuracy for low and high-risk categories, supporting its use in clinical or resource-limited settings. However, its lower sensitivity for moderate-risk patients suggests a risk of under-detection, especially in those with emerging or subtle symptoms. As moderate-risk individuals are often at a critical point for early intervention, relying solely on the app could result in missed cases.

This study has several limitations that should be considered when interpreting the results. First, as an observational study, it cannot establish causality, only associations between variables. Additionally, the small sample size limits the generalizability of the findings and reduces the statistical power to detect significant effects. Recall bias may also be present, as participants were required to self-report past behaviours or experiences, which may not always be accurate. Lastly, the condition under investigation likely has a multifactorial cause, making it difficult to isolate the impact of individual variables and potentially confounding the observed associations.

5. Conclusion

The study findings support existing literature showing that interpersonal conflict and emotional instability are major predictors of suicidal ideation, especially in vulnerable individuals. Pandemic-related stress, isolation, unemployment, and bereavement further worsened these risks—particularly for those with limited coping abilities or pre-existing mental health issues. The SAFL application showed high accuracy and specificity, particularly in detecting high-risk individuals, making it a useful tool for quick suicide risk assessment in clinical and community settings. However, its lower sensitivity for moderate-risk cases calls for cautious use and underscores the need to pair app-based screening with clinical judgment. Integrating tools like the SAFL app into routine psychological evaluation and follow-up care can improve early detection and timely intervention for mental health concerns in the post-COVID population. Integrating psychosocial assessment, grief counseling, and emotional support into post-COVID care is vital, particularly for those facing unresolved relationship or occupational stress.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflicts of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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