Effect of Internet Addiction on Depression among Pakistani Population amidst the COVID 19

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Abstract

Background:

Internet addiction has proved to have detrimental effects on the mental health wellbeing of people. During COVID19, these effects are amplified significantly; therefore, this study aims to assess the effect of internet addiction (IA) on the presence of depression among the Pakistani population amidst COVID 19.

Methods

A cross-sectional design was employed using an anonymous web-based survey link. This link was disseminated via different social media platforms. The "Young's Internet Addiction Test" (IAT) and "Depression, Anxiety, and Stress Scale-21" (DASS-21) screening tools were used to measure Internet addiction (IA) and level of depression respectively. Adjusted odds ratios along with 95% confidence interval were reported using multinomial logistic regression for the association of IA and other predictors associated with depression.

Results

A total of 1145 individuals has completed this survey. Overall, the prevalence of severe and extremely severe depression was found to be 9.7% and 16.4% amidst the Pakistani population during the Covid-19 outbreak. The odds of extreme depression were 15 times more among (AIU) addicted internet users (95% CI: 8.26-28.8) and 7 times more among (PIU) problematic internet users (95% CI: 4.57-12.05) as compared to (NIU) normal internet users.

Conclusion

In the aftermath of COVID 19, depression was found to be significantly related to internet addiction. This study determined that addicted and problematic internet users are more prone to suffer from depression.

Introduction

The coronavirus disease (COVID-19) has had a tremendous effect on people's lives around the world, particularly after the declaration of a global pandemic in March 2020 [1]. The pandemic came out as the most overwhelming and challenging calamity for public health. Apart from the mounting mortality rate, the pandemic created a psycho-emotional chaotic situation and excruciated psychological outcomes among people of all ages [2]. The unrivaled experience of being quarantined along with the academic and professional career uncertainty and the fear of pandemic has triggered negative impacts on the mental health and wellbeing of the people. It has forced the masses to experience more severe emotional reactions, psychological difficulties, and behavioral changes [3].

According to the global data, depression rates are rising significantly during the current pandemic [4-7]. A study in the US reported depression has increased by three-time during the pandemic compared to the year 2019 [8]. The burden was found to be greatest among Covid-19 patients (42%) followed by the healthcare workers (25%-50.4%) and the general population (24%-26.9). [9]–[13] A similar trend was seen in Asian
countries like India, Pakistan, Iraq, and China, where the prevalence of depression ranged between 20 to 45 percent among the general population [14]–[19].

A myriad of factors was found to be associated with depression during the pandemic. One such factor that was highlighted was excessive internet use during covid 19 owing to lack of in-person social gathering and lockdown[15], [16], [20], [21]. Most of the world has shifted to virtual options during the current outbreak. Internet addiction is characterized by excessive or poorly controlled preoccupations, impulses, or behaviors related to computer use and internet access that may lead to distress [15-16]. The Covid-19 has led to an undeniable surge in internet usage. As most of the educational institutes and organizations shifted to work-from-home, many people now spend much of their time on the internet to study, work, shop, or for entertainment purposes. The internet is advantageous, if used in a reasonable way these activities help reduce stress and boredom. However, the unhealthy and excessive use may lead to addiction, which is linked to emotional problems and leads to clinical signs and symptoms of depression such as irritation, short temper, loss of interest, insomnia, reduced appetite to more serious complications like memory difficulties, physical aches and suicidal ideation [21] [22], [23].

This rising trend of depression owing to internet addiction during the challenging time of pandemic is gruesome. Furthermore, this long-term complication of the pandemic if not considered earlier could be deleterious. Studies conducted in Pakistan have shown a marked increase in the prevalence of depression but there are no studies conducted to identify the association between internet addiction. Therefore, this trend must be identified for our population for which no data exists currently. Time demands that studies be done in Pakistan to understand this pattern of factors such as internet addiction and so effective interventions can be planned and delivered timely to contain these addictions for current and future outbreaks. The main objective of the study is to determine the prevalence of depression among the Pakistani population and to assess the relationship of internet addiction and other factors with depression during the COVID-19 outbreak.

**Methods**

**Study Design & Population:**

A cross-sectional design using an anonymous web-based survey was conducted between April and August 2020 to determine the burden of depression and its relationship with internet addiction along with other factors among the Pakistani population during the pandemic. A google form was disseminated by the investigators on different social media networks including WhatsApp, Facebook, Instagram, Twitter, and E-mails. The target population included was individuals residing in Pakistan and having access to technology. Overseas Pakistanis and internationals were excluded. An electronic consent was also obtained from all the participating individuals before the initiation of the survey.

**Outcome Measure:**
The outcome was the presence of depressive symptoms that was measured using a 4-point severity/frequency score of Depression, Anxiety, and Stress Scale-21 (DASS-21) screening tool. There was a total of 7 items in the domain of depression and each rated from 0 to 3 (0: Does not apply, 1: Applies to some degree, 2: Applies considerably, and 3: Applies most of the time) and measures symptoms of depression for the past 7 days. The scores for depression were discretely calculated by adding the scores for each item and multiplying them by two. The range of depression domain was from 0 and 42 and was further classified into 5 categories: scores between 0-9 were considered normal, scores between 10-13 were considered mild, scores between 14-20 were considered moderate, scores 21-27 were considered severe and scores 28 and higher were considered extremely severe depression. This instrument has shown excellent psychometric properties and has been previously used in Pakistani settings showing internal consistency (Cronbach's $\alpha$) of 0.84 to 0.97 [24].

**Primary Exposure:**

IA was measured using Young's Internet Addiction Test (IAT). The tool comprises 20 items and each question is rated on a Likert scale (1 = hardly ever, 2 = sometimes, 3 = frequently, 4 = often, and 5 = always) for the last 30 days. The scores of the scale range from 20 to 100. 0 to 39 were categorized as "normal-internet users (NIU)”, 40 to 69 were categorized as "problematic-internet-users (PIU)" and 70 and above were classified as an "addictive-internet-users (AIU)". This instrument has shown acceptable psychometric properties and was previously validated in a Pakistani setting showing Cronbach alpha of 0.88, indicating excellent reliability. [25]

**Other Independent Variables:**

A brief structured tool was also administered to obtain information on various sociodemographic and environmental factors including age, gender, education status, marital status, social class, monthly income, and work situation.

**Sample Size:**

To determine the burden of internet addiction (PIU and AIU) among the Pakistani population, the burden was estimated to be from 9.7–47% with 2.5% of absolute precision and a level of significance of 5%; found a minimum sample of 379 individuals was required. For evaluating the effect of internet addiction and other psychological factors on depression, a minimum sample of 994 individuals was required to achieve 80% power and at the significance level of 95%. Considering it
was a web-based study, a total of 1143 respondents were needed to cater to 15% anticipated refusals and incomplete forms. A total of 1145 respondents has completed this online survey.

Statistical Analysis:

Stata version 16 was used to analyze the data. All categorical variables including IA and depression were presented as frequencies with proportions and all continuous variables such as age were presented as mean along with standard deviations. Multinomial logistic regression was used to assess the effect of IA and various factors on depression. Adjusted odds ratios along with a 95% confidence interval were reported.

Results

1145 participants completed the online survey, of which the majority were females (60%), youths within the age range of 20 to 24 years (50%), and students (69.3%). A very large number of them were single (82.4%) and approximately 38% had at least an undergraduate level of education.

Prevalence of depression:

Depressive symptoms were present among more than half of the participants. Overall, the prevalence of severe and extremely severe depression was found to be 9.7% and 16.4% among the Pakistani population during the Covid-19 pandemic.

Table 1 demonstrates the characteristics of participants as per the severity of depressive symptoms. Extremely severe depression was significantly more among individuals belonging to the upper socioeconomic class (46.8%) and having higher salaries (69.6%).

Most of the participants with extremely severe depression had extremely high levels of anxiety (80.3%) and almost one-third were suffering from elevated levels of stress (36.2%). Participants with extremely severe depression also had a considerable proportion of problematic internet users (42%) and internet addicts (32.4%) whereas, those with no/normal depression, had more proportion of normal internet users (77.9%).

A significantly large quantity of respondents with a monetary crisis during COVID-19 had extremely severe (73.9%) and severe depression (73.8%) than those with no financial burden. Additionally, the majority of the extremely depressed individuals had conflict within families during the pandemic (64.8%) and had a history of past (53.1%) and current medical illnesses (54.2%).

Table I: Descriptive characteristics of participants stratified on Level of Depression.
| Variables                        | Depression N=1145 |
|---------------------------------|------------------|
|                                 | Normal n(%)      | Mild n(%)      | Moderate n(%) | Severe n(%) | Extreme n(%) |
|                                 | 471 (41.1)       | 160 (14.0)    | 215 (18.8)   | 111 (9.7)   | 188 (16.4)   |
| Demographic information         |                  |                |              |             |              |
| Age                             |                  |                |              |             |              |
| Teenager <=19                   | 81(17.20)        | 37(23.13)      | 48(22.33)    | 28(25.23)   | 50(26.60)    |
| Youth 20 - 24                   | 236(50.11)       | 80(50.00)      | 112(52.09)   | 59(53.15)   | 84(44.68)    |
| Young adult 25 – 30              | 92(19.53)        | 30(18.75)      | 37(17.21)    | 16(14.41)   | 35(18.68)    |
| Middle / older adult            | 62(13.16)        | 13(8.13)       | 18(8.37)     | 8(7.21)     | 19(10.11)    |
| Gender                          |                  |                |              |             |              |
| Male                            | 204(43.31)       | 73(45.63)      | 85(39.53)    | 35(31.53)   | 62(32.98)    |
| Female                          | 267(56.69)       | 87(54.37)      | 130(60.47)   | 76(68.47)   | 126(67.02)   |
| Marital status                  |                  |                |              |             |              |
| never married                   | 375(79.62)       | 131(81.88)     | 181(84.19)   | 97(87.39)   | 160(85.11)   |
| Ever married                    | 96(20.38)        | 29(18.13)      | 34(15.81)    | 14(12.61)   | 28(14.89)    |
| Self-education                  |                  |                |              |             |              |
| Matriculation or less (1st – 10th) | 38(8.07)       | 13(8.13)      | 12(5.58)     | 2(1.80)     | 15(7.98)     |
|                                | 148(31.42)       | 54(33.75)      | 78(36.28)    | 51(45.95)   | 75(39.89)    |
| High secondary (11th -12th)     | 185(39.28)       | 64(40.00)      | 87(40.47)    | 37(33.33)   | 65(34.57)    |
| Undergraduate                   | 100(21.23)       | 29(18.13)      | 38(17.67)    | 21(18.92)   | 33(17.55)    |
| Postgraduate                    |                  |                |              |             |              |
| Work situation                  |                  |                |              |             |              |
| Employed                        | 120(25.48)       | 26(16.25)      | 39(18.14)    | 25(22.52)   | 35(18.62)    |
| No formal job                   | 57(12.10)        | 16(10.00)      | 17(7.91)     | 4(3.60)     | 13(6.91)     |
| Students                        | 294(62.42)       | 118(73.75)     | 159(73.95)   | 82(73.87)   | 140(74.47)   |
| Social class                    |                  |                |              |             |              |
| Lower                           | 44(9.34)         | 24(15.00)      | 15(6.98)     | 7(3.31)     | 11(5.85)     |
| Middle                          | 252(53.50)       | 88(55.00)      | 130(60.47)   | 57(51.35)   | 89(47.34)    |
| High                            | 175(37.15)       | 48(30.00)      | 70(32.56)    | 47(42.34)   | 88(46.81)    |
| Family Income per month during covid19 | 50k and less | 50k-100k | 100k-200k | >200k | 153(32.48) | 62(38.75) | 60(27.91) | 22(19.82) | 30(15.96) | 102(21.66) | 30(18.75) | 45(20.93) | 25(22.52) | 27(14.36) | 275(15.92) | 27(16.88) | 49(22.79) | 24(21.62) | 44(23.40) | 141(29.94) | 41(25.62) | 61(28.37) | 40(36.04) | 87(46.28) |
| Internet Exposure | Increase in internet usage during lockdown | No | Yes | 53(11.25) | 148(88.75) | 14(8.75) | 146(91.25) | 27(12.56) | 188(87.44) | 9(8.11) | 102(91.89) | 11(5.85) | 177(94.15) |
| internet addiction | Normal Internet User | 367(77.92) | 119(74.38) | 119(55.35) | 59(45.05) | 48(25.53) |
| Problematic Internet User | 78(16.56) | 33(20.63) | 79(36.74) | 44(39.64) | 79(42.02) |
| Addicted Internet User | 26(5.52) | 8(5.00) | 17(7.91) | 17(15.32) | 61(32.45) |
| Psychological and Medical Factors | Anxiety | Normal | Mild | Moderate | Severe | Extremely severe | 333(70.70) | 53(11.25) | 75(15.92) | 9(1.91) | 1(0.21) | 67(41.88) | 33(20.63) | 46(28.75) | 9(5.63) | 5(3.13) | 40(18.60) | 17(7.91) | 81(37.67) | 35(16.28) | 42(19.53) | 58(52.25) | 151(80.32) |
| Stress | Normal | 446(94.69) | 129(80.63) | 117(54.42) | 17(15.32) | 6(3.19) |
| Mild | 11(2.34) | 16(10.00) | 37(17.21) | 20(18.02) | 6(3.19) |
| Moderate | 12(2.55) | 13(8.13) | 41(19.07) | 38(34.23) | 27(14.36) |
| Severe | 2(0.42) | 2(1.25) | 18(8.37) | 30(27.03) | 81(43.09) |
| Extremely severe | 0(0.00) | 0(0.00) | 2(0.93) | 6(5.41) | 68(36.17) |
| Current mental condition (self) | No | 305(64.76) | 81(50.63) | 102(47.44) | 42(37.84) | 47(25.00) |
| Yes | 93 (19.75) | 36(22.50) | 62(28.84) | 49(44.14) | 102(54.26) |
|                       | I don't know | 73(15.50) | 43(26.88) | 51(23.72) | 20(18.02) | 39(20.74) |
|-----------------------|--------------|-----------|-----------|-----------|-----------|-----------|
| **Past mental condition** |              |           |           |           |           |           |
| No                    | 267(56.69)   | 76(47.50) | 98(45.58) | 40(36.04) | 62(32.98) |
| Yes                   | 156(33.12)   | 67(41.88) | 78(36.28) | 58(52.25) | 100(53.19)|
| I don't know          | 48(10.19)    | 17(10.63) | 39(18.14) | 13(11.71) | 26(13.83) |
| **Past Chronic illness(self)** |          |           |           |           |           |           |
| No                    | 65(13.80)    | 15(9.38)  | 18(8.37)  | 10(9.01)  | 34(18.09) |
| Yes                   | 19(4.03)     | 11(6.88)  | 14(6.51)  | 6(5.41)   | 34(18.09) |
| I don't know          | 387(82.17)   | 134(83.75)| 183(85.12)| 95(85.59) | 120(63.83)|
| **Mental disorder or mental illness in your family right now** | | | | | | |
| No                    | 375(79.62)   | 119(74.38)| 141(65.58)| 76(68.47) | 108(57.45)|
| Yes                   | 78(16.56)    | 26(16.25) | 43(20.00) | 18(16.22) | 55(29.26) |
| I don't know          | 18(3.82)     | 15(9.38)  | 31(14.42) | 17(15.32) | 25(13.30) |
| **Past mental problems family** |        |           |           |           |           |           |
| No                    | 341(72.40)   | 103(64.38)| 129(60.00)| 68(61.26) | 91(48.40) |
| Yes                   | 94(19.96)    | 40(25.00) | 47(21.86) | 22(19.82) | 61(32.45) |
| I don't know          | 36(7.64)     | 17(10.63) | 39(18.14) | 21(18.92) | 36(19.15) |
| **Behavioral and Environmental factors** | | | | | | |
| **Area of living during the pandemic** | | | | | | |
| In a rural area       | 82(17.41)    | 28(17.50) | 36(16.74) | 13(11.71) | 15(7.98) |
| In a suburban area    | 59(12.53)    | 25(15.63) | 37(17.21) | 18(16.22) | 31(16.49) |
| In an urban area      | 330(70.06)   | 107(66.88)| 142(66.05)| 80(72.07) | 142(75.53)|
| **Living with during pandemic** | | | | | | |
| Family                | 414(87.90)   | 145(90.3) | 186(86.51)| 94(84.68) | 166(88.30)|
| Other than family     | 57(12.10)    | 15(9.38)  | 29(13.49) | 17(15.32) | 22(11.70) |
| **Pandemic- Living in usual accommodation** | | | | | | |
| No                    | 103(21.87)   | 32(20.00) | 56(26.05) | 27(24.32) | 36(19.15) |
| Yes                   | 368(78.13)   | 128(80.00)| 159(73.95)| 84(75.68) | 152(80.85)|
| **Pandemic work situation** | | | | | | |
| Don't work            | 219(46.50)   | 80(50.00) | 104(48.37)| 65(58.56) | 94(50.00) |
| Search for Job        | 37(7.86)     | 13(8.13)  | 18(8.37)  | 5(4.50)   | 13(6.91)  |
| Part-time Job | 39(8.28) | 15(9.38) | 19(8.84) | 11(9.91) | 16(8.51) |
| Work from home + in person | 64(13.59) | 18(11.25) | 35(16.28) | 9(8.11) | 23(12.23) |
| In-person job | 112(23.78) | 34(21.25) | 39(18.14) | 21(18.92) | 35(18.62) |

| Pandemic workload |
|-------------------|
| Not currently working | 158(33.55) | 57(35.63) | 77(35.81) | 35(15.53) | 63(33.51) |
| Higher than before | 84(17.83) | 25(15.63) | 44(20.47) | 23(20.72) | 50(26.60) |
| Highly variable | 31(6.58) | 16(10.00) | 22(10.23) | 17(15.32) | 26(13.83) |
| Less than before | 116(24.63) | 37(23.13) | 47(21.86) | 13(11.71) | 25(13.30) |
| Same as before | 82(17.41) | 25(15.63) | 25(11.63) | 23(20.72) | 24(12.77) |

| Afraid to go out during covid19 pandemic |
|----------------------------------------|
| No | 117(24.84) | 31(19.38) | 53(24.65) | 20(18.02) | 37(19.68) |
| A little bit | 271(57.54) | 96(60.00) | 120(55.81) | 63(56.76) | 108(57.45) |
| Yes | 83(17.62) | 33(20.63) | 42(19.53) | 28(25.23) | 43(22.87) |

| Financial constraints during Covid 19 |
|--------------------------------------|
| No | 147(31.21) | 28(17.50) | 76(35.35) | 29(26.13) | 49(26.06) |
| Yes | 324(68.79) | 132(82.50) | 139(64.66) | 82(73.88) | 139(73.94) |

| Mood changes during Covid19 |
|-----------------------------|
| Negative | 187(39.70) | 85(53.13) | 116(53.95) | 71(63.96) | 136(72.34) |
| No change | 162(34.39) | 503(1.25) | 54(25.12) | 21(18.92) | 21(11.17) |
| Positive | 122(25.90) | 25(15.63) | 45(20.93) | 19(17.12) | 31(16.49) |

| Family system |
|---------------|
| Extended | 167(35.46) | 73(45.63) | 78(36.28) | 39(35.14) | 62(32.98) |
| Nuclear | 304(64.54) | 87(54.37) | 137(63.72) | 72(64.86) | 126(67.02) |

| Family Conflicts during Covid19 |
|-------------------------------|
| No | 307(65.18) | 89(55.63) | 115(53.49) | 61(54.95) | 66(35.11) |
| Yes | 164(34.82) | 71(44.38) | 100(46.51) | 50(45.05) | 122(64.89) |

| People living with kept a check on you |
|----------------------------------------|
| No | 240(50.96) | 69(43.13) | 118(54.88) | 60(54.05) | 98(52.13) |
| Yes | 231(49.04) | 91(56.88) | 97(45.12) | 51(45.95) | 90(47.87) |

| Mental, physical, or sexual abuse during covid19 |
|-----------------------------------------------|
| No | 71(15.73) | 18(11.25) | 13(6.63) | 11(9.91) | 16(8.51) |
| Yes | 231(49.04) | 91(56.88) | 97(45.12) | 51(45.95) | 90(47.87) |
Predictors of depression:

Multinominal logistic regression was performed between different severities of depression and independent variables of interest (Table 2). The multivariable analysis, after accounting for potential confounding factors, showed that the odds of having extreme depression were 15 times more among addicted internet users (95% CI: 8.26-28.8) and 7 times more among problematic internet users (95% CI: 4.57-12.05). Respondents who had a mental condition during the pandemic had approximately 4 times higher odds of extreme depression (95% CI: 2.56-7.15) than those with no mental condition. Likewise, the odds of extreme depression were greater for those with a history of chronic illness (95% CI: 1.82-11.17). Moreover, there was convincing evidence that conflicts within families during the pandemic situation (95% CI: 1.38-3.307) and low moods (95% CI: 1.34-4.02) double the odds of having extreme depression. Furthermore, respondents belonging to small families also had 2.5 times more odds of having extreme depression than those with large family sizes (95% CI: 1.29-4.75).

Table II: multivariable multinominal regression showing adjusted odds ratio (OR) along with 95% confidence interval (CI) of factors associated with depression among Pakistani population during COVID-19 outbreak.
| Variables                          | Mild          |              | Moderate      |              | Severe        |              | Extreme      |              |
|----------------------------------|---------------|--------------|---------------|--------------|---------------|--------------|--------------|--------------|
|                                  | Adjusted OR (95%CI) | P      | Adjusted OR (95%CI) | P      | Adjusted OR (95%CI) | P      | Adjusted OR (95%CI) | P      |
| Psychological factors            |               |              |               |              |               |              |               |              |
|                                  |               |              |               |              |               |              |               |              |
| After internet addiction         |               |              |               |              |               |              |               |              |
| Normal Internet User             | 1.21(0.75-1.94) | 0.43       | 3.14(2.12-4.66) | <0.05       | 3.9(2.38-6.47) | <0.05       | 7.4(4.57-12.05) | <0.05       |
| Problematic Internet Users       | 0.86(0.37-2.01) | 0.74       | 1.9(0.98-3.74)  | 0.05        | 4.5(2.19-9.23) | <0.05       | 15.4(8.26-28.8) | <0.05       |
| Addicted Internet Users          |               |              |               |              |               |              |               |              |
| Demographic information          |               |              |               |              |               |              |               |              |
| Gender                           |               |              |               |              |               |              |               |              |
| Male                             |               |              |               |              |               |              |               |              |
| Female                           | 0.91(0.617-1.34) | 0.63       | 1.09(0.76-1.56) | 0.63        | 1.42(0.87-2.31) | 0.15        | 1.5(0.94-2.31) | 0.08        |
| Age Category                     |               |              |               |              |               |              |               |              |
| Teenager ≤19                     | 1.5(0.93-2.36) | 0.09        | 1.3(0.86-2.05)  | 0.19        | 1.45(0.85-2.49) | 0.17        | 1.9(1.13-3.098) | 0.01        |
| Adult (20 to 30)                 | 0.67(0.34-1.30) | 0.24       | 0.76(0.42-1.37) | 0.36        | 0.64(0.27-1.46) | 0.28        | 0.94(0.46-1.90) | 0.86        |
| Older adult >30                  |               |              |               |              |               |              |               |              |
| Social class                     |               |              |               |              |               |              |               |              |
| Lower                            |               |              |               |              |               |              |               |              |
| Middle                           | 0.6(0.32-1.08) | 0.09        | 1.22(0.62-2.39) | 0.55        | 1.03(0.40-2.60) | 0.94        | 1.04(0.44-2.48) | 0.91        |
| High                             | 0.47(0.24-0.95) | 0.03       | 0.85(0.40-1.81) | 0.68        | 0.95(0.34-2.63) | 0.93        | 1.04(0.39-2.57) | 0.99        |
| Monthly Income                   |               |              |               |              |               |              |               |              |
| 50k and less                     | 1.3(0.77-2.24) | 0.31        | 1.02(0.62-1.69) | 0.90        | 0.79(0.40-1.57) | 0.50        | 1.23(0.61-2.45) | 0.55        |
| 50k-100k                         |               |              |               |              |               |              |               |              |
| 100k-200k                        | 1.45(0.82-2.88) | 0.18       | 1.72(1.0-2.96)  | 0.05        | 1.61(0.80-3.23) | 0.40        | 2.9(1.49-5.90)  | 0.002       |
|                                 |               |              |               |              |               |              |               |              |
|                                 |               |              |               |              |               |              |               |              |
|                                 |               |              |               |              |               |              |               |              |
|                    | >200k       | 1.25(0.68-2.28) | 1.16(0.68-2.00) | 1.30(0.68-2.60) | 2.70(1.41-5.31) |
|--------------------|-------------|-----------------|-----------------|-----------------|-----------------|
| **Psychological and medical factors** |             |                 |                 |                 |                 |
| **Current Self mental condition**    |             |                 |                 |                 |                 |
| No                  | -           | -               | -               | -               | -               |
| Yes                 | 1.38(0.84-2.3) | 1.70(1.08-2.63) | 3.40(2.02-5.86) | 4.30(2.56-7.15) | <0.05           |
| I don't know        | 1.87(1.15-3.03) | 1.53(0.96-2.44) | 1.50(0.78-2.83) | 1.72(0.95-3.13) | 0.07            |
| **Past history of chronic diseases** |             |                 |                 |                 |                 |
| No                  | -           | -               | -               | -               | -               |
| Yes                 | 2.00(0.75-5.38) | 2.24(0.87-5.72) | 1.80(0.52-6.23) | 4.50(1.82-11.17) | 0.001           |
| I don't know        | 1.95(1.01-3.75) | 2.30(1.25-4.22) | 2.26(1.04-4.92) | 1.19(0.64-2.19) | 0.57            |
| **Current family mental disorder or illnesses** |             |                 |                 |                 |                 |
| No                  | -           | -               | -               | -               | -               |
| Yes                 | 0.88(0.52-1.49) | 1.25(0.78-1.98) | 0.86(0.46-1.62) | 1.30(0.77-2.18) | 0.32            |
| I don't know        | 2.31(1.07-4.98) | 4.04(2.08-7.84) | 4.21(1.95-9.30) | 3.20(1.48-6.88) | 0.003           |
| **Behavioural and Environmental factors during the pandemic** |             |                 |                 |                 |                 |
| **Pandemic financial impact on budget** |             |                 |                 |                 |                 |
| No                  | -           | -               | -               | -               | -               |
| Yes                 | 2.02(1.26-3.25) | 0.78(0.54-1.13) | 1.24(0.75-2.06) | 1.02(0.64-1.63) | 0.91            |
| **Describe your mood during the pandemic?** |             |                 |                 |                 |                 |
| Negative            | 2.05(1.23-3.45) | 1.58(1.01-2.46) | 1.93(1.06-3.50) | 2.30(1.34-4.02) | 0.003           |
| No change           | 1.56(0.89-2.73) | 1.01(0.62-1.66) | 0.97(0.48-1.96) | 0.83(0.41-1.67) | 0.61            |
| Positive            | -           | -               | -               | -               | -               |
| **Conflicts within your family during pandemic** |             |                 |                 |                 |                 |
| No                  | -           | -               | -               | -               | -               |
| Yes                 | 1.46(0.98-2.18) | 1.53(1.05-2.19) | 1.25(0.78-1.99) | 2.14(1.38-3.307) | 0.001           |
Discussion

This study aimed to measure the burden of depression among the population in Pakistan during the COVID-19 outbreak. The results suggested that 59% of the population had depressive symptoms which were comparable to previous studies that reported a similar rate during the pandemic ranging from 7.5% to 48.3%. [26]

The proportion of extremely severe depression found in the study was also considerably high compared to the pre-covid global rates of 2-6%. [27] Such a drastic increase in prevalence could be explained by various sociodemographic, health, and behavioral related factors. [28]–[31]

A strong association was found between internet use and depression. Consistent with previous literature, internet addicts in the present study were more likely to be extremely depressed than normal users. As per historical data, there is often a vicious cycle of depression leading to increased use of the internet which further precipitates depression. It is well known that a lot of people use the internet as a coping strategy to release the daily stressors and lessen their internalizing behaviors. Excessive internet use stimulates autonomy, boosts self-esteem, and induces a sense of belongingness among the users which reduces their interest in the real world and leads to an increased likelihood of staying online. This intensified level of psychological arousal from internet addiction further results in numerous physical and mental health problems including insomnia reduced physical activity, loss of appetite, low social life, heightened aggression, anxiety, and depressive symptoms. [32], [33] Besides, due to the imposition of strict lockdown during the pandemic, the internet was also the primary source for health-related updates and entertainment. Which may have doubled the frequency of use leading to aggravated rates of depression. [29]

Another significant factor was the age of the participant. Teenagers had higher odds of depression than adults. Comparable to other studies, teenagers are far more sensitive to their environments as they are going through a transitional phase of life. The possible justification of higher odds of depression among them could be the exposure to dramatic lifestyle changes during the pandemic like a shift to virtual classrooms, limited social interaction, and restricted group activities. [34]

The results also highlighted higher susceptibility to extreme depression among females. This could be explained by the different hormonal and neurobiological changes among women that might raise the risk of mental health issues. Other than that, a variety of cultural and life stressors which are more common among females like inequality, stereotyping, work overload, emotional or physical abuse could have also played a role in this increased vulnerability. [35]–[37]

Similarly, the presence of comorbidity had a major impact on an individual’s level of depression. People with a history of medical conditions like psychiatric or chronic illness are more vulnerable as their pre-existing conditions deteriorate under such tense circumstances. [38] Likewise, worse outcomes and progression of COVID-19 among people with underlying chronic conditions could have led to increased fear, stress, and depressive symptoms. [38] It was anticipated that people with ongoing conflicts within their families also had higher depression rates than those with no family conflicts. Relative to other studies, unresolved family
conflicts could lead to disputes and bitterness impacting each member of the family. Disturbed family relations could potentially affect the work-life, academic performance, and psychological well-being of all family members. [39]

The study sheds light on the role of Internet addiction and other predictors on the development of depression among the Pakistani population especially, during the pandemic. However, there are several limitations of the study that could have impacted the interpretation of results. Firstly, the sample was not representative of the entire population as it was carried out online. Also, it was impossible to reduce selection and information bias due to the online nature of the study. Secondly, the lack of random sampling could have led to questionable study power and statistical significance. Lastly, the causality of the associations could not be studied due to the design of the study.

**Conclusion**

During the pandemic, the prevalence of depression and other psychological issues has increased among Pakistan's population. This study has found that depression during the pandemic is substantially associated with internet addiction. The findings of this study may serve as the first step in early detection and prevention of internet addiction, so avoiding or reducing the severity of any serious mental health problems.

**Declarations**

**Ethics approval and consent to participate:** Ethical approval was taken from The Aga Khan University Ethical Review Committee (2020-5750-14980). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional committee. Before data collection (access to electronic form), all participants were asked to electronically sign a form of consent to be included in this study.

**Consent for publication:** All authors consented to the publication of this paper. All authors have read and approved the final manuscript. This manuscript has not been published and is not under consideration for publication elsewhere.

**Availability of data and materials:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to information that could compromise the privacy of research participants.

**Competing interests:** The authors declare that they have no competing interests. The authors report no conflict of interest.

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**Authors' contributions:** Conception or design of the work: MPL; Proposal development: MPL, ANH, MA, MTN, MMHK; Proposal review: GP, AA, SIA; Data collection: MPL, ANH, MA, MTN, MMHK, GP; Data Cleaning: MPL, ANH, MA, MTN, MMHK, AA; Data Coding: MPL, ANH, MA, MTN, MMHK, SIA; Data analysis and interpretation:
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**Abbreviations**

| Abbreviation | Description                  |
|--------------|------------------------------|
| AIU          | Addicted internet users      |
| CI           | Confidence interval          |
| DASS-21      | Depression, Anxiety, and Stress Scale-21 |
| IA           | Internet addiction          |
| IAT          | Internet Addiction Test      |
| NIU          | Normal internet users        |
| OR           | Odds ratio                   |
| PIU          | Problematic internet users   |

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