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# The impact of gender and ethnic background on physical and mental health in a post-pandemic student cohort in the UK

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## Abstract

**Introduction:** The COVID-19 pandemic has had a profoundly negative impact on the population's mental health, which was most severe on young people, particularly those students studying at University. This study examines the effects of gender, age, ethnic background, physical exercise, and smartphone use on the psychological well-being of UK students in a post-pandemic setting.

**Methods:** A cross-sectional study design was utilized. The study was conducted online, with participants studying at a Higher Education Institution within the UK. The current study sampled seven hundred and ninety-eight undergraduate students. Data was gathered through a series of anonymous questionnaires administered online.

**Results:** We found that gender significantly impacted mental health, levels of physical exercise, and mobile phone use. Further analysis demonstrated that age, amount of exercise, and mobile phone use were significant predictors of depression, and mobile phone use was a significant predictor of anxiety.

**Discussion and Conclusion:** Overall, we found far higher-than-expected mental health problems within the student cohort. These findings are discussed concerning potential interventions.

**Take-home message:** A high proportion of university students post-COVID-19 are above thresholds for clinical depression and anxiety. Age, physical exercise, and mobile phone use are significant predictors of depression.

**Keywords:** Anxiety; depression; exercise; gender; mental health; mobile phone use.

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## INTRODUCTION

The Coronavirus disease 2019 (COVID-19) pandemic has profoundly impacted the world's population. Furthermore, the consequent 'lockdowns' and social restrictions have negatively impacted society's physical and mental health. In the UK, the first nationwide lockdown was imposed on March 23rd 2020, which closed all educational institutions, including all schools and universities.

Children and adults alike were restricted to their homes, and interactions were limited to the online. Restrictions were partially relaxed later in the summer of that year, but a second partial lockdown was enacted on 2nd Dec 2020 and a 3rd full lockdown on the 6th of January, which returned the UK to the strict restrictions of the 1st lockdown.

However, behind these closures and re-openings is a story of upheaval for many young people, particularly for University students. Even with the partial lifting of restrictions at the beginning of the 20/21 academic year, the majority of students were taught mainly online and had none of the usual social interactions associated with University life. We are only now starting to understand how the COVID-19 pandemic and ensuing restrictions have impacted mental health in the medium term, particularly in our young people in Higher Education (H.E.).

Marshall et al. [1] calculated an approximate 8% worsening in the general mental health of the UK population due to the COVID-19 pandemic. They also found that the pandemic disproportionately impacted young adults and women. In an online survey of 2,000 participants, Rahman et al. [2] found that it was specifically the social isolation of the COVID-19 pandemic that created feelings of anxiety and depression. Furthermore, in a large meta-analysis of over 9000 individuals, Salari et al. [3] found that the prevalence rates for depression, anxiety, and stress during the pandemic were around 30%. Focussing specifically on the Higher Education population, Kaparounaki et al. [4], in a survey of 1000 Greek University students' mental health, found that there was a dramatic increase in scores for anxiety (42.5%) and depression (74.3%). Furthermore, Evans et al. [5] found, in a UK student population, that longitudinal analyses showed a significant rise in depression symptoms and a reduction in well-being. Over a third of their sample could be classed as clinically depressed at lockdown compared to 15% at baseline.

We know that there is a range of other factors that can affect mental health. For example, there is a plethora of research that demonstrates that one's gender can have a significant impact on one's likelihood of suffering from mental health issues. For example, Kessler et al. [6] found gender differences in various mental health problems. In particular, they found that women exceeded men in manifesting symptoms of both anxiety and depression. This included both milder and more severe forms of depression, as well as most types of anxiety, including generalized anxiety disorder and phobias. Greater depression meant that more women than men often lived with profound sadness and loss, serious problems with negative self-concept, and feelings of guilt, self-reproach, and self-blame.

Furthermore, greater anxiety meant that the women in their study suffered more often from phobias, panic attacks, and anxiety states [7]. Rimes et al. [8] also showed that participants who had been female at birth were significantly more likely than those male at birth to report a wide range of mental health problems that often were severe enough to interfere with daily activities. It is also important to note that analyses based on data from the 2015 US Transgender Survey found that 49% of non-binary adults reported severe psychological distress in the past month, compared to 35% of binary-identified transgender men and women and 5% of the overall US population [9].

A large-scale study of transgender adolescents and young adults ages 14 to 25 in Canada showed a similar trend. It concluded that non-binary participants consistently reported worse mental health outcomes than their binary-identified counterparts [10]. More broadly, Proto et al. [11] used the UK Household Longitudinal Study to compare pre-COVID-19 pandemic (2017-2019) and during-COVID-19 pandemic data (April 2020) for the same group of individuals to assess and quantify changes in mental health. They found that the average increase in mental distress varied by gender and, importantly also, ethnicity. Both women (regardless of their ethnicity) and Black, Asian, and minority ethnic (BAME) men experienced a higher average increase in mental distress compared to White British men, so the gender gap in mental health increased only among White British individuals. Bringing these two variables of race and gender together - Fox et al. [12] found that sexual minority and gender minority participants reported higher depressive symptoms, Asian participants were less likely to report self-injury, and Latin American participants were more likely

to report suicide attempts. Furthermore, contrary to their expectation, multiple minority identification was not associated with greater mental health problems.

One of the behaviors that have been shown to impact on mental health is mobile phone use. In a recent study, Catling et al. [13] demonstrated that COVID-19 had had a significant impact on self-reported levels of depression, anxiety, and smartphone addiction – which all significantly increased from 2019 to the 2020 cohort. Smartphone addiction levels rose from 39% to 50%. The correlational analysis also showed a significant relationship between smartphone usage and depression and anxiety. Smartphone use has become an intrinsic part of young people's lives, and we know that for many young people, this use can become excessive and 'unhealthy,' and consequently may contribute to mental health problems. For example, Elhai et al. [14] found that problematic smartphone use among Chinese undergraduate students significantly increased depression and anxiety symptoms. These findings are supported by a large-scale meta-analysis of 41 studies by Sohn et al. [15], who found that strong evidence for problematic smartphone use is linked to an increased risk of depression and anxiety in young people.

Another behavior that has significant multiple effects on mental health is physical exercise. We know that regular physical activity promotes both mental and physical health. It is beneficial for people of all ages and abilities [16,17]. In a meta-analysis of 13 previous studies, Josefsson et al. [18] found a significantly large overall beneficial effect of exercise on mental health. The effect size was reduced to a moderate level when only studies with high methodological quality were included in the analysis. Josefsson et al. suggest that exercise should be recommended for people with mild and moderate depression. Silveira et al. [19], in another meta-analysis review of 10 previous studies, found that physical exercise improved the response to treatment of depression, especially taking part in aerobic training. They also found that exercise's efficacy in treating depression was influenced by both age and the severity of symptoms. More recently, Dauwan et al. [20] performed a large-scale meta-analysis of 122 studies and found exercise significantly improved participants' quality of life, depressive symptoms, and cognitive functions. Furthermore, their meta-regression analysis showed a dose–response effect for exercise time (min/week) on depressive symptoms. They conclude that exercise is an 'efficacious and safe add-on therapeutic intervention' that can significantly impact both quality of life and mental health.

In a review paper, Ai et al. [21] explored the relationship between physical exercise and mental health during the COVID-19 pandemic. While acknowledging the significant positive impact of exercise during the pandemic, they also specifically suggest a range of explanations for the efficacy of exercise on mental health. They suggest that physical exercises during the COVID-19 pandemic were conducive to enhancing happiness and improving mental health. Physical exercise actively reduced people's anxiety, sadness, and depression during the COVID-19 pandemic. Notably, the maintenance and improvement of mental health are related to the intensity and frequency of physical exercise. Again this suggests a dose-response effect for the relationship between exercise and mental health.

Finally, it is important to note that University students often experience a range of added risk factors, such as academic, financial, and social pressures [22]. These added pressures have been shown to lead to increased mental health problems, including depression and anxiety [23]. Wyatt and Oswald [24] focused on the impacts of stress on mental health issues among university students compared to graduates. They found that undergraduates reported significantly higher rates of poor mental health, which negatively impacted their academic performance. In particular, they found that the transition to university life could significantly affect students' mental health.

Within the current study, we undertook an online survey of Undergraduate students that gathered data on both their identified gender and ethnic background and assessed a range of aspects linked to their Physical and Mental Health in order to get a snapshot of the general health and health behaviors in a large-scale post-pandemic University student sample. It should be noted that all remaining legally enforced COVID-19-related restrictions concluded in Northern Ireland and England during February 2022.

## **METHODS**

### ***Study design and participants***

The study was of a cross-sectional design. The target population was undergraduate students within a UK University. Seven hundred ninety-eight undergraduate students aged 17-66 (mean age 22) completed an online survey between March and May 2022. An opportunity sampling method was utilized where the survey was advertised online within the University and was open to all students. Participants could opt-in to a competition to win a £100 voucher. Participants' gender was 65.6% Female, 32.5 Male, 1.9% non-binary. The total undergraduate population was 25,150. Hence a sample of 798 or (3.2%) gave a 95% chance that any real values are within  $\pm 3.41\%$  of the measured values.

### ***Study instruments***

A demographic questionnaire for age, gender, and ethnic background was utilized. *Patient Health Questionnaire* (PHQ-9) [25] was used as a self-report measure of depression severity. The questionnaire focuses on diagnostic criteria for depression (DSM-IV), assessing severity via nine questions on a scale from experiencing a problem 'not at all' (0) to 'nearly every day' (3) over the last two weeks. Higher scores represent higher depression severity. The highest possible score is 27. Internal consistency was reviewed with a Cronbach's  $\alpha$  coefficient of 0.86, with good test-retest reliability. Beard et al. [26] identified good convergent and discriminant validity in a psychiatric sample. Manea et al. [27] identified an optimal cut-off score of 10 when diagnosing (moderate to severe) depression with the PHQ-9 with 88% sensitivity and 88% specificity.

*Generalised Anxiety Disorder-7* (GAD-7) [28] was used as a self-report measure of anxiety. Seven symptoms of anxiety based on diagnostic criteria (DSM-IV) are measured, from the problem bothering an individual 'not at all' (0) to 'nearly every day' (3) over the last two weeks. Higher scores represent higher anxiety severity. The highest possible score is 21. Cronbach's  $\alpha$  coefficient for internal consistency was measured at 0.92, and test-retest reliability correlated at 0.83, and good criterion and procedural validity was shown. Spitzer et al. [28] identified a cut-off score of 10 when diagnosing (moderate to severe) anxiety with the GAD-7 with 89% sensitivity and 82% specificity.

*Smartphone Addiction Scale Short-Version* (SAS-SV) [29] was used as a self-report measure of SA. The questionnaire contains ten statements measured on a scale from 1 to 6 (strongly disagree to strongly agree), with a highly reliable Cronbach's  $\alpha$  coefficient of 0.91. Higher scores represent higher SA. The highest possible score is 60. Kwon et al. [29] suggested a general cut-off value of 33 to signify clinical addiction.

In addition, participants were asked: How much time, on average, do you usually spend doing moderate or vigorous exercise each day? Answer in minutes.

### ***Data analysis***

For the statistical analysis of the data, first, a series of MANOVA were undertaken with Mental and Physical health measures as dependent variables and 1) gender and 2) ethnicity as the Independent variables. Second a series of multiple regression analyses were undertaken to assess the impact of exercise, mobile phone use, and age on levels of depression and anxiety. Data was analyzed through SPSS software (Version 24). P-value < 0.05 was considered significant.

### ***Ethical aspects***

The study was conducted in accordance with the Declaration of Helsinki and approved by the University of Birmingham STEM ethics committee (code: ERN\_20-1093B). Participants needed to sign a consent form before proceeding with the questionnaires. Participants were informed that all data would be kept confidential and their identity would be kept anonymous. We acknowledge that some questions on the mental health measure appear sensitive thus, it was made clear to participants they were not obligated to answer questions they did not feel comfortable answering. Accessible support services were outlined at the end of the debrief. The right to withdraw was available for 48 hours post completing the questionnaire.

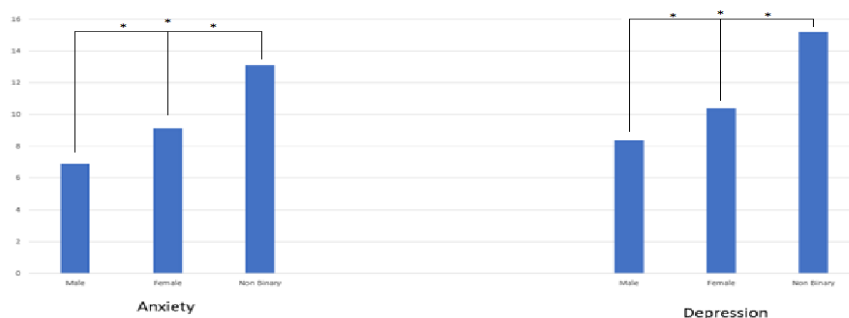
## **RESULTS**

### ***Effect of gender on mental and physical health***

For the statistical analysis of the data, a MANOVA was undertaken with Mental and Physical health measures as dependent variables and gender as the Independent variable. Overall, the MANOVA was significant  $F(4,8) = 5.76, p < 0.001$ . Individually there was a significant difference in levels of anxiety  $F(2,760) = 17.45, p < 0.001$ , depression  $F(2,760) = 13.17, p < 0.001$ , mobile phone use  $F(2,760) = 3.661, p < 0.05$ , and physical exercise  $(2,760) = 4.822, p < 0.01$

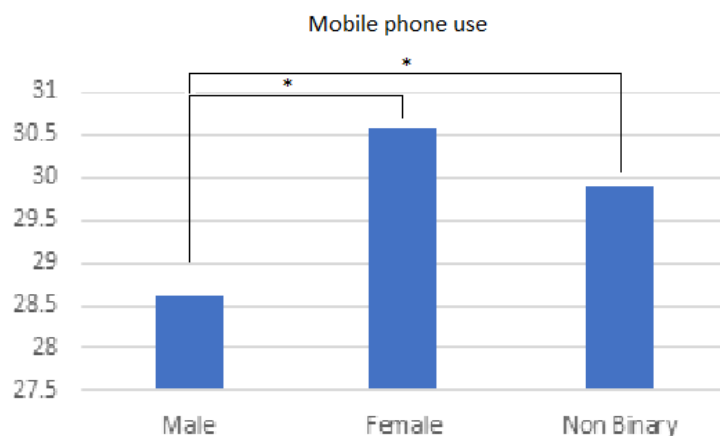
Post Hoc Tukey tests showed that for anxiety there were significant differences between all 3 levels ( $p < 0.05$ ), and the same pattern was evident for depression ( $p < 0.05$ ; see Figure 1), for mobile phone use, there was only a significant difference between male and (female and non-binary) students ( $p < 0.05$ ; see Figure 2), and for exercise there was only a significant difference between male and female students ( $p < 0.01$ ; see Figure 3).

**Figure 1.** Rated levels of anxiety and depression by gender.



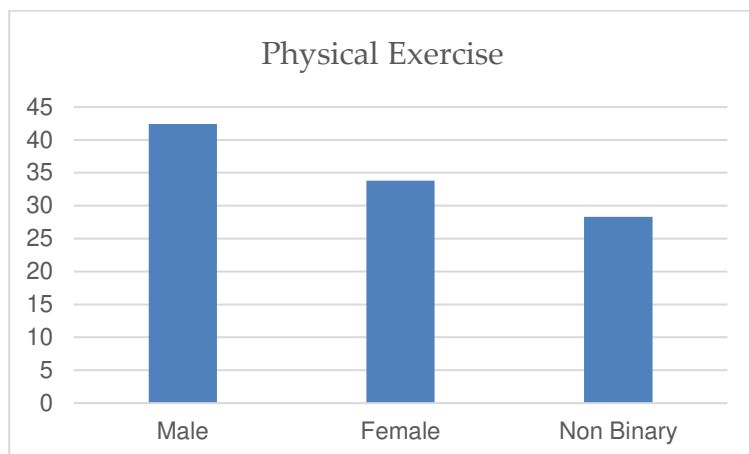
Note: \*  $p < 0.05$

**Figure 2.** Rated levels of mobile phone use by gender.



Note: \*  $p < 0.05$

**Figure 3.** Rated levels of Physical Exercise by gender.



**Effect of ethnicity on mental and physical health**

A second MANOVA was undertaken with Mental and Physical health measures as dependent variables and ethnic background as the Independent variable. There was no significant difference in any outcome measures by ethnic background ( $p > 0.05$ ).

**Regression predictors of depression and anxiety**

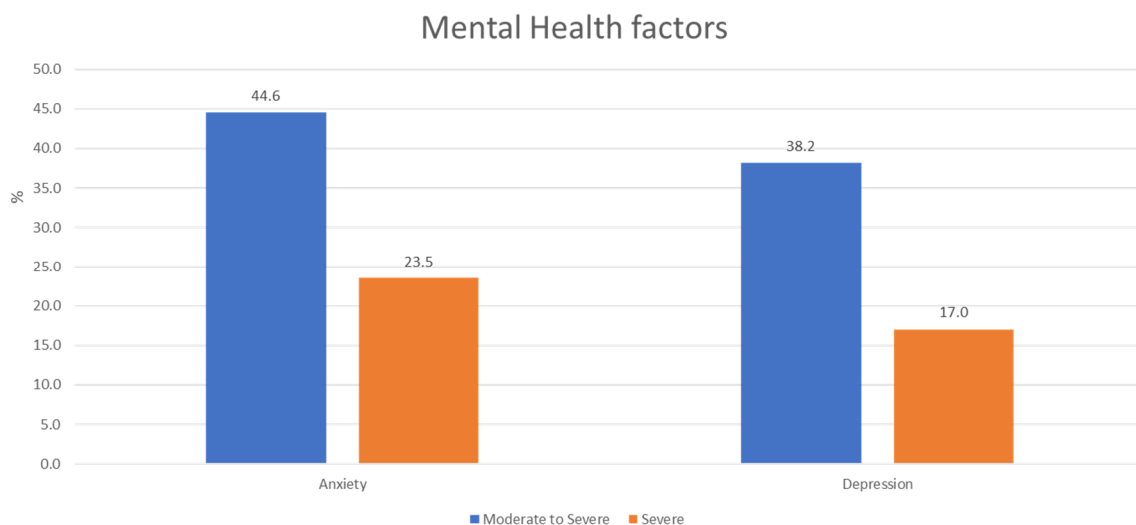
A multiple regression was undertaken to assess the impact of exercise, mobile phone use, and age on levels of depression. The regression model was statistically significant  $F(3,766) = 9.27$ , adjusted  $r^2 = 0.067$ . The significant predictors were age ( $p = 0.015$ ), amount of exercise ( $p = 0.01$ ), and mobile phone use ( $p < 0.001$ ). As age increased, levels of depression decreased. As the amount of exercise increased, levels of depression decreased, and as mobile phone use increased, levels of depression increased.

A second multiple regression was undertaken to assess the impact of exercise, mobile phone use, and age on anxiety levels. The regression model was statistically significant  $F(3,766) = 9.75$ , adjusted  $r^2 = 0.045$ . Only mobile phone use significantly predicted anxiety ( $p < 0.001$ ). As mobile phone use increased, so did levels of anxiety.

**Clinical levels of depression and anxiety in the sample**

Further assessment of the data at the clinical level showed a high proportion of students reaching clinical levels of depression and anxiety (see Figure 4).

**Figure 4.** Student clinical levels of anxiety and depression.



## DISCUSSION

The current study demonstrated significant gender differences in levels of both depression and anxiety, physical activity, and mobile phone use in a university sample post the COVID-19 pandemic. Significant predictors of depression were age, physical exercise, and mobile phone use. Only mobile phone use was a significant predictor of anxiety. Finally, we found surprisingly high proportions of students that reached thresholds for clinical depression and anxiety.

Our findings of greater mental health issues in female and non-binary students are broadly in line with previous research, such as that by Kessler et al. [30] and James et al. [9], respectively. Focussing on female preponderance to mental health issues, Parker and Brotchie [31], in a review of gender differences in mental health, posit an explanation for higher rates of depression in the female population. They suggest that one possible explanation is linked to biological factors (for example, 'limbic system hyperactivity') that cause the imbalance in the prevalence of depression and anxiety across the genders. This is a manifestation of the impact of gonadal steroid changes at puberty.

Nolen-Hoeksema and Hilt [32] agree that the emergence of gender differences in depression comes in adolescence but suggest that this is because this is when significant changes in the frequency of traumatic events and social roles coincide. Furthermore, they state that even when women and men are confronted with similar stressors, women may be more vulnerable than men to developing depression and related anxiety disorders. In addition, the reality is that, in most cases, women tend to suffer certain stressors more often than men. Hence, this combination of factors may make women more vulnerable to developing depression in response to stress. Both the direct experience of stress and reactivity to stress contribute directly to women's greater rates of depression compared with men [32].

Our results show disproportionate depression and anxiety symptoms reported by non-binary participants. Lipson et al. [33] found, across a range of mental health measures, that there was a significantly higher prevalence of symptoms observed in those identified as gender minority students than in cisgender students. Specifically, 45% of cisgender students, compared with 78% of gender minority students, met the criteria for one or more mental health problems. Gender minority status was associated with 4.3 times higher odds of having at least one mental health problem. Based on their findings, the researchers suggest an urgent need to identify any relevant protective factors and reduce the observed mental health inequities for this vulnerable population [33].

In a large-scale survey of city residents of Chicago in the wake of the initial COVID-19 lockdown, Ruprecht et al. [34] compared COVID-19-related outcomes and impacts by gender, sexuality, and race. They found that marginalized populations experienced significant disparities with the impact of COVID-19 on their lives. Notably, Black and Latino respondents reported significantly lower levels of access to medical services and, specifically, in accessing mental health services. Sexual minority respondents reported substantially lower rates of accessing mental health services, and gender minority respondents reported significantly lower primary care provider access levels. They found significant disparities due to COVID-19 experiences, especially for Black, Latino, sexual minority, and gender minority groups. Ruprecht et al. [34] suggest that a greater focus must be paid to health equity, including providing increased resources for affected groups and ensuring adequate access to healthcare services (especially mental health care) to ameliorate the burden of COVID-19 on marginalized populations.

With respect to the significant predictors of mental health problems, as seen above, there is an abundance of literature that supports a positive relationship between physical exercise and mental health [e.g., 19-21]; therefore, it is no surprise to see in the current study that levels of physical exercise were a significant predictor of mental health measures. Again, the linear relationship between physical exercise and mental health suggests a dose-response effect, with more exercise being beneficial, specifically on the severity and impact on quality of life of depression and associated symptoms.

The current study found that smartphone use was also a significant predictor of mental health, with greater use being related to greater levels of depression and anxiety. This aligns with previous



research such as that by Catling [13], who specifically showed a significant positive relationship between smartphone usage and depression within a UK student cohort. One attempt at explaining this problematic smartphone use is through the 'excessive reassurance pathway' [35], which states that smartphone use becomes problematic when individuals persist in seeking reassurance from others. If an individual lacks emotional stability in 'real' life, this may cause them to seek assurance and support through online relationships. In time this can lead to a form of dependency on these online relationships who become 'dependent users,' and these individuals are more susceptible to depression and anxiety. Finally, qualitative research has suggested that problematic smartphone use can be linked to the excessive reassurance pathway, where students specifically experienced fear of missing out (FOMO) when they were not using their devices [36].

The age of the participant was found to be a significant predictor of levels of depression within the current study, with older participants experiencing lower levels of depression. The picture of this issue within the literature is mixed. Sümer et al. [37], in a study of depression and anxiety within an international student cohort, found that age contributed uniquely to the variance in anxiety. Older students were more likely to report higher levels of anxiety. Whereas, Mirowsky and Loss [38], in a large-scale survey of US adults, showed a steady fall of depression from early adulthood to about age 45, and suggest that this reflects life-cycle gains, changes in employment, and economic well-being. Also, in a cross-sectional study of adults aged 18-87, Lawton, Kleban, and Dean [39] found a significant negative relationship between age and depressive symptoms. It has also been widely suggested that the relationship between age and depression is U-shaped. In an analysis of data from two large national surveys, Kessler and colleagues [30] reported that depressive symptoms decline from young adulthood to midlife and then begin to rise again with increasing age [cited from Street; 40]. Our data seems to fit in with this concept of a U-shape to depression by age. The majority of our sample was in the 18-25 age range, where, according to this model, a reduction (with an increase in age) in depressive symptoms would be expected.

The observed high levels of anxiety and depression reported within the current study, although concerning, are not dissimilar to previous surveys of young people – for example, an ONS [41] report based on Census data stated that there was evidence of increasing anxiety and depression among young women aged 16 to 24 years in the UK, with nearly one-third (31%) reporting some evidence of depression or anxiety in 2017 to 2018. It needs to be remembered that this level of 31% was recorded before the pandemic, and hence, it is an uncomfortable but not unexpected truth that the prevalence of mental health issues among young people is very high.

### ***Study limitations***

Limitations of the current study are primarily based on the sample. The cohort was drawn from a single HE Institute within the Russell Group of universities and could be biased. Furthermore, the sample was heavily skewed towards female students, which could impact, in particular, the levels of mental health problems reported. Finally, although we did have a wide range of ethnic backgrounds within our sample, these are still from a single sample from a single HE Institute and do not directly map onto the ethnic diversity of the UK population.

Regarding applications of the findings from the current study, we strongly suggest that strong and proactive support is embedded within HE institutes with pastoral support structures. These should focus on increasing student resilience [42] by concentrating on 'positive' mental health behaviors such as exercise (and the associated positive social, physiological, and psychological benefits) and reducing 'negative' mental health behaviors such as excessive mobile phone use. These interventions can be targeted at the transition phase of starting University, where new students are both younger and most at risk of developing mental health problems or already present mental health problems that may be exacerbated. The current research emphasizes the vulnerability of our current cohort of students and is also a call to action.

### **CONCLUSION**

The current paper demonstrates that the gender of a student has a significant impact on their levels of mental health, the amount of physical exercise they undertake, and their mobile phone use.

Interestingly, ethnic background did not significantly affect these outcome measures. We also demonstrate that age, amount of exercise, and mobile phone use were significant predictors of depression, and mobile phone use was a significant predictor of anxiety. Our results highlight the potential vulnerability of the current cohort of young people coming into Higher Education and, therefore, also act as a cautionary notice to Higher Education providers that targeted intervention should be embedded within pastoral support programs.

**Author Contributions:** Conceptualization: JC. Methodology: JC, ES. Formal analysis: ES. Investigation: JC, ES. Resources: JC Data curation: ES. Writing-original draft preparation: JC. Writing: LA Review & Editing: ES. Supervision: ES

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**Conflicts of Interest:** None.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

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