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A nexus of student food (in)security, common mental disorders, and academic success in the midst of the covid-19 pandemic

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A NEXUS OF STUDENT FOOD (IN)SECURITY, COMMON MENTAL DISORDERS, AND ACADEMIC SUCCESS IN THE MIDST OF THE COVID-19 PANDEMIC

By
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Submitted to the School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, in fulfilment of the requirements for the degree of

Doctor of Philosophy
Johannesburg, South Africa

2024

Dedicated to

All South African university students who have experienced food insecurity and mental distress. Thank you for allowing me to tell your story.

Declaration

I, Fezile Wagner, declare that this thesis is my original work. Contributions made by other people to this body of work have been duly acknowledged. It is being submitted for the degree of Doctor of Philosophy in Public Health in the University of the Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination at this or any other university.

Name: Fezile Wagner

Signature:  Date: 29 October 2024

Table of Contents

Abstract ..... *i*

Original Manuscripts ..... *iii*

Conference Presentations ..... *v*

Introduction *1*

Aims and objectives *3*

PhD hypothesis **4**

Structure of doctoral thesis **4**

Chapter 1: Background *6*

1.1 Challenge of low student throughput and dropout **6**

1.2 Measuring academic success **7**

1.2.1 Student throughput 8

1.2.2 Graduation rates 8

1.2.3 Student progression 9

1.2.4 Dropout 9

1.3 Predictors of student success **10**

1.4 Contextualising wellbeing **11**

1.4.1 Cognitive wellbeing 11

1.4.2 Social wellbeing 12

1.4.3 Physical wellbeing 12

1.4.4 Psychological wellbeing 12

1.5 Food insecurity and hunger among university student populations: Literature prior to COVID-19 ..... **13**

1.6 Anxiety and depression among university student populations: Literature prior to COVID-19 ..... **15**

1.7 Food insecurity and common mental disorder pathways to poor academic outcomes **16**

1.8 Empirical evidence linking food insecurity and common mental disorders to poor academic outcomes prior to COVID-19 ..... **16**

1.9 COVID-19 and lockdown in South Africa **18**

1.9.1 Consequences of lockdown on South Africa's universities 18

1.9.2 Connectivity and access to enable Emergency Remote Teaching and Learning (ERTL) 19

1.9.3 Pedagogical redesign 19

1.9.4 Psychosocial impact 20

1.9.5 Impact on physical wellbeing 20

1.10 The rationale **21**

Chapter 2: Research Context *22*

2.1 Student Success and Student Support at Wits University **23**

2.2 Study population **24**
2.3 The parent study and role of the doctoral student **26**
Chapter 3: Methods ***28***
3.1 Research design **28**
3.2 Quantitative methodology **30**
3.2.1 Study sample 30
3.2.2 Sampling and data collection procedure 31
3.2.3 Analysis 31
3.2.4 Measures 32
3.3 Qualitative methods **38**
3.3.1 Study sample 38
3.3.2 Data collection procedure 38
3.3.3 Analysis 39
3.4 Ethical considerations **39**
3.4.1 Distress protocol 39
Chapter 4: Results ***41***
4.1 Objective 1: The prevalence and determinants of anxiety, depression and mental distress symptomology, and food insecurity prior to COVID-19 and their influence on academic performance **41**
4.1.1 Description of the sample 41
4.1.2 Description of the sample by student failure 41
4.1.3 Description of the sample by student dropout 41
4.1.4 Prevalence of wellbeing variables- before the COVID-19 pandemic 45
4.1.5 Description of severe food insecurity and hunger 46
4.1.6 Description of severe mental distress symptoms 47
4.1.7 Regression models 49
4.2 Objective 2: Impact of the COVID-19 pandemic on South African universities **55**
4.2.1 Challenges with technology 56
4.2.2 Pedagogical drawbacks and advantages 56
4.2.3 Multidimensional impact on wellbeing 58
4.3 Objective 3: Food insecurity, anxiety, and depression symptomology prevalence during the COVID-19 pandemic **61**
4.3.1 Description of the sample 61
4.3.2 Description of the sample by student failure 61
4.3.3 Description of the sample by student dropout 61
4.3.4 Student failure pre and during the COVID-19 pandemic 66
4.3.5 Prevalence of wellbeing variables- during the COVID-19 pandemic 66
4.3.6 Description of severe food insecurity and hunger and mental distress 67
4.3.7 Regression models 73
4.3.8 Comparisons of the prevalence of food insecurity and common mental disorders before and after COVID-19 77
4.4 Objective 4: Individual and combined effect of food insecurity, anxiety, and depression on students' academic outcomes during the COVID-19 pandemic **78**
4.4.1 Regression models 78
Chapter 5: Discussions and Conclusions ***80***

5.1 Academic success **80**
5.1.1 Failure levels before and during the COVID-19 pandemic 80
5.1.2 Qualitative insights on lower rates of academic failure 81
5.1.3 Determinants of failure before and during the COVID-19 pandemic 81
5.1.4 Dropout rates before and during the COVID-19 pandemic 82
5.1.5 Determinants of dropout before and during the COVID-19 pandemic 82
5.1.6 Concluding remarks 83

5.2 Food insecurity and hunger **85**
5.2.1 Food insecurity and hunger levels before and during the COVID-19 pandemic 85
5.2.2 Determinants of severe food insecurity and hunger before and during the COVID-19 pandemic 86
5.2.3 Concluding remarks 86

5.3 Common mental disorders (CMDs) **88**
5.3.1 CMDs before and during the COVID-19 pandemic 88
5.3.2 Determinants of severe CMDs during the COVID-19 pandemic 88
5.3.3 Qualitative insights on increasing rates of CMDs 89
5.3.4 Implications of CMDs on academic outcomes and food insecurity 89
5.3.5 Concluding remarks 90

Chapter 6: Strengths and limitations ***91***

Chapter 7: Research Implications ***92***

Acknowledgements ***94***

Funding ***95***

References ***96***

Appendices ***107***

Appendix A **107**
Validation analysis of the Household Food Insecurity Access Scale (HFIAS) 107
Methodology 107
Ethical clearance 109
Data analysis 109
Results 109

Appendix B **116**

Appendix C **116**

Figures

Figure 1. Conceptual Framework describing the relationship between food security status, common mental disorders (CMDs) and academic outcomes during the COVID-19 pandemic. 3
Figure 2: Overall schema of PhD objectives and manuscripts 4
Figure 3: York, Gibson & Rankin operationalised model for academic success (York et al., 2019) 8
Figure 4: Dimensions and sources of students' wellbeing (OECD, 2017) 13
Figure 5: Changes to the Wits student population between 1990 and 2019 (HEDA, 2023) ...22
Figure 6: Model for student-centred support at Wits University (Wits, 2019a) 24
Figure 7: Overall schema of data collection used to address objectives 28

Tables

Table 1: Distribution of first-year students by socio-demographic variables from 2016-2020 (Wits AIRU, 2020).....25
Table 2: Unadjusted description of the sample by student progression and retention- before the COVID-19 pandemic 43
Table 3: The crude and adjusted prevalence of wellbeing variables- before the COVID-19 pandemic 45
Table 4: Unadjusted description of the sample by severe food insecurity and hunger- before the COVID-19 pandemic 46
Table 5: Unadjusted description of the sample by severe common mental disorder symptoms- before the COVID-19 pandemic 48
Table 6: Adjusted logistic regression models of severe food insecurity and hunger before the COVID-19 pandemic 50
Table 7: Adjusted logistic regression of determinants of severe CMD symptoms before the COVID-19 pandemic 52
Table 8: Adjusted logistic regression model of the determinants of student dropout before the COVID-19 pandemic 53
Table 9: Adjusted logistic regression model of determinants of student failure before the COVID-19 pandemic 54
Table 10: Demographics of IDI and FGD participants 55
Table 11: Unadjusted description of the sample by student progression and retention- during the COVID-19 pandemic 62

Table 12: Unadjusted COVID-19 pandemic-related variables by student progression and retention 64
Table 13: Student failure before and during the COVID-19 pandemic 66
Table 14: The crude and adjusted prevalence of wellbeing variables- during the COVID-19 pandemic 66
Table 15: Unadjusted description of the sample by severe food insecurity and hunger- during the COVID-19 pandemic 67
Table 16: Unadjusted description of severe common mental disorder symptoms- during the COVID-19 pandemic 69
Table 17: Distribution of severe food insecurity and hunger by COVID-19 variables. 70
Table 18: Unadjusted distribution of severe common mental disorder symptoms by COVID-19 variables. 72
Table 19: Adjusted logistic regression of determinants of severe food insecurity and hunger during the COVID-19 pandemic....75
Table 20: Adjusted logistic regression of determinants of severe common mental disorder symptoms during the COVID-19 pandemic 76
Table 21: Re-tabulation of the adjusted prevalence of wellbeing variables before and during the COVID-19....77
Table 22: Adjusted multivariate logistic regression of determinants of student dropout during the COVID-19 pandemic 78
Table 23: Adjusted multivariate logistic regression model of determinants of student failure during the COVID-19 pandemic....79

Abstract

Background: South African Higher Education Institutions (HEIs), akin to their global counterparts, grapple with the challenge of low throughput and dropout rates, as students often extend beyond the minimum required duration to complete their academic programmes. Research has identified the first year of study as the period carrying the highest risk for student failure and attrition. Factors such as prior academic performance, family background, and the student's ability to integrate into various aspects of university life emerge as significant determinants of academic success. Notably absent from these determinants are considerations pertaining to student wellbeing, encompassing mental health and food security status. These aspects assumed heightened awareness during the coronavirus disease of 2019 (COVID-19) pandemic, which posed threats to social, economic physical, and psychological wellbeing. For university students, the pandemic necessitated a swift adoption of a new pedagogical approach - Emergency Remote Teaching and Learning (ERTL) – along with most students being forced to relocate home, while simultaneously facing the harsh realities of mass job loss, illness, and grief brought on by the pandemic.

Objective: This PhD aims to measure the impact of the COVID-19 pandemic on first time, first year university students' food insecurity and mental health status (specifically, the common mental disorders (CMDs): anxiety, depression and mental distress symptoms), as well as to understand the implications of this on academic success.

Methods: Taking place at a large, urban South African university, this research made use of a concurrent triangulation research design. Two cross-sectional surveys were administered in the years 2019 (before the pandemic) and 2020 (during the COVID-19 pandemic). Included in the surveys were validated tools used to measure depression (Patient Health Questionnaire 9-item (PHQ 9)), anxiety (Generalized Anxiety Disorder 7-item (GAD-7)), and mental distress symptoms. The Household Food Insecurity Access Scale (HFIAS) was also included in the two cross-sectional surveys to measure food insecurity levels. This tool was validated before being administered. Academic success was evaluated through two distinct approaches: i) the first method involved scrutinizing student failure rates and progress; ii) the second method focused on assessing retention and dropout rates. Qualitative data collection took place in 2020 and took the form of in-depth interviews (IDIs) and focus group discussions (FGDs).

Results: Due to the lockdown directive, students living at home during studies increased from 29% in 2019 to 88% in 2020. In terms of the student failure rate, a reduction was noted from 23.4% (95% CI: 20.7- 26.3) in 2019 to 14.6% (95% CI: 12.0- 17.7) in 2020. Teaching staff acknowledged that students seemed to have a better grasp of complex content during ERTL, and feedback from students themselves indicated the benefits of being able to access and replay lecture recordings as well as the flexibility introduced by ERTL. Increased dropout levels were found - increasing from 5.5% (95% CI 4.2- 7.2) in 2020 to 10.5% (95% CI 8.2- 13.2) in 2021. Moderate food insecurity status (OR= 2.50; 95% CI: 1.12- 5.55; p=0.025), and severe mental distress symptoms (OR= 7.08; 95% CI: 2.67- 18.81; p<0.001) increased the odds of student dropout. The adjusted prevalence of food security was found to be better during the later time point - 30.3% (95% CI: 27.4- 33.4) in 2019 before the COVID-19 pandemic, to 37.9% (95% CI: 34.1- 41.9) 2020 during the COVID-19 pandemic. While the prevalence of CMD symptoms worsened over time; the prevalence of severe anxiety symptoms increased from 17.5% (95% CI: 15.2- 20.1) in 2019 to 25.4% (95% CI: 22.0- 29.1) in 2020.

Conclusions: The study found an increase in student dropout and a decrease in failure rates during the pandemic, findings corroborated by other studies. Analyses suggest mental distress symptoms and food insecurity were important drivers of student dropout during the pandemic. Findings highlighted a clear decline of food insecurity when compared to figures before the pandemic. Literature highlighted how food and eating practices change when students are at home; this may have reduced food insecurity levels. A significant increase in the prevalence of CMD symptoms during the COVID-19 pandemic was observed and is believed to have been influenced by various intricate factors including grief, job loss and confinement. These findings provide important insights to HEIs in the event of future disruptions and as they embrace hybrid teaching and learning approaches post COVID-19. Although the reduction in failure rates may have been possibly due to changing the delivery of content (ERTL), HEIs must consider economic, social and mental health factors that may exclude certain groups of students when designing these approaches. It is crucial to explore ways to facilitate remote learning for students that address epistemological access challenges while maintaining inclusivity and connectedness as this is likely to contribute positively to academic success.

Original Manuscripts

I. **Wagner, F**., Kaneli, T. and Masango, M. 2021. Exploring the Relationship Between Food Insecurity with Hunger and Academic Progression at a Large South African University. South African Journal of Higher Education 35 (5), 296-309. (2021) https://doi.org/10.20853/35-5-4099

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript and responding to the reviewers' comments.

II. **Wagner, F**., Wagner, RG., Kolanisi, U., Makuapane, LP., Masango, M. and Gómez-Olivé, FX. The relationship between depression symptoms and academic performance among first-year undergraduate students at a South African university: a cross-sectional study. BMC Public Health 22 (2067), 1-9. (2022). https://doi.org/10.1186/s12889-022-14517-7

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript, responding to the reviewers' comments, and seeking partial funding for publication costs.

III. **Wagner, F**., Masango, M., Moch, S., Krull, G., Wagner, RG., Dison, L. and Grayson, D. Challenges of teaching and learning under lockdown at Wits University: implications for the future of blended learning. Progressio, 1-18 (2024). https://doi.org/10.25159/2663-5895/14226

Student's contribution to the manuscript: Research conceptualisation and design, Study project management including coordination of data collection and management (including cleaning and data analysis), writing of the manuscript, and responding to the reviewers' comments.

IV. **Wagner, F**., Kolanisi, U., Wagner, RG., Makuapane, LP., Masango, M. and Gómez-Olivé, FX. Impact of returning home on university student hunger during South African

Covid-19 lockdown. (Under review; Journal: Food Security. First outcome- Major revision. Manuscript revised and resubmitted)

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript and responding to the reviewers' comments.

V. **Wagner, F.**, Wagner, RG., Makuapane, LP., Masango, M., Kolanisi, U. and Gómez-Olivé, FX. Mental distress, food insecurity and university student dropout during the COVID-19 pandemic in 2020: Evidence from South Africa. Frontiers in Psychiatry 15 (1336538), 1-10. (2024). https://doi.org/10.3389/fpsyt.2024.1336538

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript and responding to the reviewers' comments.

Conference Presentations

Wagner, F., Kaneli, T. and Masango, M. 2020. Exploring the relationship between food security status, student progression and retention at a large South African University. An oral presentation at the 14th annual conference of the South African Association of Family Ecology and Consumer Science (SAAFECS), 3- 5 March 2020. Pretoria.

Wagner, F. and Masango, M. Understanding student wellbeing challenges before and during COVID-19. A virtual oral presentation at the 7th Siyaphumelela "we succeed" Annual Conference, 22-25 June 2021. Johannesburg.

Wagner, F., Makuapane, L., Wagner, RG., Muloiwa, T., Kaneli, T. and Masango, M. Learning and teaching online during the COVID-19 pandemic. A virtual oral presentation at the Wits University Conference on Teaching and Learning, 2-4 August 2021. University of the Witwatersrand, Johannesburg.

Accolades: Invited paper

Wagner, F., Makuapane, L., Wagner, RG., Muloiwa., T., Kaneli T. and Masango, M. Challenges and opportunities of teaching online: reflecting on ERT in 2020. An oral virtual presentation at the 28th Southern African Association for Institutional Research (SAAIR) Conference, 2-5 November 2021. University of the Free State, Bloemfontein.

Accolades: Runner up for best conference paper

Wagner, F. and Kolanisi, U. Understanding the impact of wellbeing dimensions on academic achievement among South African university students: a narrative review of the evidence. A virtual oral presentation the 5th Teaching and Learning Conference, 12-14 October 2021. University of Zululand, Dlangezwa.

Wagner, F., Makuapane, L., Wagner, RG., Muloiwa, T., Kaneli T. and Masango, M. Challenges and opportunities of teaching online: reflecting on Emergency Remote Teaching in 2020. An oral presentation at the Association for Institutional Research Forum, 6-9 June 2022. Phoenix Arizona, USA.

Accolades: Winner of 2022 USA Travel Award, presented at AIR Forum, USA

Wagner. F., Makuapane, L.(presenter), Wagner, RG., Muloiwa, T., Kaneli, T. and Masango, M. “Out with the Old, in with the new”. How the pandemic and 4IR influenced innovation in teaching approaches: Challenges and opportunities of new ways of teaching – reflecting on Wits University ERT in 2020. SAAIR Quality Forum 2022, 6-7 October 2022, Regent Business School, Durban.

Accolades: Invited paper

Introduction

South Africa currently has more than 1 million students in higher education as participation in tertiary education continues to increase after the official end of *Apartheid* in 1994 (DHET, 2021). However, South African (SA) Higher Education Institutions (HEIs), like institutions internationally, are faced with a low throughput and dropout challenge as students are taking more time than the minimum required duration to complete their programs (DHET, 2020). There is a substantial body of work that has explored factors and determinants of throughput and student academic success in general, both internationally and within South Africa (Kuh et al., 2006; van der Zanden et al., 2018). This research has identified factors such as previous academic achievement, family background, and the student's capacity to assimilate into various facets of university life to be important determinants of academic success (Bokana & Tewari, 2014; Kuh et al., 2006; Pillay & Ngcobo, 2010; Tinto, 1993; van Zyl et al., 2016). Absent in these determinants are factors to do with student wellbeing, including their mental health as well as their food security status.

Although student wellbeing was recognized as an important factor in student life prior to the onset of the Coronavirus pandemic beginning in 2019 (COVID-19), the mental and financial devastation brought about by the pandemic and lockdown forced into focus how poor student wellbeing negatively impacted on the higher education learning experience (Gittings et al., 2021; Nyar, 2021; van der Berg et al., 2022). The national state of disaster, a result of the pandemic, created widespread confusion and uncertainty due to the ceasing of all in-person activities, including educational instruction at SA universities (Nyar, 2021). The subsequent lockdown necessitated the inception of a novel approach to teaching and learning known as Emergency Remote Teaching and Learning (ERTL), a temporary measure providing online instruction and instructional support that previously took place in person (Charles Hodges et al., 2020). This novel, virtual learning approach, coupled with the turmoil of the pandemic, intensified emotional distress and despair, adversely affecting the wellbeing of students (Landa et al., 2021; Motala & Menon, 2020). Mental distress resulted due to feelings of despondency, isolation, anxiety, and grief, as well as precarious financial positions due to job loss, increasing the risk of food insecurity and hunger (Gittings et al., 2021; Laher et al., 2021; Landa et al., 2021; van-Schalkwyk, 2020); all this while contending with the electricity crisis, unstable internet connectivity and poor access to the necessary hardware for sustained and productive learning (Laher et al., 2021; Themane & Mabasa, 2022; Visser & Law-van Wyk, 2021).

Unlike other parts of the world, there is a limited understanding of the burden of food insecurity and common mental disorders (CMDs) among South African university students during the pandemic, as well as the consequent effects on their academic performance. In fact, our comprehension of the relationships between food insecurity and CMDs on academic outcomes were largely unknown even prior to COVID-19, with a paucity of South African literature investigating these associations. However, given the challenges experienced by students during the pandemic, it is plausible that the COVID-19 pandemic and lockdown may have worsened existing burdens and severity of food insecurity and CMDs among the university student population. Furthermore, these elevated levels of food insecurity and CMDs due to the pandemic were likely to impact negatively on the academic outcomes of students.

This doctoral thesis, guided by the conceptual framework (Figure 1) and informed by existing literature, seeks to fill this gap by analysing the complex interactions of these three variables: food insecurity status, CMDs and academic outcomes within the context of the COVID-19 pandemic. In the conceptual framework depicted in Figure 1, solid lines denote the established relationships between variables supported by existing literature. Dotted lines, informed by relevant literature, illustrate the assumed relationships affected by the complexities introduced by COVID-19, aligning with the hypotheses proposed in this research. This framework acknowledges that the impact of COVID-19 is likely both direct and indirect, with COVID-19 indirectly impacting on academic outcomes by amplifying food insecurity and CMDs. The new ERTL approach had direct implications on student academic outcomes. Furthermore, the 'food insecurity status' variable impacts on student academic outcomes both indirectly (when mediated by CMD status) and directly, while the relationship between the 'CMD status' variable and the 'academic outcomes' variable is described as bi-directional.

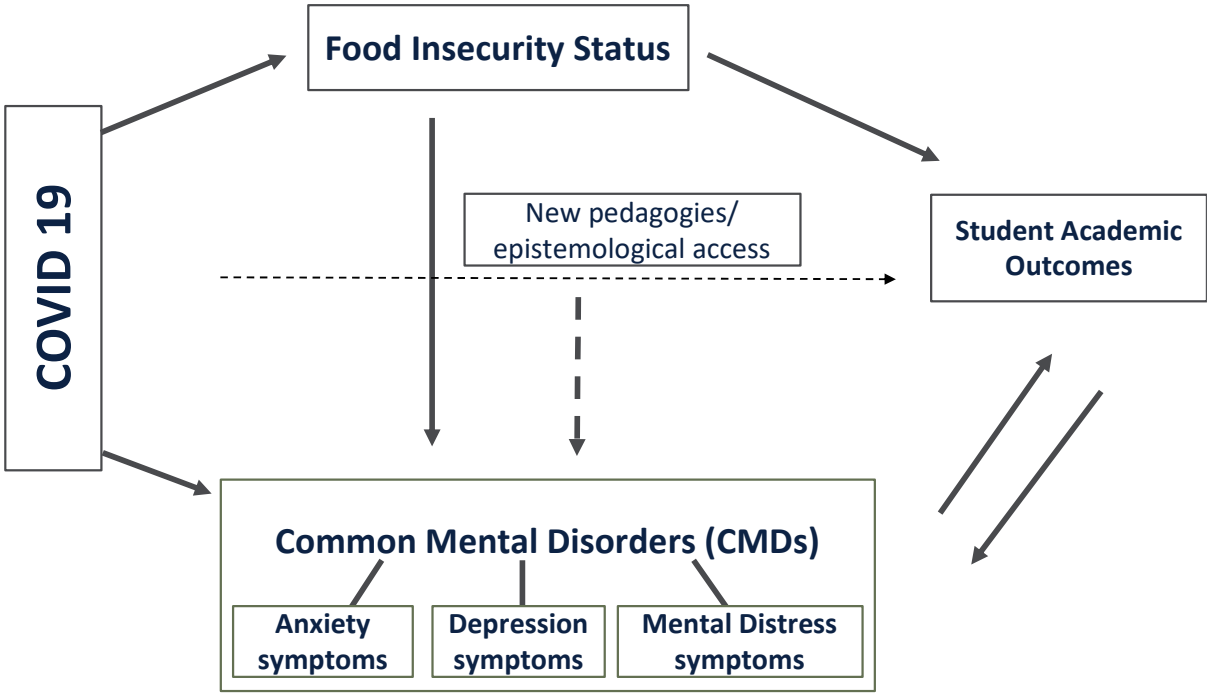


Figure 1. Conceptual Framework describing the relationship between food security status, common mental disorders (CMDs) and academic outcomes during the COVID-19 pandemic.

Aims and objectives

This PhD aims to measure the influence of the COVID-19 pandemic on first year university students' food security and mental health status (specifically, anxiety, depression and mental distress), as well as to understand the implications of this on academic success. This overall aim can be divided into four specific research questions:

1. What is the prevalence and what are the determinants of common mental disorders (anxiety, depression and mental distress) and food insecurity before the COVID-19 pandemic, and how do they relate to academic success?
2. What is the impact of the COVID-19 pandemic on teaching and learning in South African universities?
3. Does the prevalence and determinants of food insecurity and common mental disorders change during the COVID-19 pandemic?
4. What are the individual and combined effects of food insecurity and common mental disorders on students' academic success during the COVID-19 pandemic?

These research questions are answered in five manuscripts (Figure 2) that are attached to this doctoral thesis narrative as appendices (Appendix C).

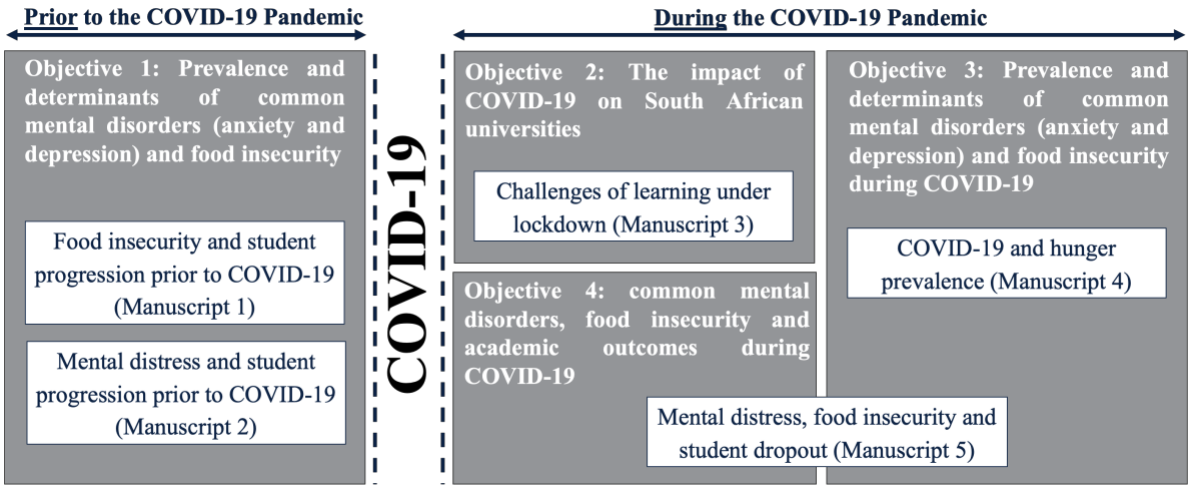


Figure 2: Overall schema of PhD objectives and manuscripts

PhD hypothesis

This PhD hypothesizes that the presence of CMDs and food insecurity, both before and during the COVID-19 pandemic, have adverse effects on student academic success. Additionally, it is anticipated that the prevalence and severity of food insecurity and CMDs will be higher during the COVID-19 pandemic, due to the negative effects of the pandemic on financial and mental wellbeing. Finally, I hypothesize that higher levels of food insecurity and CMDs, and the increase of their severity due to the pandemic, as well as the introduction of ERTL, will result in overall declines in student progression and increases in dropout rates.

Structure of doctoral thesis

The next six chapters present the integration of these five manuscripts into a doctoral thesis narrative. Chapter One provides a summary of the landscape of South African HEIs with a specific focus on universities, their conceptualisation of student academic success and the various dimensions of wellbeing. This chapter also delves deeper into understanding the impact of the pandemic on universities, focusing on food insecurity and CMDs. Chapter Two presents the research context. Chapter Three presents the methods employed to address the research objectives. Chapter Four presents the results of the thesis which relay the main findings for each of the four research questions. Chapter Five, the Discussion, presents how these outcomes enhance our current understanding of food insecurity and mental distress among university students. The strengths and limitations of this research are expanded upon in Chapter Six. The

concluding chapter (Chapter Seven) offers final reflections and considerations for future research undertakings.

Chapter 1: Background

The advent of a democratic South Africa resulted not only in political change but a re-conceptualization of higher education, espousing the values of equity and access, with the goal of transformation. The White Paper of Higher Education of 1997, entitled "A Programme for the Transformation of Higher Education", detailed the higher education transformation trajectory of a democratic South Africa (DHET, 1997). The Higher Education Act of 1997, the National Plan for Higher Education 2001, and the subsequent establishment of the National Student Financial Aid Scheme (NSFAS), targeted at previously disadvantaged groups, were all directives of the 1997 White Paper. As a result, higher education has become more accessible to previously disadvantaged South Africans.

South Africa currently has twenty-six state-funded universities which are some of the top-ranked institutions in the world (Business Tech, 2022). South African public universities are differentiated into 3 categories: traditional universities offering bachelor qualifications; universities of technology which offer vocational programmes and diplomas; and comprehensive universities which offer vocational programmes, diplomas and degrees (Branson & Whitelaw, 2023; DHET, 2013). The entire South African post-school education and training programme, which includes public universities, is coordinated by the Department of Higher Education and Training (DHET).

1.1 Challenge of low student throughput and dropout

A 2019 report released by the DHET suggested that accessibility of tertiary education has not translated into tertiary degree attainment. The report revealed that from the 2015 student cohort registered for three-year degrees, only 32% graduated in minimum time (in other words, low student throughput) (DHET, 2020). Apart from low throughput, the DHET report also highlighted high student dropout, also commonly referred to as attrition where students withdraw from the programme of study before completing it, another challenge facing SA universities (Adusei-Asante & Doh, 2016; Savio et al., 2022; Scott, 2018). The DHET reported that 12% of first-time, first-year students pursuing three-year bachelor degrees dropped out during their first year, with significantly lower dropout rates noted in the second (3%) and third years (0.1%) (Cele, 2021; DHET, 2020). These figures are consistent with those from other parts of the world which range from 6-20% for first-year attrition (Aina et al., 2022).

Low throughput and high attrition present a challenge for South Africa for several reasons. Firstly, South Africa already has one of the lowest tertiary education attainment levels in the world at 13%, compared to the world average of 47% for those aged between 25 and 34 years (OECD, 2023). Secondly, with only 2% of those unemployed being university graduates, a tertiary qualification is important in the labour market, especially given the extremely high unemployment levels currently seen among young South Africans (Stats SA, 2023b). Finally, a tertiary qualification is one of the best enablers of social mobility and is thus critical for improving the socio-economic prospects of the previously disadvantaged (OECD, 2023).

The following sections of this Chapter introduce the different measures that have been used to define student academic success, as well as its determinants. The argument is made to expand the scope of determinants to include various dimensions of wellbeing including mental health and food security, which are the focus of this research. It is through this lens that existing literature is interrogated to understand how student wellbeing, in the era of the COVID-19 pandemic, has been framed and understood.

1.2 Measuring academic success

A universally accepted definition of student academic success does not exist. Instead, there is agreement that success is defined by indicators that can include student retention, progression, throughput, and dropout (Versporten et al., 2014). These indicators are often grouped into two: i) *leading indicators*, using measures such as retention and progression rates - which measure short-term changes that may impact long-term trends; and ii) *lagging indicators*, such as throughput rates, which serve a useful purpose in validating trends over time, offering limited foresight into potential events happening now or in the near future (Manuele, 2009). York, Gibson & Rankin's operationalised model for academic success (Figure 3), defines student success as not only academic achievement, which reflects the acquisition of skill and attainment of learning outcomes (often captured by measures such as Grade Point Average [GPA] in the USA and grades, which allows for progression), but also persistence, student satisfaction and ultimately post-university success (York et al., 2019). It is crucial to acknowledge that the definitions of these concepts and their measurements differ according to global region, institutions and even programme types (Sondlo & Nieuwenhuis, 2013). Student throughput and dropout are measures most predominantly used to monitor success in South African universities (DHET, 2020).

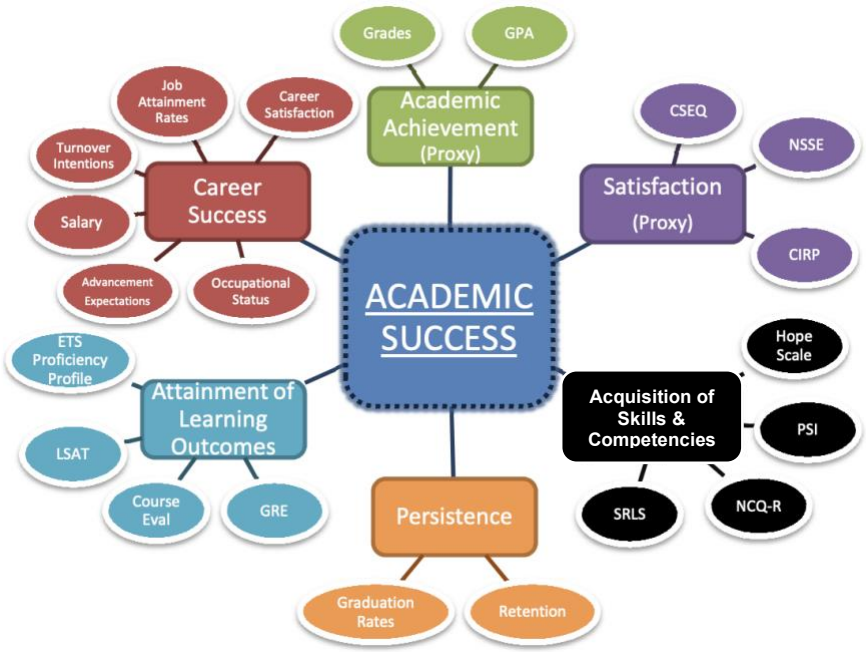


Figure 3: York, Gibson & Rankin operationalised model for academic success (York et al., 2019)

1.2.1 Student throughput

The South African DHET often uses throughput rates as a measure of success and institutional efficiency and defines it as: "the number of first–time entry undergraduate students of a specific cohort of a specific year who have graduated either within the minimum time, or up to two years beyond the minimum time, compared to the number of students in the baseline enrolments of that cohort" (DHET, 2021). However, using student throughput as a measure of the 'success' of student cohorts, although preferred and considered accurate, may be a disadvantage as it is a lagging indicator looking into the past, giving limited insight into what may happen in the present or future (Manuele, 2009).

1.2.2 Graduation rates

An alternative indicator to throughput may be more cross-sectional measures such as graduation rates, which measure the proportion of students graduating compared to all students registered (Lewin & Mawoyo, 2014). Another example of a cross-sectional indicator of student success are course success rates, which measures the proportion of students who have passed a course compared to overall course enrolments (DHET, 2021). Calculating graduation and course success rates is simple; however, there are several shortcomings which should be

considered. One shortcoming is the failure of graduation rates to account for students who are registered part-time or those who have transferred from other institutions, both which may be a significant number (Gold & Albert, 2006). This measure also masks the issue of student dropout, as these students are not considered in the determination of this indicator (Gold & Albert, 2006).

1.2.3 Student progression

Academic progression is an additional metric for measuring student success, encompassing a student's advancement from one academic level to the next (Nettles et al., 1999). As an illustration, a student is deemed 'successful' when they fulfil the criteria to advance from one semester to the next, or from one year of study to next. The monitoring of student progression offers institutions an opportunity to pinpoint students who may be at risk for not completing within the minimum time, enabling timely intervention and the provision of necessary support (HETI Higher Education, 2021). One drawback of this indicator is that students who barely meet the requirement to progress may be overlooked in the provision of student support interventions that may have been beneficial to them.

1.2.4 Dropout

Student dropout and retention are binary metrics whose purpose is to understand the registration status of students in periods after their initial registration (Savio et al., 2022). In their paper, Adusei-Asante and Doh (2016) describe retention as instances where students continue to enroll (in the same institution) in successive academic periods until they successfully complete their program of study. Conversely, dropout encapsulates declining levels of re-registrations among a student cohort (Adusei-Asante & Doh, 2016; Savio et al., 2022).

This PhD uses student progression and dropout as measures to define student success. The decision to use these indicators is based on this research's specific focus on first-year students, as these students are at highest risk of not progressing and dropout, compared to other years of study (DHET, 2020). These metrics were, therefore, most appropriate as they offer a more targeted understanding of student success trends, rather than throughput and graduation rates which typically encompass the entire academic journey and might not capture the intricacies of success in each academic year.

The following section briefly highlights the importance of the first year of study on student success, highlighting its documented predictors. Moreover, it summarizes empirical evidence showcasing important findings in the field of university student success from both South African and international studies, highlighting similarities and differences.

1.3 Predictors of student success

Questions looking at what makes a university student academically successful have become critical, especially in South Africa given its low student throughput and high levels of dropout (DHET, 2020). Much of the research and interventions that have taken place globally and in South Africa have identified the first year of study as being particularly critical as it has been identified to have the highest dropout and failure rates (Cele, 2021; DHET, 2020; Nelson et al., 2009). These findings highlight the need for targeted support programs aimed at helping students navigate the challenges of their first year.

International research in this field has identified male students, students with low socio-economic status, students in their first year of study and individuals facing challenges with integrating into the academic and social structures of the university system to be at higher risk of poor academic achievement and more likely to drop out (Murray, 2014; Paura & Arhipova, 2014; Stinebrickner & Stinebrickner, 2012; Tinto, 1993; York et al., 2019). Findings from South African research align with global patterns, identifying matriculation scores and performance in subjects such as English, Mathematics, and Science as crucial determinants of success in university academics (van Zyl et al., 2016). Furthermore, local research has identified student age as an important predictor of academic success, with younger students having a slight advantage over those who register at older ages (Aina et al., 2022; van Zyl et al., 2016). In terms of race and gender, Bhorat et al., (2010) concluded that Black African students, especially males, were at the highest risk of dropping out or attaining poor academic outcomes when compared to other races (and females). This disparity can be attributed to a range of socio-economic and academic factors. (Kuh et al., 2006) Note that students from marginalized groups often face challenges related to financial constraints, lack of adequate academic preparation, and limited access to educational resources, which contribute to their higher risk of failure. Moreover, van Zyl et al., (2016) found that pre-entry attributes such as school performance and academic readiness are crucial predictors of first-year academic success. In addition to this, literature has also identified the formal education level of family members as well as receiving career counselling as other important factors that may positively

impact academic success (Bhorat et al., 2010; Bokana & Tewari, 2014; Maree, 2014; Pillay & Ngcobo, 2010; van Zyl et al., 2016). These elements are often less accessible to Black African students, which compounds the risk of poor academic outcomes for this group.

Notably absent, especially in South African literature, are investigations into wellbeing as a potential determinant of academic success. This absence is despite the substantial levels of food insecurity and mental distress that have been documented in South African University students (Bantjes et al., 2016; Mall et al., 2018; Pillay & Ngcobo, 2010; van den Berg & Raubenheimer, 2015). Given the strong link between student wellbeing and academic performance seen in international research, addressing this gap in the South African context could provide critical insights into improving student success and retention. Future research should focus on the role of wellbeing in shaping academic outcomes, particularly within underserved student populations.

1.4 Contextualising wellbeing

This thesis focuses on two of the four dimensions of student wellbeing described by the Organization for Economic Cooperation and Development (OECD), physical and psychological wellbeing (OECD, 2017). In this instance, the physical dimension is explored through the lens of food security, and the psychological dimension through CMD. In their report, the Organization for Economic Cooperation and Development (OECD) define student wellbeing as "the psychological, cognitive, social and physical functioning and capabilities that students need to live a happy and fulfilling life" (OECD, 2017). It is the interaction of these four dimensions (Figure 4), also influenced by complex proximal (including the home, school, and community environments) and contextual environments (including policy, politics, and global trends), that demarcate the concept of wellbeing (OECD, 2017). The next four sections provide further detail regarding the four dimensions found in the OECD definition of student success. The sections intend to recognize the inherent connections between the various facets of wellbeing and student achievement. They illustrate that deficiencies in one or more dimensions of wellbeing ultimately hinder their ability to thrive academically.

1.4.1 Cognitive wellbeing

Cognition is the ability to learn; it encompasses the processes of thinking, knowing, remembering, judging, and problem-solving (Demetriou & Spanoudis, 2017). Linked to

cognition, but notably different, is a related concept of intellect. Intellect is characterized as the capacity to acquire and apply knowledge effectively in various situations (Demetriou & Spanoudis, 2017; Wagman, 1996). The Admission Points Score (APS in matric) and National Benchmark Tests (NBTs) are tools used in South African higher education to gauge intellect and aid in identifying students most likely to succeed in tertiary programmes (Minimum Admission Requirements for Higher Certificate, Diploma and Bachelor's Degree Programmes Requiring a National Senior Certificate Pretoria, 2005; NBTP, 2005). This suggests that, generally, students entering higher education after having met the APS and NBT criteria have the intellectual potential to be academically successful within the stipulated time.

1.4.2 Social wellbeing

Social integration is a critical concept in the student success discourse. In their work, Schwartz and Tinto (1987) detail how a lack of social integration can lead to student dropout. Understanding social wellbeing in the South African context is challenging because of the high levels of social ills which often appear amplified in university microcosms (Johnson, 2022). Discussions and societal attitudes around gender, sexual orientation, income, and race, which also happen to be traditional determinants of academic success, profoundly impact students' sense of belonging (Bhorat et al., 2010). This means that many students enter higher education with compromised social wellbeing.

1.4.3 Physical wellbeing

This dimension prioritizes the promotion of health, specifically concentrating on physical fitness, dietary habits, and the adoption of a health-conscious way of living. When describing this dimension, the OECD highlights physical fitness as "how much physical activity students engage in" as well as food and nutrition security (i.e., "whether they eat regularly") (OECD, 2017). This dimension is critical in mitigating the risk of disease, maintaining cognitive health and facilitating healthy development (McNaughton et al., 2012).

1.4.4 Psychological wellbeing

This dimension encompasses principles that include purpose, self-awareness, motivation, resilience, and confidence, while psychological distress including anxiety, stress and depression can impede on psychological wellbeing (Visser & Law-van Wyk, 2021). The psychological dimension is one of the most complex dimensions because there are several factors that may predispose students to psychological distress, while the interactions of the

other dimensions of wellbeing, as well as the proximal and contextual sources of wellbeing can precipitate and perpetuate distress (Liu et al., 2022). *Predisposing* factors such as genetics, may make participants more vulnerable to anxiety; *precipitating* factors such as traumatic events may trigger feelings of anxiety; *perpetuating* factors such as poor relations with loved ones may sustain feelings of anxiousness longer term (Winters et al., 2007).

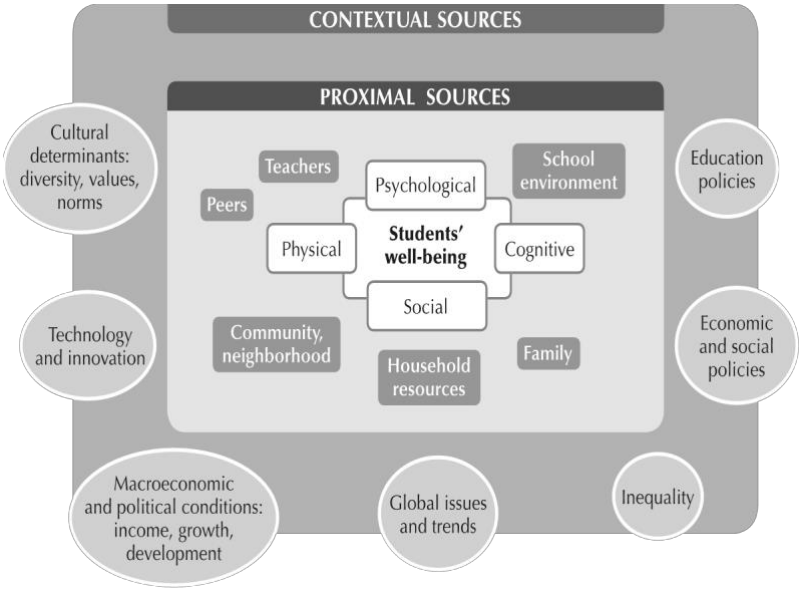


Figure 4: Dimensions and sources of students' wellbeing (OECD, 2017)

Although work on the impact of food insecurity, anxiety and depression has taken place globally, evidence linking these variables to university student academic outcomes is limited. The section that follows distils key findings from literature, identifying important trends and insights from empirical evidence from South Africa, Africa and internationally.

1.5 Food insecurity and hunger among university student populations: Literature prior to COVID-19

The term food insecurity is employed to characterize continuously inadequate access to safe and nutritious food that fulfils dietary needs essential for growth and the sustenance of a lively and healthy life (FAO, 2022). Food security is founded on four key pillars: availability, ensuring an adequate supply of food; access, guaranteeing both physical and economic means to obtain food; utilization, the capability to secure the necessary dietary intake and benefit from

its nourishment; and stability, an indication of whether the pillars are stable over time (FAO, 2008, 2015).

Colloquially, and even in literature, food insecurity and hunger are often used interchangeably, but it is important to distinguish between the two. Although certainly interconnected, hunger specifically describes the "uncomfortable or painful sensation caused by insufficient food energy consumption" (FAO, 2008). On the other hand, food insecurity is defined as the access to food of inadequate quality, quantity, variety, or desirability. Food insecurity can occur concurrently with hunger, i.e. ‘food insecurity with hunger’ is the most severe form of food insecurity. Conversely, food insecurity can also occur in the absence of hunger, “food insecurity without hunger” (USDA, 2023; van den Berg & Raubenheimer, 2015).

The occurrence of food insecurity (with or without hunger) amongst South African university students in 2012- 2013, prior to the pandemic, was estimated to be between 66-84% (Kassier & Veldman, 2013; van den Berg & Raubenheimer, 2015). These levels were notably elevated compared to the national average of 21% described by Statistics South Africa (Stats SA, 2019b). Furthermore, research on food insecurity among university students found variables such as race, first-generation status, gender and lack of financial means as strong predictors of food insecurity (Kassier & Veldman, 2013; Munro et al., 2013; van den Berg & Raubenheimer, 2015).

The presence of food insecurity in educational settings is cause for concern, with significant consequences. Research conducted at colleges in the United States of America (USA) revealed that academically, students experiencing food insecurity performed weaker and took longer to graduate compared to their food secure counterparts (El Zein et al., 2019; Morris et al., 2016; van Woerden et al., 2019). Evidence further suggests that food insecure students were at increased risk of struggling with disordered eating behaviours (including ‘feast or famine’ eating patterns depending on food availability) (El Zein et al., 2019), with studies from New Zealand suggesting that this phenomenon disproportionally affected younger students (Carter et al., 2011; Pourmotabbed et al., 2020).

1.6 Anxiety and depression among university student populations: Literature prior to COVID-19

Anxiety is defined as the feeling of unease, nervousness, and worry; while depression is a complex disorder described as persistent low mood and loss of interest. Both are common mental disorders affecting university student populations (Bantjes et al., 2016; Bernal-Morales et al., 2015; Ibrahim et al., 2013). Depressive symptoms frequently include low optimism, heightened anxiety, poor concentration and disrupted sleeping patterns (Nsereko, 2018). On the other hand, those with anxiety, which is often linked to depression, have persistent feelings of apprehension and, at times, even fear, particularly in relation to uncertain or ambiguous future outcomes (Ibrahim et al., 2013).

Anxiety and depression are two of the most common mental disorders among university students both globally and in South Africa (Bantjes et al., 2016, 2019; Mall et al., 2018; Samuolis et al., 2015; Verger et al., 2010). This is particularly worrisome since both anxiety and depression have been linked to lower Grade Point Averages (GPAs), reduced probability of students progressing from one year of study to the next, and higher student attrition (Aluh et al., 2020; Awadalla et al., 2020; Eisenberg et al., 2009; Fröjd et al., 2008; Lawrence et al., 2019).

What is interesting, and similar to food insecurity trends, is that the prevalence of these common mental disorders is significantly higher among university students when compared to national averages. South African literature prior to COVID-19 found the 12-month prevalence of depression among university students to be 16% (Mall et al., 2018), more than three times higher than the general population when using the same recall period (Tomlinson et al., 2009). Anxiety levels between the two groups indicated a similar trend, with the 12-month prevalence of anxiety among university students found to be 21% (Bantjes et al., 2019), nearly three times that of the general population at 8% (Tomlinson et al., 2009).

South African literature before the pandemic, like international literature, suggested that students who are female, Black Africans, living with a disability, under financial strain, who are anxious about their academics and having experienced childhood adversity were at greater risk of depression and anxiety (Bantjes et al., 2019; Mall et al., 2018; Pillay & Ngcobo, 2010). Furthermore, there is evidence suggesting that youth with depression had an elevated likelihood of being food insecure as well (Jesson et al., 2021).

1.7 Food insecurity and common mental disorder pathways to poor academic outcomes

There is compelling evidence that an inadequate diet or eating patterns can jeopardize physical wellbeing, and potentially hinder the learning process (Taras, 2005). Sorhaindo and Feinstein (2006), in their conceptual framework, highlighted the repercussions of poor nutrition on various aspects including: i) physical development, reflected in lower (or higher) body mass index and delayed motor skill development; ii) cognition, encompassing attention, memory, and concentration; and iii) behaviour, manifesting as aggression and hyperactivity. As a result, students who are food insecure or hungry may display psychosomatic symptoms like dizziness, headaches, and irritability, ultimately leading to diminished concentration (Pickett et al., 2015; Sabi et al., 2020). This framework therefore aligns with literature that highlights the compounded adverse effects of food insecurity, especially with hunger, on student learning and their overall wellbeing.

The pathway of how mental distress impacts on academic performance has also been conceptualised. Work carried out by Eisenberg, Golberstein, and Hunt (2009) suggests that symptoms associated with depression and anxiety, such as reduced energy levels and difficulties in maintaining focus have an impact on non-cognitive skills such as persistence and motivation (Eisenberg et al., 2009; Humensky et al., 2010). These non-cognitive skills, in turn, directly affect cognitive function and, consequently, knowledge acquisition. Non-cognitive skills may be adversely affected by mental distress, resulting in reduced academic productivity and potentially diminished levels of skill acquisition. This is evident in individuals experiencing depression and anxiety, as reflected in lower grades (Awadalla et al., 2020; Eisenberg et al., 2009; Lawrence et al., 2019).

1.8 Empirical evidence linking food insecurity and common mental disorders to poor academic outcomes prior to COVID-19

International literature has begun to unpack the link between food insecurity, and mental distress including anxiety and depression, on student academic performance. For instance, studies from the United Arab Emirates (UAE), USA and Finland have associated depression with low GPA scores (Awadalla et al., 2020; Fröjd et al., 2008; Graunke & Woosley, 2005). South African literature revealed that students who experience major depressive disorder (MDD) were more likely to underperform academically by four fold (Bantjes, Saal, Lochner, et al., 2020). Work among depressed adolescents in the USA attributed poor academic performance to their inability to concentrate in class and interact with peers, which may lead

to absenteeism (Humensky et al., 2010). Students with common mental disorders, such as depression and anxiety, tend to have higher levels of class absenteeism and struggle with completing homework when compared to their counterparts without mental disorders. This limits their opportunities to learn which in turn, is reflected in their academic outcomes (Humensky et al., 2010; Lawrence et al., 2019; Ruz et al., 2018).

It is essential to recognize the potential bidirectionality of the relationship between CMDs and academic success. Some authors suggest that academic setbacks elevate the risk of developing anxiety and depression symptoms (Eisenberg et al., 2009; Ruz et al., 2018). Additionally, studies emphasize the compounding repercussions of poor academic performance, including the added financial implications and stress of re-registration and increased time commitments due to heavier workloads. All these factors can profoundly impact mental health (Ajjawi et al., 2019).

Regarding food insecurity, research in the USA has established connections between student food insecurity and poor academic outcomes. These studies indicate that students facing food insecurity are more prone to poor academic performance and tend to take longer to graduate compared to their food secure counterparts (El Zein et al. 2019; Morris et al. 2016). In South Africa, findings have shown that students experiencing both food insecurity and hunger struggle with concentration in class and frequently choose to skip classes altogether (Sabi et al., 2020). Moreover, these students are documented to experience heightened stress levels, an elevated probability of poor sleep, and irregular eating patterns in contrast to their food secure counterparts (Diamond et al., 2019; El Zein et al., 2019; Jesson et al., 2021).

The data presented suggests a potential connection between food insecurity, mental distress, and academic success. With both food insecure and mentally distressed students struggling to concentrate in class, skipping classes, as well as experiencing stress. Modelling conducted by Martinez et al. (2018) provides further insights on the relationship between these three variables. Martinez's work suggests that student food insecurity can lead to poor academic outcomes both directly and indirectly when mental distress acts as a mediator variable (Martinez et al., 2018).

The poor wellbeing described above could be further intensified by external elements, such as the COVID-19 pandemic and the subsequent lockdown of 2020. The following section outlines the actions taken by the South African government to reduce the transmission of COVID-19

and, through the lens of teaching and learning at universities, elucidates the impact that these measures had on students.

1.9 COVID-19 and lockdown in South Africa

In March 2020, due to widespread concerns about the COVID-19 virus, the South African government declared a nationwide state of disaster resulting in a lockdown of all non-essential activities (Declaration of National State of Disaster: Disaster Management Act, 2002 by the Minister of Cooperative Governance and Traditional Affairs, 2020). To control the transmission of the COVID-19 virus, the SA government instituted a lockdown using a five-level alert system (Regulation 3(3) of the Disaster Management Act (57/2002): Regulations Made in Terms of Section 27(2) by the Minister Health, 2020). Alert Level 5 was the highest alert level and was implemented when the transmission of COVID-19 was highest. Confinement at home and closure of non-essential establishments were mandatory under Alert Level 5, while food supply and medical services were permitted to operate (Disaster Management Act (57/2002): Regulations Made in Terms of Section 27(2) by the Minister of Cooperative Governance and Traditional Affairs, 2020). The least stringent alert level, Alert Level 1, was implemented during periods of low COVID-19 infections (Regulation 3(3) of the Disaster Management Act (57/2002): Regulations Made in Terms of Section 27(2) by the Minister Health, 2020). Measures including a curfew from midnight to 04:00am and the requirement to wear face masks were instituted under Alert Level 1 (Disaster Management Act (57/2002): Amendment of Regulations Issued in Terms of Section 27(2) by the Minister of Cooperative Governance and Traditional Affairs, 2020).

1.9.1 Consequences of lockdown on South Africa's universities

Because of the lockdown, South African universities suspended in-person activities and instructed students to vacate campus residences (Declaration of National State of Disaster: Disaster Management Act, 2002 by the Minister of Cooperative Governance and Traditional Affairs, 2020). Due to the lockdown and social distancing requirements, and in order not to lose the school year, South African universities introduced Emergency Remote Teaching and Learning (ERTL), a new mode of teaching and learning conducted entirely online. Frequently mistaken for online learning, ERTL refers to a temporary shift from traditional, in-person teaching and learning to an alternative mode of delivery, such as teaching on online platforms, in response to a crisis that prevents normal educational activities (Charles Hodges et al., 2020). This new mode effectively puts online all materials previously used in face-to-face teaching

(Charles Hodges et al., 2020). Some pedagogical redesign is required, such as the development of assessments, for instance, but not to the extent required for "online learning". For ERTL to be successful, both staff and students required reliable computer hardware, a reliable internet connection, ongoing technical support, and a physical environment that was conducive for work (Landa et al., 2021; Motala & Menon, 2020; Nyar, 2021; Themane & Mabasa, 2022). Given this, it is no surprise that the implementation of ERTL by South African universities was riddled with challenges, which included: i) challenges of access and connectivity; ii) challenges imposed by the rapid pedagogical redesign and technological adaptation required for ERTL; and iii) psychosocial challenges due to the adverse effects of the COVID-19 pandemic, lockdown and ERTL on wellbeing. These challenges are spelt out in greater detail below.

1.9.2 Connectivity and access to enable Emergency Remote Teaching and Learning (ERTL)

The most pressing concerns with the implementation of ERTL were regarding connectivity and access (Motala & Menon, 2020; van-Schalkwyk, 2020). Universities responded by instituting various measures including the zero-rating of essential websites, allocation of mobile data as well as the distribution of laptop devices (Motala & Menon, 2020; Nyar, 2021). However, despite these provisions, students continued to struggle. Poor cell signal, especially in rural areas where some students had returned to, restricted students' access to online platforms (Motala & Menon, 2020; Themane & Mabasa, 2022). These network issues were exacerbated by power cuts (load shedding) with some students having no power for extended periods of time (Laher et al., 2021; Landa et al., 2021). Unfortunately, these challenges disproportionately impacted students from poorer backgrounds who were often from more rural communities, compromising their learning experience (Fouche & Andrews, 2022; Laher et al., 2021; Landa et al., 2021; Themane & Mabasa, 2022).

1.9.3 Pedagogical redesign

Arguably, the most formidable challenge of ERTL adoption was the pedagogical redesign required to facilitate effective and inclusive remote teaching and learning (Motala & Menon, 2020). A successful transition from contact teaching and learning to ERTL required technical capacity, the upskilling of staff, collaboration between different internal departments as well as cooperation and contributions from external providers (Krull & MacAlister, 2022; Phakeng et al., 2020).

Due to the novelty of ERTL, teaching staff required pedagogical guidance and support to ensure teaching, course structures and assessments were coherent across the university (Bekker & Carrim, 2021). Furthermore, reliable, and consistent support was essential for both staff and students as they navigated new online environments for ongoing pedagogical refinement and technological adaptation (Krull & MacAlister, 2022).

1.9.4 Psychosocial impact

COVID-19, the lockdown, and shift to ERTL presented challenges that went beyond issues related to access and pedagogical approaches. An additional challenge was the psychological wellbeing of staff and students, a recurrent challenge as both staff and students grappled with uncertainty regarding the evolving nature of the pandemic. Students expressed feeling isolated and anxious about learning under lockdown and were concerned about contracting the COVID-19 virus (coronaphobia) (Gittings et al., 2021; Laher et al., 2021; Olawale et al., 2021). Students also struggled with the move to ERTL, had financial anxiety, some fell ill, some were confronting grief and some were living in unfavourable home environments (Essadek & Rabeyron, 2020; Landa et al., 2021; Wang et al., 2020). In fact, among university students, the prevalence of depression and anxiety disorder were found to be higher when compared to before COVID-19, with some studies reporting depression levels of between 15- 35% during COVID-19 when using tools requiring 30-day and two-week recalls (Bantjes et al., 2023; Visser & Law-van Wyk, 2021); pre-COVID-19 levels were 16% using 12-month recall (Mall et al., 2018). While anxiety levels were at 11% during COVID-19 when using tools requiring a 30-day recall (Bantjes et al., 2023); pre-COVID-19 levels were 21% using 12-month recall (Bantjes et al., 2019). Despite the variations in recall thresholds among the tools used in these comparisons, it is reasonable to infer that heightened levels of anxiety and depression in the short term would aggregate to elevated levels over prolonged durations. Although these statistics are interesting, there is a need to understand the implications of these increasing burdens during the pandemic on student academic outcomes.

1.9.5 Impact on physical wellbeing

It is important to acknowledge the devastating impact of COVID-19 on students' physical wellbeing. This included students falling ill due to contracting COVID-19 or being compelled to take on a caregiver role for family members affected by the illness (Nyar, 2021). The vulnerability to food insecurity was also a risk to physical wellbeing due to potentially disordered eating patterns and lack of nourishment. Food insecurity among students during the

pandemic may have stemmed from financial hardships due to job loss and delays in student funding pay-outs which left students stranded (Gittings et al., 2021; Nyar, 2021; van der Berg et al., 2022).

Research from overseas institutions during the pandemic produced interesting findings, showcasing the complexities of food insecurity among university student populations. In instances where the levels of food insecurity increased, this was strongly associated with student job loss during the pandemic (Soldavini et al., 2021). In instances where food insecurity prevalence decreased, the decrease was associated with students moving out of university residence to return home (Davitt et al., 2021; Owens et al., 2020). Comparing these outcomes to trends in South Africa during the COVID-19 pandemic is precluded by the scarcity of scholarly literature on the topic, despite the pervasiveness of food insecurity in this setting. Finally, although literature documenting prevalence trends of food insecurity, anxiety and depression during and after the COVID-19 pandemic exists, none has linked these trends to academic outcomes.

1.10 The rationale

Literature has highlighted the high prevalence of food insecurity and common mental disorders among university students (Eisenberg et al., 2009; Kassier & Veldman, 2013; Lawrence et al., 2019; van den Berg & Raubenheimer, 2015). There is also evidence linking low levels of academic success with food insecurity and common mental disorders (Bantjes, Saal, Gericke, et al., 2020; El Zein et al., 2019; Morris et al., 2016). However, evidence from South Africa is limited. Where evidence does exist, it does not examine the impact of the COVID-19 pandemic. This PhD therefore aims to contribute to the literature and our understanding of the interplay between these factors by measuring the impact of the COVID-19 pandemic on university students' food insecurity and common mental disorder prevalence and to understand the implications of this on academic outcomes. The next Chapters details the settings and methods used to address these aims.

Chapter 2: Research Context

The research undertaken as part of this PhD was conducted at the University of the Witwatersrand, Johannesburg (Wits). Wits is the top-ranked university in Sub-Saharan Africa and ranked in the top 1% globally (Business Tech, 2022). Wits spans five campuses, has 5 faculties and 34 schools that accommodate its roughly 40 000 registered students (Wits, 2021). Students registered for undergraduate programmes make up roughly 60% of the student body (Wits, 2019b, 2020b).

The demographic profile (especially the racial profile) of students attending Wits has transformed dramatically since 1994 (Figure 5). Not only have enrolments more than doubled, from close to 20 000 in 1995 compared to 40 000 in 2020, but the demographic profile of the entire Wits student body has also reversed, from a majority male demographic (56%) in 1995 to majority female demographic (55%) in 2020, and from majority White race in 1995 (53%) to majority Black African (59%) in 2020 (HEDA, 2023). A closer look reveals the following: in 2020 around one-third of the incoming cohort of undergraduate students were the first in their family to go to university (first-generation), and 29% of students came from high schools with limited resources, meaning little to no access to libraries, science labs and computers (Wits AIRU, 2020).

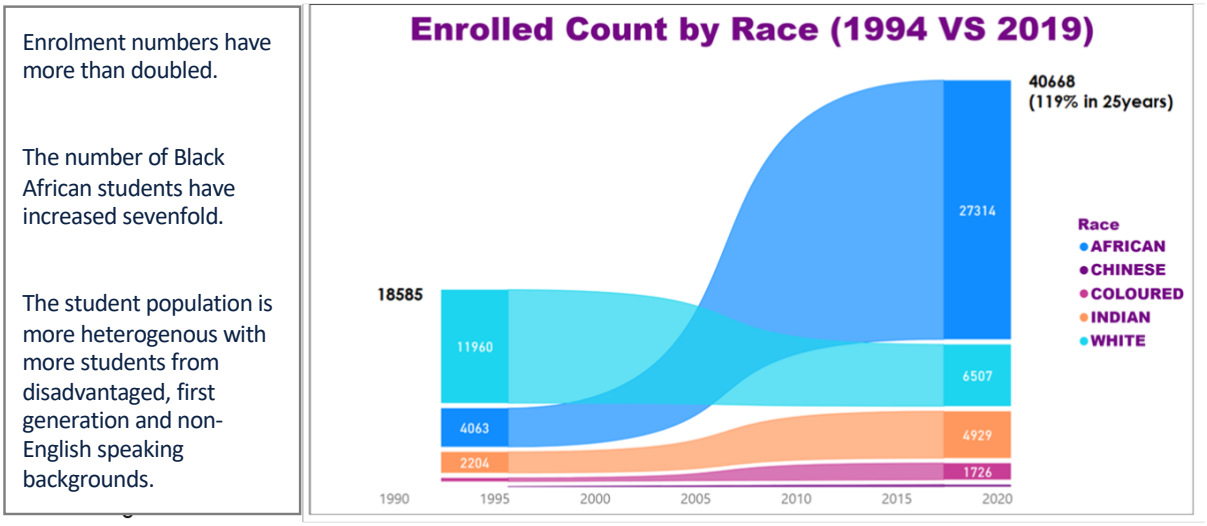


Figure 5: Changes to the Wits student population between 1990 and 2019 (HEDA, 2023)

Given these changes and the challenge with throughput in South African universities, Wits has focused resources and policies on student support programmes, with the hopes of ultimately improving student academic outcomes. In terms of policies, 2023 saw the Wits University 2033

strategy come to effect (Wits, 2022). This 10-year plan, together with other key policies, including the Wits Learning and Teaching Plan (2020-2024), aims to foster a student-centred culture, enhance data capacity and evidence-based practices, and leverage institutional strengths to address barriers to student success (Wits, 2019b, 2022).

2.1 Student Success and Student Support at Wits University

Student success at Wits University is laid out in the Wits Institutional Framework for Student Success of 2019 (Wits, 2019a). In this framework, Wits asserts that, ultimately, student success means that graduating students uphold Wits' graduate attributes, which include graduates having "In-depth knowledge of specialist discipline" as well as being "Innovative and [having] critical thinking skills with commitment to continuous learning" (Wits, 2017). However, prior to reaching the graduation milestone, students must navigate the various stages of success, including the application and admission processes, retention through years of study, and progress from one academic year of study to the next. As such, the university measures success using leading indicators: monitoring retention rates, progression rates, course credits and bottleneck courses (Wits, 2019a). Lagging indicators monitor completion rates, time to completion as well as disparities in completion by race and gender (Wits, 2019a).

Student support at Wits University follows a holistic and integrated student-centred support model, grounded on four domains: academic support, health and wellness support, material needs support and personal development (Wits, 2019a). This is demonstrated in the Model for student-centred support at Wits University (Figure 6). In the context of this study, the model highlights the various dimensions: academic, personal, health, and material, that intersect to shape a student's experience and success in higher education, illustrating the complex, interconnected nature of student needs and the resources required to address them. By addressing all these factors, institutions can develop more comprehensive intervention strategies, which is particularly important in the South African context where high dropout rates and academic underperformance are prevalent.

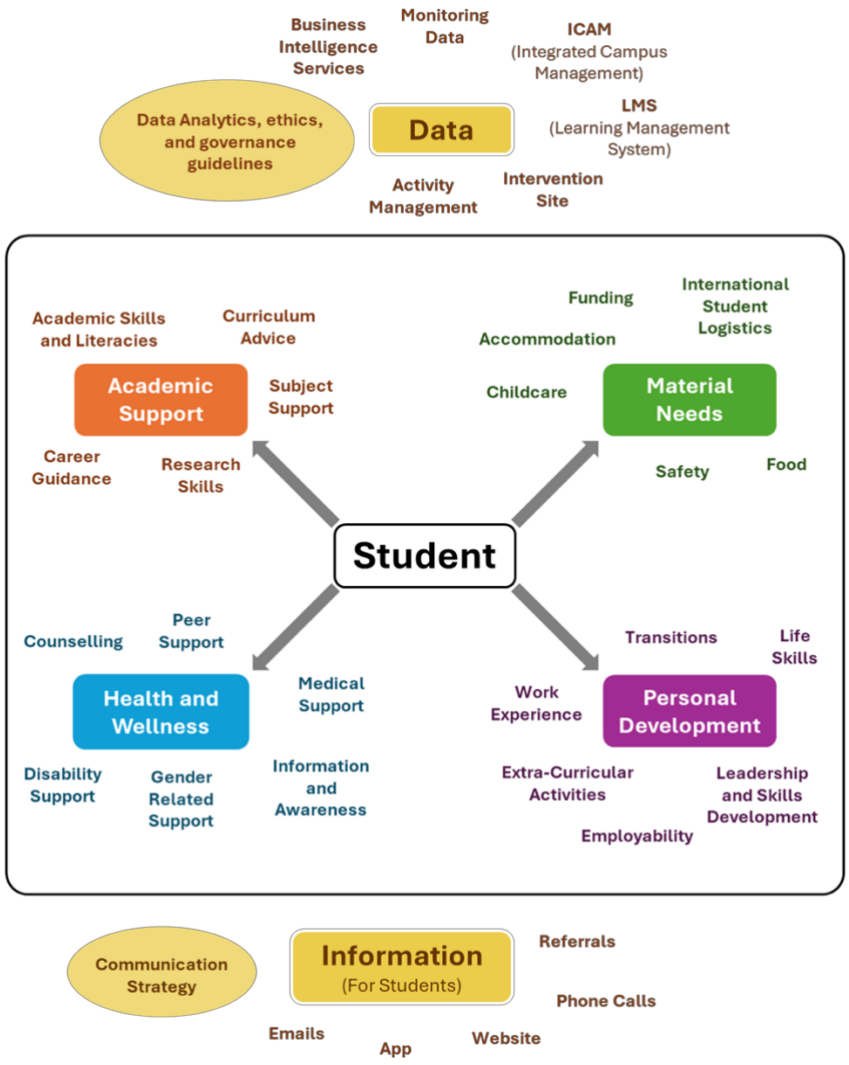


Figure 6: Model for student-centred support at Wits University (Wits, 2019a)

Student data is gathered, compiled, and cross-referenced from several sources. The Department of Basic Education provides matriculation data; demographic details are acquired during university admissions, and programme information (alongside school and home background information for first-time, first-year students (Masango et al., 2020)) is collected during the enrolment process. At Wits University, the interactive Student Information Management System (SIMS) plays a crucial role in managing essential academic and student success data, including test and exam scores, as well as progression and dropout statuses, among other functions.

2.2 Study population

The research presented in this doctoral thesis targeted all Wits first-time, first-year students, aged 18 years and older. Some key trends of this population over a 5-year period (2016 to

2020) are presented in Table 1. Notably, the proportion of female students has consistently been higher than male students with a proportion of 57:43 in 2020. In terms of race, the proportion of Black African students has consistently been the highest race group (69% in 2020), followed by White students (14% in 2020). Most students are South African nationals (96% in 2020), with the totality of other nationalities ranging from 3% in 2016 and 4% in 2020 (Wits AIRU, 2020).

Proportions of first-generation students have been on a downward trend between 2016 to 2020, with 48% of students being first-generation in 2016. This number has decreased to 37% in 2020. Most students come from suburban (40% in 2020) and township (30% in 2020) communities, with most students (46% in 2020) attending quintiles 4 and 5 high schools (the best-resourced high schools) (Wits AIRU, 2020). Quintile categories are an important concept in the South African public school system, and are the basis of the funding model (Amended National Norms and Standards for School Funding: South African Schools Act, 1996 (Act No. 84 of 1996) by the Minister of Education, 2006). Quintiles are assigned to a school based on the socio-economic context of their neighbourhoods around it. As such, schools in the most affluent communities will be classified as Quintile 5, and as such will receive the least funding from the government, and those in low-resourced areas classified as Quintile 1 and receive the most funding as per the funding model (Amended National Norms and Standards for School Funding: South African Schools Act, 1996 (Act No. 84 of 1996) by the Minister of Education, 2006; Burger & Naudé, 2019).

In terms of accommodation during studies, there was an increase (of around 10%) in the proportion of students living in university residences in the year 2019. This was due to the implementation of a new policy that aimed to prioritise university accommodation for first-time, first-year students, aiming for 50% of all beds to be allocated to first-year students by the year 2021 (Wits, 2020b).

Table 1: Distribution of first-year students by socio-demographic variables from 2016-2020 (Wits AIRU, 2020)

Sex	**2016**	**2017**	**2018**	**2019**	**2020**
Male	45%	46%	46%	43%	43%

Female	55%	54%	54%	57%	57%
Race					
Black African	68%	68%	67%	66%	69%
Chinese	0%	0%	1%	1%	0%
Coloured	4%	4%	4%	4%	4%
Indian	12%	12%	13%	13%	13%
White	15%	15%	15%	15%	14%
Nationality					
South Africa	97%	95%	97%	96%	96%
International	3%	5%	3%	4%	4%
First in family to attend university (First generation status)					
First generation	48%	47%	47%	43%	37%
Non-first generation	52%	53%	53%	57%	63%
Home location					
Farm	1%	2%	1%	1%	1%
Informal settlement	2%	1%	2%	2%	2%
City/Town	9%	18%	9%	9%	10%
Rural village	17%	15%	18%	17%	18%
Township	29%	23%	29%	29%	30%
Suburb	42%	40%	42%	43%	40%
High School Quintile					
Q1-3	33%	31%	31%	30%	29%
Q4-5	46%	47%	45%	45%	46%
Int/Pvt*	20%	21%	22%	25%	20%
Accommodation					
Home	45%	42%	41%	35%	32%
University residence	17%	23%	23%	33%	33%
Off campus/private	37%	34%	36%	31%	34%

*Int/Pvt: International/Private

2.3 The parent study and role of the doctoral student

This doctoral research is, in part, a sub-study of Wits' Impact of COVID-19 on Teaching and Learning study, described in Manuscript III (Wagner, Masango, et al., 2024). The PhD student led this study as a Project Manager, in her role as an Institutional Researcher in Wits' Institutional Research Division. The PhD student led all scientific aspects of the project including proposal and protocol development, methodology and instrument design, the process

of acquiring ethics and University Registrar approval, report writing and the scientific publication output. The PhD student also led operational aspects including coordinating meetings with the project research team as well as the project reference committee.

Chapter 3: Methods

This chapter outlines the data collection procedures employed in the study, providing a rationale for the methods used in relation to the research objectives and highlighting the key variables collected. It details the steps taken to gather both quantitative and qualitative data, using cross-sectional surveys and in-depth interviews to understand the impact of various factors on student success. The approach integrates multiple methods to ensure a robust analysis of the research questions. While this chapter provides an overview of the processes, greater detail on the specific methods is available in the scientific publications that have resulted from this PhD, which are appended to this thesis. The following sections discuss the research design, sample selection, procedures, and the analysis performed on the data collected during the study.

3.1 Research design

To answer the research objectives, this research made use of cross-sectional surveys administered in the years 2019 (before the pandemic) and 2020 (during the COVID-19 pandemic). Qualitative data collection in 2020, which took the form of in-depth interviews (IDIs) and focus group discussions (FGDs), occurred concurrently with the 2020 quantitative data collection. Figure 7 below provides a summary of the overall data framework.

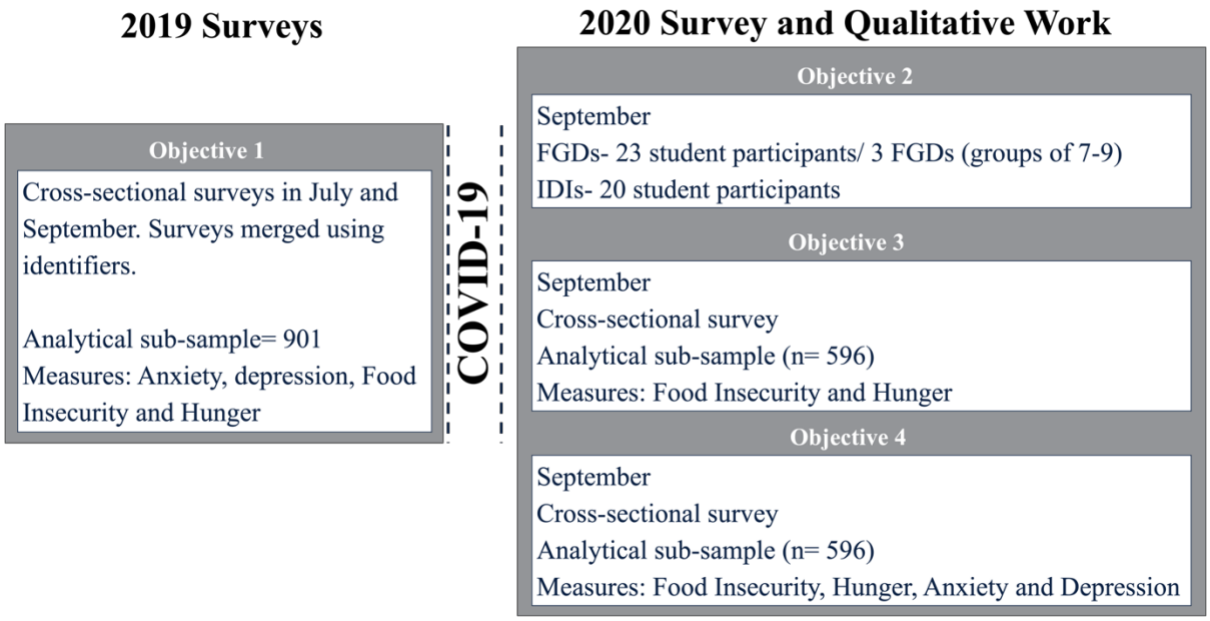


Figure 7: Overall schema of data collection used to address objectives

A concurrent triangulation research design was applied in this study, which enabled the simultaneous collection and integration of both qualitative and quantitative data (Creswell & Clark, 2018). The approach increased the depth and understanding of participant experiences by interrogating discrepancies between qualitative and quantitative methods (Agency for Healthcare Research and Quality, 2013). This research design was preferable to sequential designs as there were time constraints preventing prolonged data collection.

3.2 Quantitative methodology

Quantitative methods were employed to answer objectives one, three and four. These objectives sought to understand the prevalence and determinants of CMDs (which in the context of this research were depression, anxiety, and mental distress symptoms) as well as food insecurity and hunger before and after the COVID-19 pandemic. Further, these objectives sought to explore the relationships of these variables to academic success outcomes (which in the context of this research were progression and retention). Cross-sectional self-administered surveys were carried out in July and September 2019 for objective one, and in September 2020 for objectives three and four.

3.2.1 Study sample

Objective 1: To answer objective one, a sample of all students meeting the following criteria was extracted from the central university data warehouse: first-time entering first-year undergraduate students, who were aged 18 years and older, and registered for full-time study towards a three or four-year bachelor's degree. Students who did not meet the inclusion criteria were not invited to participate in the study. The July 2019 survey aimed to define the prevalence of anxiety and depression symptomology, with 5195 individuals meeting the inclusion criteria and being invited to participate. The September 2019 survey aimed to define the prevalence of food insecurity and hunger, 5 356 individuals met the inclusion criteria and were invited to participate. The discrepancy in the sample numbers despite identical inclusion criteria is attributed to more students turning 18 between July and September, therefore increasing the number of students eligible in the September survey.

Objectives 3 and 4: To answer objectives three and four, a sample was extracted from the central university data warehouse using the following criteria: over the age of 18, first-time, first-year students registered for full-time study towards an undergraduate degree. Students not meeting these inclusion criteria were excluded from the analysis.

Whilst entire populations were invited to participate in the study, the minimum sample required to sufficiently power the study was 591 for the 2019 sample and 595 for the 2020 sample. This was determined using Cochran's equation $n_0=Z^2 \bullet p \bullet (1-p)/e^2$, corrected for finite populations $n=n_0/1+[(n_0-1)/N]$ (Cochran, 1988). The assumptions included a 99% level of confidence and a 5% of marginal error.

3.2.2 Sampling and data collection procedure

Data collection began by identifying eligible individuals using the inclusion criteria and retrieving their email addresses from the central university database. In each survey instance, students were sent a recruitment email which detailed information about the research that was being conducted as well as a unique link to the survey. Written permission to contact students via email was received from the University Registrar and ethics. The survey was hosted on the Research Electronic Data Capture (REDCap) web application (Harris et al., 2019) and remained open for data collection for 6 weeks.

Following data collection, the two datasets for objective one (emanating from the two surveys) were merged into one dataset using unique identifiers. This resulted in a single data set for the year 2019 and another for the year 2020. Only records which contained entries in the variables of interest (see section *3.2.4 Measures*) were retained and formed the analytical sample, as these variables were crucial for addressing the research objectives. When each of the academic years concluded (2019 and 2020), academic performance data, specifically progression data (whether students met the requirements to advance to the second year of study) and retention data (whether students registered in 2019 re-registered at any time in 2020; and whether students registered in 2020 re-registered at any time in 2021), were requested for all study participants in the analytical sample. In this instance, an analytical sample refers to a subset of data, selected from a larger dataset, whose records meet the requirements I have outlined (have all the variables of interest outlined under section 3.2.4 Measures). These academic performance data were then linked to survey data. All unique identifiers (participant identifying information) were removed from the final datasets as a measure to maintain the confidentiality of the analytical dataset.

3.2.3 Analysis

STATA (version 18; College Station, Texas, USA), was used to clean and analyse the data due to its robustness in handling large datasets and its comprehensive suite of statistical tools. STATA is widely recognized for its flexibility in performing complex data manipulations and its ability to generate reliable outputs for both descriptive and inferential statistics, making it well-suited for this study's needs. Frequency and descriptive analyses were conducted to summarise the data and provide a clear understanding of the distribution of key variables. These analyses are fundamental to any study, allowing for a straightforward presentation of data trends, averages, and proportions. Where appropriate 95% confidence intervals (95% CI) are

reported adding an additional layer of precision, offering insight into the range within which we can be confident that the true values for the population lie. This enhanced the reliability of the findings by showing the degree of uncertainty in the estimates.

For comparing categorical variables, Pearson's chi-square test of independence was used, for determining whether there is a significant association between categorical variables, making it an ideal method for the study's goal of examining relationships between demographic and outcome variables. The Mann-Whitney U test was used to compare the continuous variable (age) between groups because it is a non-parametric test. This choice is justified when the data do not meet the assumptions of normal distribution, ensuring a more accurate comparison of age across different groups in the study.

The data were weighted by adjusting for sex and race to account for variations between the study participants and the underlying student population. The weightings were calculated and applied on STATA. The weighting process involved 1. determining the proportions for each group in both the population and sample; 2. calculating the weights using the formula: weight for group = population proportion of group / sample proportion of group; 3. assigning each participant a weight based on their race and sex; and 4. including weights to adjust statistical analyses.

Modelling strategy

Logistic regression was used in this study because it is well-suited for analysing relationships between one or more predictor variables and a binary outcome variable. In this context, logistic regression is particularly useful for modelling the probability of an event occurring, such as whether a student will progress or fail, or drop out or remain enrolled. For the logistic regression models, which utilized odds ratios (OR) as a test statistic, variable selection was performed through a backward stepwise regression approach with variables having a significance threshold set at $p \leq 0.20$ being included in the multivariate. Statistical significance was defined at a level of $p \leq 0.05$ for all analyses.

3.2.4 Measures

This section outlines the instruments and variables used to collect data for the study, focusing on socio-demographic characteristics, academic outcomes, mental health assessments, and

food security measures. The tools utilised were carefully selected to ensure a comprehensive assessment of the factors under investigation.

Socio-demographic characteristics

The study investigated various socio-demographic factors. These data formed part of the extraction from the university data warehouse and included race (categorised as White, Coloured, Black African, Chinese and Indian), sex (categorised as either female or male), first-generation status (categorised as either yes or no) referring to individuals who were first in their family to attend university, field of study (Health Sciences, Commerce, Law and Management, Sciences, Engineering, and Humanities), financial aid recipient (categorised as 'no' for those who did not receive funding or 'yes', for those who received funding). Finally, high school quintile information was collected (this information was presented on a scale of 1-5, with an additional category 'international/private or other' indicating students whose high schools were unknown as well as those attending international or private high schools). As mentioned previously, South African public schools are assigned a quintile based on the socio-economic context of the communities they cater to: schools in the most affluent communities will be classified as Quintile 5 and those in low-resourced areas classified as Quintile 1 (Burger & Naudé, 2019).

Academic outcomes

Progression

At the end of each academic year, each enrolled Wits University student is assigned a progress code reflecting their academic performance for the year. Academic progression, in the context of this research, refers to a student in their first year of study (YOS 1) satisfying all conditions to progress to the second year of study (YOS 2) and failure as not satisfying all conditions to progress to YOS 2. As such, progress codes were categorised into two groups: 1) Progression and 2) Failure.

Dropout

Official university records were requested for all students who completed the survey in 2020 (as part of objective 3) to understand their enrolment status in the year 2021. Students who did not re-register for study at any point during the 2021 academic year were classified as having dropped out. Conversely, students who did re-register were categorized as 'retained'. Thus, in the present study, the dropout status was represented as a binary variable, distinguishing between those who did not re-register (dropped out) and those who remained (retained). This

definition of dropout aligns with definitions commonly found in the existing literature (Adusei-Asante & Doh, 2016).

Common mental disorders

To evaluate common mental disorders, well-validated instruments like the Generalized Anxiety Disorder questionnaire (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9) were used. These tools allow for the identification of varying levels of anxiety and depression, ranging from minimal to severe. Additionally, the Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS), a scale combining the GAD-7 and PHQ-9 scores, was used to provide a comprehensive measure of mental distress. This section discusses the use of these instruments and their validation across different populations, highlighting their reliability and effectiveness in assessing mental health symptoms.

Anxiety symptoms

The Generalized Anxiety Disorder questionnaire (GAD-7), an instrument consisting of seven questions, was used to screen for anxiety symptoms (Spitzer et al., 2006). The GAD-7 employs a two-week recall period for each survey item which is scored on a four-point Likert scale, ranging from not at all (scored as 0) to nearly every day (scored as 3). After completion, the responses were totalled and classified into one of four categories: minimal anxiety symptoms (for scores between 0–4), mild anxiety symptoms (scores between 5–9), moderate anxiety symptoms (scores between 10–14) and severe anxiety symptoms for scores between 15–21). These categories have been employed in similar studies (Islam et al., 2020).

The GAD-7 is regularly used to ascertain levels of generalised anxiety among students (Awadalla et al., 2020; Farrer et al., 2016; Tadi et al., 2022). Validation studies have found the GAD-7 to have good construct validity and reliability. Validation studies for the GAD-7, among university students, reported good internal consistencies, with Cronbach α values ≥0.85 in studies taking place in USA, 0.903 among Spanish students and 0.892 among South African university students (Martínez-Vázquez et al. 2022; Byrd-Bredbenner, Eck, and Quick 2021; Tadi et al. 2022). The GAD-7 also displayed good convergent validity with the PHQ-9 and PHQ-ADS with coefficients ≥0.75 (Dhira et al. 2021). The current study yielded good internal consistencies of 0.908 and 0.913.

Depression symptoms

The Patient Health Questionnaire-9 (PHQ-9), an instrument consisting of nine questions, was used to screen for depression symptoms (Spitzer et al., 1999). Like the GAD-7, the PHQ-9 uses a two-week recall for each question, which is then rated on a four-point Likert scale, ranging from not at all (scored as 0) to nearly every day (scored as 3) (Kroenke et al., 2001). After completion of the questionnaire, the responses were totalled and classified into one of five categories: minimal depression symptoms (score between 0–4); mild depression symptoms (scores between 5–9), moderate depression symptoms (scores between 10–14), moderate-severe depression symptoms (scores between 15–19), and severe depression symptoms (scores between 20–27), these categories have been employed in similar studies (Islam et al., 2020).

The PHQ-9 has been used extensively in university settings both in South Africa, and other parts of the world (Awadalla et al., 2020; Eisenberg et al., 2007; Tadi et al., 2022). Validation studies have found the PHQ-9 to have good construct validity and reliability. Validation studies among university students reported internal consistencies of α=0.85 in Nigeria (Adewuya et al., 2006), α=0.83 in South Africa (Makhubela & Khumalo, 2023) and α=0.84 in Iran (Dadfar et al., 2021). Validation analysis based on work in Nigeria and Bangladesh found the PHQ-9 to have good test-retest reliability (r=0.894, $p<0.001$) and displayed good convergence with the GAD-7 and PHQ-ADS at 0.751 and 0.934, respectively, and both significant at $p<0.001$ (Adewuya et al., 2006; Rahman et al., 2022). The current study yielded good internal consistencies of 0.858 and 0.871.

Mental distress

To assess mental distress, the Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS), a composite scale, was employed. The PHQ-ADS merges the cumulative scores of two distinct self-report questionnaires: the Patient Health Questionnaire (PHQ-9) and the Generalized Anxiety Disorder-7 (GAD-7), both described above. The merging of the PHQ-9 and GAD-7 into the PHQ-ADS is justified by the high prevalence of comorbid anxiety and depression (Kroenke et al., 2016), the practical benefits of using a single composite measure, and the established validity of this tool in the literature (Rahman et al., 2022). The PHQ-ADS, amalgamating these two questionnaires, utilizes a scale ranging from 0 to 48, with categories as follows: 0–10 indicating minimal mental distress, 11–20 denoting mild mental distress, 21–30 indicating moderate mental distress, and 31–48 denoting severe mental distress. These specific cut-offs align with those applied in similar studies also investigating mental distress among students (Dhira et al., 2021; Rahman et al., 2022).

Food insecurity and hunger

To assess food insecurity and hunger, the Household Food Insecurity Access Scale (HFIAS) and the Household Hunger Scale (HHS) were utilised. These tools enable the identification of varying levels of food insecurity and hunger, from minimal to severe. The HFIAS categorises individuals into four levels of food insecurity, while the HHS assesses hunger across three defined levels. Both instruments have been widely applied in similar studies, particularly among South African university students. This section discusses the use of these instruments, their validation within this context, and their demonstrated reliability in accurately measuring food insecurity and hunger.

Food insecurity

The Household Food Insecurity Access Scale (HFIAS), an instrument consisting of nine questions was utilised to assess food insecurity (Coates, Swindale, and Bilinsky 2007). The HFIAS uses a four-week recall for each question, which is then rated on a four-point Likert scale ranging from never (coded as 0) to often (coded as 3). Using an algorithm, the responses were then grouped into four categories: food secure, ii) mild food insecurity, (iii) moderate food insecurity and (iv) severe food insecurity, these categories have been employed in similar studies (Kassier & Veldman, 2013).

The HFIAS is one of the most predominantly used tools to measure food insecurity among South African university students (Kassier & Veldman, 2013; Munro et al., 2013; Sabi et al., 2020). Although studies among university students have reported satisfactory internal consistencies, the HFIAS tool, to our knowledge, has not undergone a comprehensive validation exercise in the South African higher education context. The HFIAS tool was therefore validated before data collection and found to be valid with a good internal consistency (the validation procedure of the HFIAS can be found in Appendix A). The current study yielded a good internal consistency of 0.9267 and 0.950.

Household hunger

The Household Hunger Scale (HHS), an instrument consisting of three questions was used to assess household hunger (USAID FANTA Project, 2011). The HHS uses a four-week recall for each question, which is then rated on a four-point Likert - ranging from never (coded as 0) to often (coded as 3). After completion of the questionnaire, the responses were totalled and classified into one of three categories: little to no hunger (scores between 0-1), moderate hunger (scores between 2-3), and severe hunger (scores between 4-6). These categories have been

employed in similar studies among youth in South Africa (Jesson et al., 2021). In this study, ‘hunger’ was defined as a score of 2-6, while ‘no hunger’ was defined as a score of 0-1 (Coates et al., 2007). The HHS was validated as part of the HFIAS validation exercise and found to be valid with a good internal consistency (Appendix A).

COVID-19 and lockdown related variables

The variables related to COVID-19 and the subsequent lockdown were included to capture a comprehensive understanding of the social, environmental, and psychological challenges faced by participants during this period. The decision to include variables such as 'Self-reported COVID-19 infection,' 'Place of residence during lockdown,' and 'Household size' was informed by the unique circumstances created by the lockdown and its impact on both living conditions and mental health, as demonstrated in previous studies. The variable on 'Self-reported COVID-19 infection' was selected due to the well-documented association between COVID-19 exposure and various adverse physical and psychological outcomes (Essadek & Rabeyron, 2020; Wang et al., 2020). Understanding whether participants or their close contacts were affected by the virus provides insight into potential sources of stress and anxiety during the pandemic. Similarly, the importance of 'Place of residence during lockdown' and 'Household size' is supported by studies highlighting the differential impact of living conditions during lockdown, including challenges of space, connectivity, and social support (Motala & Menon, 2020; Themane & Mabasa, 2022).

The variable ‘Self-reported COVID-19 infection’ (categorised as yes or no) sought to understand if research participants and/or their close friends and family had ever been infected with the COVID-19 virus. The variable ‘Place of residence during lockdown’ sought to understand where study participants were residing during the lockdown (categorised as: on or off-campus residence, with relatives, at home and no stable accommodation). The number of people living in the household was captured by the variable ‘Household size’ (categorised as living alone, 2, 3-4 and 5 or more), and data on the location of the participant’s residence ‘Household location during lockdown situated in:’ during lockdown (categorised as 'City/Suburb,' ‘Township,' 'Town,' or 'Village/Farm’). The final three variables captured whether ‘Financial stress/ worry, having ‘Home circumstances that were challenging’ as well as ‘limited workspace at home’ were present during this time, to which responses were captured as either ‘yes’ or ‘no’.

3.3 Qualitative methods

Objective two sought to understand the impact of COVID-19 on Wits University. This was important because the new pedagogies, and resulting issues around epistemological access, as articulated in the conceptual framework (Figure 1), were thought to impact students' mental wellbeing as well as their academic success. Qualitative methods in the form of FGDs and IDIs were used to answer objective two.

Both staff members and students participated in the qualitative component of the study. The inclusion of staff members in the study was intentional, as they played a key role in shaping the student experience, especially in the context of the challenges brought on by the COVID-19 pandemic and the transition to Emergency Remote Teaching and Learning (ERTL). The perspectives of staff members, particularly those involved in student support and teaching, could add valuable insights into the institutional and pedagogical factors that influence student success. Further to this, the inclusion of staff allowed the study to gather a more holistic understanding of the environment in which students were operating, including the support structures and challenges from an educator's viewpoint. This complements the student data by providing context around the academic, psychological, and social dynamics that impacted student progression and retention.

3.3.1 Study sample

Participants were identified using several strategies including: stratified randomisation, using the excel randomiser feature, from the sample retrieved from the central university data warehouse. Stratified randomisation entailed grouping participants prior to randomising and ensuring each group was represented in the study sample. others were referred by members of the university community and a few were suggested by potential study participants who declined to participate (snowball approach). The only inclusion criterion was that participants were 18 years of age or older. Efforts were made to ensure representation across different faculties, sex, ages, years of study and programme types (undergraduate and post-graduate). The representation of hard-to-reach students, such as those living with disabilities or in remote areas, was prioritised.

3.3.2 Data collection procedure

Data collection took place between September and November 2020 and typically began with a recruitment email which detailed all study information. Participants who were referred by

others were recruited primarily via text messaging or voice call. Individuals were invited to take part in one of two activities: either an IDI or FGD. Participation in these activities was contingent upon obtaining their consent. These sessions were conducted off camera via Zoom and MS Teams and were recorded and saved for reference. To ensure the confidentiality of the participants during IDIs and FGDs, pseudonyms were assigned to them. The majority of IDIs and all FGDs were conducted in English, with a few IDIs being carried out in IsiZulu or Sesotho. Importantly, the audio recordings were devoid of any information that could potentially reveal the identities of the participants. In cases where the activity was not conducted in English, the audio recordings were translated into English and subsequently transcribed. The coordination of this work was carried out by the PhD student, however, the IDI and FGDs interviews were led by an external consultancy. Data collection ceased when data saturation was reached.

3.3.3 Analysis

Thematic analysis was used to analyse qualitative data. Two researchers independently conducted thematic analyses on several IDI and FGD transcripts, resulting in the development of initial coding frameworks. Through subsequent discussion and comparison, these separate frameworks were amalgamated into a unified framework for analysis. One researcher then applied the consolidated framework to analyse all transcripts using NVIVO 12 Pro software.

3.4 Ethical considerations

This doctoral research project obtained ethical clearance from the Human Research Ethics Committee (Medical) at the University of the Witwatersrand, Johannesburg (Clearance no. M210712). The parent study research project obtained ethical clearance from the Human Research Ethics Committee (Non-medical) at the University of the Witwatersrand, Johannesburg (Clearance no. (H20/06/22). Permission was also granted by the University Registrar for the collection of data.

Furthermore, alongside ethical approval, all individuals invited to partake in the studies voluntarily provided informed consent. Written informed consent was obtained online for both the survey and qualitative components of the study.

3.4.1 Distress protocol

A distress protocol, in partnership with the university's counselling services, was formulated to link students reporting severe depression symptoms and/or suicidal ideation symptoms in

the survey to care. Students who when answering the survey met any of the criteria below received the following pop-up message: "*If you would like to be contacted, please provide us with your contact details*.":

1. *Severe depressive symptomology defined as a Patient Health Questionnaire-9 (PHQ-9) score of greater than or equal to 20;*
2. *Suicidal ideation defined as "the thoughts of taking one's life" and defined in the PHQ as any affirmative response to Question 1.9: "Thoughts that you would be better off dead or of hurting yourself in some way".*

This was in addition to the counselling support details appearing at the top of each page of the online questionnaire, as well as an auto-direct to the institutional counselling services webpage at the end of the survey.

Participants who shared their contact details were called shortly after completing the questionnaire by a staff member who spoke to them about the various counselling options available to them.

Students and staff members participating in the qualitative work also received contact details of institutional mental support services, should they need them.

This chapter has outlined the comprehensive and methodologically rigorous approach taken to collect both quantitative and qualitative data for this study. By employing a mixed-methods design, including cross-sectional surveys and in-depth interviews, the research aimed to capture a multifaceted understanding of the factors influencing student success, particularly in the context of the COVID-19 pandemic. The inclusion of both mental health and food insecurity measures, alongside academic outcomes, enabled a detailed exploration of the challenges faced by students during this unprecedented time. The careful consideration of ethical issues, including the distress protocol and ensuring the confidentiality of participants, further cements the robustness of the study design. The following chapters will present and discuss the findings, integrating insights from both the quantitative and qualitative data to provide a holistic analysis of the impact of these factors on student progression and retention.

Chapter 4: Results

The results section is structured by research objective, and as such, is divided into four subsections. The first objective focuses on food insecurity, hunger and CMDs before the COVID-19 pandemic. Objectives two, three and four focus on food insecurity, hunger and CMDs during the pandemic. Only severe states of food insecurity, hunger and CMDs symptoms are tabulated, this is to simplify the tables while emphasizing the traits of students who face the highest risk.

4.1 Objective 1: The prevalence and determinants of anxiety, depression and mental distress symptomology, and food insecurity prior to COVID-19 and their influence on academic performance.

4.1.1 Description of the sample

Following the merger of two surveys administered in 2019, 727 records appeared only in the 'master' dataset, 711 records appeared in the 'using' dataset and 901 observations appeared in both the 'master' and 'using' dataset. Therefore, 901 student records formed part of the analytical sample, just over the required target of 591 required to sufficiently power the study. The sample was made up of 64.0% female students and 36.0% male students (Table 2). Most students were Black (75.7%) and attended quintile 5 (30.5%) and private/ international or other high schools (19.1%); most were registered in the Faculty of Humanities (28.9%), almost half were first-generation students (48.2%) and just over half were recipients of financial aid (51.3%) (Table 2).

4.1.2 Description of the sample by student failure

The crude student failure rate, defined as the percentage of students who did not meet the criteria to progress, was 23.4% (95% CI: 20.7- 26.3); when adjusted by sex and race, the failure rate remained similar at 23.0% (95% CI: 20.3- 25.8). Significantly higher percentages of failure were noted among Coloured (26.3%) and Black (25.8%) students ($p=0.011$ for race); students attending quintile 3 (30.9%) and quintile 1 (28.8%) high schools ($p=0.003$ for high school quintile); and students pursuing studies in the Faculty of Engineering (52.3%) ($p<0.001$ for faculty) (Table 2).

4.1.3 Description of the sample by student dropout

The crude student dropout rate, defined as students registered in 2019 who did not re-register at any time in the year 2020, was 5.1% (95% CI: 3.8- 6.8) and 5.5% (95% CI: 4.2- 7.2) when

adjusted. Significantly higher percentages of dropout were noted among students registered in the Faculty of Science (10.1%; p=0.006) and students who were recipients of NSFAS (6.8%; p=0.022).

Table 2: Unadjusted description of the sample by student progression and retention- before the COVID-19 pandemic

		Progression status			Retention status		
	Total sample n (%)	**Progression n (%)**	**Failure n (%)**	**p-value**	**Retained n (%)**	**Dropped out n (%)**	**p-value**
Sex				0.056			0.170
Female	575 (64.0)	452 (78.6)	123 (21.4)		550 (95.7)	25 (4.4)	
Male	326 (36.0)	238 (73.0)	88 (27.0)		305 (93.6)	21 (61.4)	
Race				0.011*			0.132
Black	682 (75.7)	506 (74.2)	176 (25.8)		647 (94.9)	35 (5.1)	
Coloured	19 (2.1)	14 (73.7)	5 (26.3)		16 (84.2)	3 (15.8)	
Indian	94 (10.4)	77 (81.9)	17 (18.1)		89 (94.7)	5 (5.3)	
White	106 (11.8)	93 (87.7)	13 (12.3)		103 (97.2)	3 (2.8)	
Age* [M (SD)]	19 (± 1.7)	19 (± 1.7)	19 (±1.8)	0.524	19 (± 1.7)	19 (± 1.7)	0.502
High school quintile				0.003*			0.539
1 (Lowest resourced schools)	66 (7.3)	47 (71.2)	19 (28.8)		62 (93.9)	4 (6.1)	
2	110 (12.2)	79 (71.8)	31 (28.2)		102 (92.7)	8 (7.3)	
3	162 (18.0)	112 (69.1)	50 (30.9)		153 (94.4)	9 (5.6)	
4	116 (12.9)	83 (71.6)	33 (28.5)		110 (94.8)	6 (5.2)	
5 (Highest resourced schools)	275 (30.5)	226 (82.2)	49 (17.8)		260 (94.6)	15 (5.5)	
Private/ Int./ Other	172 (19.1)	143 (83.1)	29 (16.7)		168 (97.7)	4 (2.3)	
Faculty				<0.001*			0.006*
Commerce, Law & Management	143 (15.9)	127 (88.8)	16 (11.2)		140 (98.0)	3 (2.1)	
Engineering	174 (19.3)	83 (47.7)	91 (52.3)		163 (93.7)	11 (6.3)	
Health Sciences	145 (16.1)	119 (82.1)	26 (17.9)		140 (96.6)	5 (3.5)	
Humanities	260 (28.9)	243 (93.5)	17 (6.5)		251 (96.5)	9 (3.5)	

Science	179 (19.9)	118 (65.9)	61 (34.1)		161 (90.0)	18 (10.1)	
First generation status				0.316			0.799
First-generation	434 (48.2)	326 (77.9)	108 (22.1)		411 (94.7)	23 (5.3)	
Non-first generation	467 (51.8)	364 (75.1)	103 (24.9)		444 (95.1)	23 (4.9)	
Financial-aid recipient				0.615			0.022*
Yes	462 (51.3)	357 (77.3)	105 (22.7)		446 (96.5)	30 (6.8)	
No	439 (48.7)	333 (75.9)	106 (24.2)		409 (93.2)	16 (3.5)	
Living with a disability				0.880			0.834
Yes	16 (1.8)	12 (75.0)	4 (25.0)		15 (93.8)	1 (6.3)	
No	885 (98.2)	678 (76.6)	207 (23.4)		840 (94.9)	45 (5.1)	

As the data is not normally distributed; age is described using median, Interquartile ranges and the Mann Whitney U test; the chi-square test was used to compare categorical variables to progression and retention status

*Significance at $p<0.05$.

4.1.4 Prevalence of wellbeing variables- before the COVID-19 pandemic

The prevalence of the various wellbeing measures is presented in Table 3. The crude prevalence of severe food insecurity among participants was 35.8% (95% CI: 32.8- 39.0) and 33.8% (95% CI: 30.1-37.0) when adjusted. The crude prevalence of severe hunger among participants was 4.3% (95% CI: 3.1- 5.9) and 4.0% (95% CI: 2.9- 5.5) when adjusted. In terms of CMDs, the crude prevalence of severe anxiety symptoms was 17.9% (95% CI: 15.5- 20.5) and 17.5% (95% CI: 15.2- 20.1) when adjusted. The crude prevalence of severe depression symptoms was 10.3% (95% CI: 8.5- 12.5) and 10.2% (95% CI: 8.5- 12.5) when adjusted. Finally, the crude prevalence of severe mental distress symptoms was 18.5% (95% CI: 16.1- 21.2) and 18.7% (95% CI: 16.3- 21.4) when adjusted.

Table 3: The crude and adjusted prevalence of wellbeing variables- before the COVID-19 pandemic

	Total	**Prevalence**	**Prevalence**
		Crude	Adjusted
		% (95% CI)	% (95% CI)
Food insecurity and hunger			
Food insecurity (HFIA Scale)			
Food secure	246	27.3 (24.5- 30.3)	30.3 (27.4- 33.4)
Mildly food insecure	108	12.0 (10.0- 14.3)	12.5 (10.5- 14.8)
Moderately food insecure	224	24.9 (22.1- 27.8)	23.4 (20.7- 26.3)
Severely food insecure	323	35.8 (32.8- 39.0)	33.8 (30.1- 37.0)
Hunger (HH Scale)			
Little to no hunger	704	78.1 (78.0- 78.2)	79.4 (76.6-81.9)
Moderate hunger	158	17.5 (17.5- 17.6)	16.7 (14.4-19.2)
Severe hunger	39	4.3 (3.1- 5.9)	4.0 (2.9-5.5)
Common mental disorders (CMDs)			
Anxiety symptoms (GAD-7)			
Minimal	261	29.0 (26.1- 32.0)	30.0 (27.1-33.1)
Mild	303	33.6 (30.6- 36.8)	33.2 (30.2-36.3)
Moderate	176	19.5 (17.1- 22.3)	19.3 (16.9-22.1)
Severe	161	17.9 (15.5- 20.5)	17.5 (15.2-20.1)
Depression symptoms (PHQ-9)			
Minimal	167	18.5 (16.1- 21.2)	19.3 (16.8- 22.0)
Mild	311	34.5 (31.5- 37.7)	34.5 (31.4- 37.6)
Moderate	208	23.1 (20.4- 26.0)	22.7 (20.1- 25.5)
Moderate Severe	122	13.5 (11.5- 16.0)	13.3 (11.2- 15.7)
Severe	98	10.3 (8.5- 12.5)	10.2 (8.5- 12.5)
Mental distress symptoms (PHQ-ADS)			
Minimal	223	24.8 (22.0- 27.7)	26.0 (23.3- 29.0)
Mild	316	35.1 (32.0- 38.3)	34.4 (34.4- 37.6)

Moderate	195	21.6 (19.1- 24.5)	20.8 (18.3- 23.6)
Severe	167	18.5 (16.1-21.2)	18.7 (16.3-21.4)

4.1.5 Description of severe food insecurity and hunger

Significantly higher rates of severe food insecurity were noted among male students (40.2%) when compared to female students (33.4%) (p=0.041) (Table 4). In terms of race, significantly more Coloured students (47.4%) and Black students (44.0%) experienced the highest levels of severe food insecurity (p<0.001). The highest levels of severe food insecurity were also found among students who attended quintile 1 high schools (57.6%; p<0.001), students who were pursuing studies in engineering (43.7%; p<0.001), students who were first generation (39.4%; p<0.001), students who were first in their family to attend university (39.4%; p=0.031), and students who were recipients of financial aid (41.1%; p<0.001).

In terms of hunger, higher rates of severe hunger were noted among male students (6.1%) when compared to female students (3.3%) (p=0.045). In terms of race, Black students were significantly more likely to experience severe hunger (5.7%; p=0.004). Additionally, the highest levels of severe hunger were found among students who attended quintile 1-3 high schools ranging from 4.6-8.0% (p=0.007). A total of 6.0% of first generation students experienced severe hunger; a significant proportion compared to non-first generation students (p=0.018).

Table 4: Unadjusted description of the sample by severe food insecurity and hunger- before the COVID-19 pandemic

	Total sample n (%)	**Food insecurity and hunger**			
		Severe food insecurity n (%)	**p-value**	**Severe hunger n (%)**	**p-value**
Sex			0.041*		0.045*
Female	575 (64.0)	192 (33.4)		19 (3.3)	
Male	316 (36.2)	131 (40.2)		20 (6.1)	
Race			<0.001*		0.004*
Black	682 (75.7)	300 (44.0)		39 (5.7)	
Coloured	19 (2.1)	9 (47.4)		0 (0)	
Indian	94 (10.4)	5 (5.3)		0 (0)	
White	106 (11.8)	9 (8.5)		0 (0)	
Age* [M (SD)]	19.0 (± 1.7)	19.0 (± 2.3)	0.786	20.0 (± 4.1)	0.388
High school quintile			<0.001*		0.007*
1 (Lowest resourced schools)	66 (7.3)	38 (57.6)		3 (4.6)	
2	110 (12.2)	52 (47.3)		6 (5.5)	

3	162 (18.0)	73 (45.1)		13 (8.0)	
4	116 (12.9)	56 (48.3)		9 (7.8)	
5 (Highest resourced schools)	275 (30.5)	73 (26.6)		5 (1.8)	
Private/ Int./ Other	172 (19.1)	31 (18.2)		3 (1.7)	
Discipline of study			<0.001*		0.445
Commerce, Law & Management	143 (15.9)	35 (24.5)		7 (4.9)	
Engineering	174 (19.3)	76 (43.7)		9 (5.2)	
Health Sciences	145 (16.1)	40 (27.6)		2 (1.4)	
Humanities	260 (28.9)	107 (41.2)		12 (4.6)	
Sciences	179 (19.9)	65 (36.3)		9 (5.3)	
First generation status			0.032*		0.018*
First-generation	434 (48.2)	152 (39.4)		26 (6.0)	
Non-first generation	467 (51.8)	171 (32.6)		13 (2.8)	
Financial-aid recipient			0.001*		0.512
Yes	462 (51.3)	133 (41.1)		22 (4.8)	
No	439 (48.7)	190 (30.3)		17 (3.9)	
Living with a disability			0.506		0.703
Yes	16 (1.8)	7 (43.8)		1 (6.3)	
No	885 (98.2)	316 (35.7)		38 (4.3)	

Age is described using median, Interquartile ranges and the Mann Whitney U test; the chi-square test was used to compare categorical variables to severe food insecurity and hunger.
*Significance at $p<0.05$.

4.1.6 Description of severe mental distress symptoms

Significantly higher rates of severe anxiety symptoms were noted among students from quintile 1-3 ranging from 16.7- 39.4%, with the lowest levels of severe anxiety symptoms noted among students from quintile 3 high schools (13.8%; $p<0.001$) (Table 5).

In terms of severe depression symptoms, Coloured students had the highest levels of severe depression symptoms (36.8%) followed by Black students (11.0%). White students had the lowest rates (3.8%; $p<0.001$). Significantly higher rates of severe depression symptoms were noted among students from quintile 1 (19.7%) and 2 (14.6%) high schools, with students coming from high schools categorised as 'private/ international or other' having the lowest rates (6.4%; $p=0.040$). Significantly higher rates of severe depression symptoms were noted among students living with disabilities 31.3% ($p=0.005$).

Finally, Coloured students had the highest levels of severe mental distress symptoms (42.1%), with the lowest rates occurring among White students (12.3%; $p=0.020$). At 37.5% students living with disabilities exhibited the highest levels of severe mental distress symptoms, compared to 18.2% among those not reporting any disabilities ($p=0.049$).

Table 5: Unadjusted description of the sample by severe common mental disorder symptoms- before the COVID-19 pandemic

	Total Sample n (%)	Common mental disorder symptoms					
		Severe anxiety n (%)	p-value	Severe depression n (%)	p-value	Severe Mental distress % (n)	p-value
Sex			0.342		0.546		0.799
Female	575 (64.0)	108 (18.8)		62 (10.8)		108 (18.8)	
Male	316 (36.2)	53 (16.3)		31 (9.5)		59 (18.1)	
Race			0.217		<0.001*		0.020*
Black	682 (75.7)	128 (18.8)		75 (11.0)		129 (18.9)	
Coloured	19 (2.1)	5 (26.3)		7 (36.8)		8 (42.1)	
Indian	94 (10.4)	16 (17.0)		7 (7.5)		17 (18.1)	
White	106 (11.8)	12 (11.3)		4 (3.8)		13 (12.3)	
Age* [M (SD)]	19 (± 1.7)	19.0 (± 1.6)	0.141	19 (± 0.9)	0.259	19 (± 1.1)	0.511
High school quintile			<0.001*		0.040*		0.118
1 (Lowest resourced schools)	66 (7.3)	26 (39.4)		13 (19.7)		20 (30.3)	
2	110 (12.2)	25 (22.7)		16 (14.6)		25 (22.7)	
3	162 (18.0)	27 (16.7)		15 (9.3)		28 (17.3)	
4	116 (12.9)	16 (13.8)		11 (9.5)		19 (16.4)	
5 (Highest resourced schools)	275 (30.5)	40 (14.6)		27 (9.8)		46 (16.7)	
Private/ Int./ Other	172 (19.1)	27 (15.7)		11 (6.4)		29 (16.9)	
Study Discipline			0.111		0.557		0.139
Commerce, Law & Management	143 (15.9)	24 (16.8)		15 (10.5)		25 (17.5)	
Engineering	174 (19.3)	26 (14.9)		16 (9.2)		29 (16.7)	
Health Sciences	145 (16.1)	19 (13.1)		11 (7.6)		18 (12.4)	
Humanities	260 (28.9)	50 (19.2)		33 (12.7)		57 (21.9)	
Sciences	179 (19.9)	42 (23.5)		18 (10.1)		38 (21.2)	
First generation status			0.801		0.483		0.789
First-generation	434 (48.2)	79 (18.2)		48 (11.1)		82 (18.9)	
Non-first generation	467 (51.8)	82 (17.6)		45 (9.6)		85 (18.2)	
Financial-aid recipient			0.671		0.612		0.814
Yes	462 (51.3)	85 (18.4)		50 (10.9)		87 (18.8)	
No	439 (48.7)	76 (17.3)		43 (9.8)		80 (18.2)	
Living with a disability			0.221		0.005*		0.049*
Yes	16 (1.8)	1 (6.3)		5 (31.3)		6 (37.5)	
No	885 (98.2)	160 (18.1)		88 (9.9)		161 (18.2)	

Age is described using median, Interquartile ranges and the Mann Whitney U test; the chi-square test was used to compare categorical variables to severe CMD symptoms. *Significance at p<0.05.

4.1.7 Regression models

Severe food insecurity: Being a White (OR = 0.09; 95% CI: 0.04- 0.20; p <0.001) or Indian (OR= 0.12; 95% CI: 0.06- 0.24; p <0.001) student decreased the odds of severe food insecurity odds ratio. Furthermore, attending a high school categorised as private/ international or other also decreased the odds of severe food insecurity (OR= 0.39; 95% CI: 0.23- 0.66; p <0.001). Students pursuing studies in the Faculty of Humanities (OR= 2.84; 95% CI: 1.71- 4.71; p <0.001), Faculty of Engineering (OR= 2.52; 95% CI: 1.50- 4.21; p <0.001) and Faculty of Sciences (OR= 1.98; 95% CI: 1.16- 3.35; p =0.012) had an increased odds of severe food insecurity (Table 6).

Severe hunger: In terms of severe hunger, students who were first generation were at more than double the risk of experiencing severe hunger (OR= 2.44; 95% CI: 1.19- 5.00; p =0.015) (Table 6).

Table 6: Adjusted logistic regression models of severe food insecurity and hunger before the COVID-19 pandemic

	Severe food insecurity		**Severe hunger**	
	OR (95 CI)	**p-value**	**OR (95 CI)**	**p-value**
Sex (reference: female)				
Male	1.22 (0.89- 1.69)	0.211	1.74 (0.88- 3.43)	0.111
Race (reference: Black)			**	
Coloured	1.33 (0.65- 2.72)	0.436	-	-
Indian	0.09 (0.04- 0.20)	<0.001*	-	-
White	0.12 (0.06- 0.24)	<0.001*	-	-
High school quintile category (reference: quintiles 1-3)				
Quintiles 4&5	0.72 (0.50- 1.02)	0.071	-	-
Private/ Int./ Other	0.39 (0.23- 0.66)	<0.001*	-	
Financial-aid recipient				
Yes	0.73 (0.51- 1.03)	0.074	-	-
Faculty (reference: Commerce, Law & Management)				
Engineering	2.52 (1.50- 4.24)	<0.001*	-	-
Health Sciences	1.77 (0.99- 3.19)	0.055	-	-
Humanities	2.84 (1.7- 4.71)	<0.001*	-	-
Sciences	1.98 (1.16- 3.35)	0.012*	-	-
First Generation category (reference quintiles: No)				
Yes	-	-	2.44 (1.19- 5.00)	0.015*

**Indicates variables that did not meet the variable selection criteria

*Significance at p<0.05.

Severe anxiety symptoms: Students who attended high schools categorised as quintile 4 and 5 had a decreased risk of severe anxiety symptoms (OR= 0.56; 95% CI: 0.37- 0.87; p =0.009) (Table 7).

Severe depression symptoms: Being a Coloured student increased the risk of severe depression symptoms almost five-fold (OR= 4.87; 95% CI: 2.15- 11.00; p <0.001). Students living with disabilities also had a more than five-fold risk of severe depression symptoms (OR= 5.49; 95% CI: 1.86- 16.17; p =0.002) when compared to students reporting no disabilities. Students who had attended high schools categorised as private/ international or other had a decreased odds of severe depression symptoms (OR= 0.42; 95% CI: 0.19- 0.92; p=0.031) (Table 7).

Severe mental distress symptoms: Being a Coloured student increased the risk of severe mental distress symptoms almost three-fold (OR= 2.63; 95% CI: 1.28- 5.42; p =0.008). Finally being a student living with disabilities more than tripled the risk of severe depression symptoms (OR= 3.15; 95% CI: 1.18- 8.40; p =0.022) (Table 7).

Table 7: Adjusted logistic regression of determinants of severe CMD symptoms before the COVID-19 pandemic

	Severe anxiety symptoms		**Severe depression symptoms**		**Severe mental distress symptoms**	
	OR (95 CI)	**p-value**	**OR (95 CI)**	**p-value**	**OR (95 CI)**	**p-value**
Sex (reference: female)						
Male	0.76 (0.53- 1.11)	0.161	0.74 (0.46- 1.17)	0.193	0.96 (0.67- 1.38)	0.846
Race (reference: Black)						
Coloured	1.88 (0.81- 4.36)	0.148	4.87 (2.15- 11.00)	<0.001*	2.63 (1.28- 5.42)	0.008*
Indian	1.18 (0.68- 2.04)	0.566	0.78 (0.35- 1.72)	0.534	1.07 (0.65- 1.76)	0.785
White	0.67 (3.48, 1.29)	0.229	0.47 (0.18- 1.24)	0.127	0.58 (0.33- 1.01)	0.055
High school quintile category (reference: quintiles 1-3)						
Quintiles 4&5	0.56 (0.37- 0.87)	0.009*	0.66 (0.39- 1.12)	0.126	-	--
Private/ Int./ Other	0.65 (0.37- 1.14)	0.136	0.42 (0.19- 0.92)	0.031*	-	
Faculty (reference: Commerce, Law & Management)						
Engineering	0.82 (0.44- 1.52)	0.522	-	-	-	-
Health Sciences	0.81 (0.42- 1.60)	0.550	-	-	-	-
Humanities	1.23 (0.71- 2,13)	0.469	-	-	-	-
Sciences	1.63 (0.93- 2.87)	0.088	-	-	-	-
Living with a Disability (reference: No)						
Yes	-	-	5.49 (1.86- 16.17)	0.002*	3.15 (1.18- 8.40)	0.022*

**Indicates variables that did not meet the variable selection criteria

*Significance at p<0.05.

Student dropout: Being a Coloured student more than quadrupled the risk of dropout (OR= 4.12; 95% CI: 1.51- 11.20; p =0.006). Students who were recipients of financial aid were less likely to drop out (OR= 0.49; 95% CI: 0.25- 0.96; p =0.038). Finally, being registered in the Faculty of Sciences increased the risk of dropout almost 6-fold (OR= 5.97; 95% CI: 1.64- 21.68; p=0.007) (Table 8).

Table 8: Adjusted logistic regression model of the determinants of student dropout before the COVID-19 pandemic

	OR (95% CI)	**Standard error**	**p-value**
Sex (reference: Female)			
Male	1.51 (0.81- 2.81)	0.478	0.197
Race			
Coloured	4.12 (1.51- 11.20)	2.102	0.006*
Indian	1.16 (0.45- 3.02)	0.565	0.755
White	0.48 (0.14- 1.60)	0.295	0.231
Food Insecurity			
Mildly food insecure	0.98 (0.31- 3.04)	0.566	0.967
Moderately food insecure	0.69 (0.24- 2.03)	0.380	0.501
Severely food insecure	2.10 (9.15 4.82)	0.890	0.080
Financial-aid recipient (reference: No)			
Yes	0.49 (0.25- 0.96)	0.168	0.038*
Faculty (reference: Commerce, Law & Management)			
Engineering	2.56 (0.67- 9.79)	1.751	0.112
Health Sciences	2.55 (0.60- 10.86)	1.886	0.152
Humanities	1.95 (0.49- 7.78)	1.376	0.244
Sciences	5.97 (1.64- 21.68)	3.929	0.007*

*Significance at p<0.05.

Student failure: Being registered in the Faculty of Engineering increased failure risk 11-fold (OR = 11.06; 95% CI: 5.80- 21.11; p<0.001) and the Faculty of Science by almost 4-fold (OR = 3.98; 95% CI: 2.10- 7.56; p<0.001). Students who were severely food insecure were almost twice as likely to experience failure (OR = 1.77; 95% CI: 1.10- 2.84; p=0.018). Furthermore, students who experienced any kind of mental distress symptoms were more than twice as likely to experience a delay: mild mental distress (OR = 2.36; 95% CI: 1.39- 4.01, p=0.001), moderate mental distress (OR = 3.36; 95% CI: 1.90- 5.92, p<0.001), severe mental distress (OR = 3.29; 95% CI: 1.82- 5.94, p<0.001) (Table 9).

Table 9: Adjusted logistic regression model of determinants of student failure before the COVID-19 pandemic

	OR (95% CI)	Standard error	p-value
Sex (reference: Female)			
Male	0.78 (0.53-1.14)	0.152	0.195
High school quintile category (reference: Quintile 1)			
2	0.80 (0.35-1.80)	0.330	0.585
3	1.18 (0.55-2.53)	0.460	0.679
4	0.83 (0.37-1.86)	0.342	0.651
5 (High resourced schools)	0.55 (0.26-1.15)	0.207	0.110
Private/ Int./ Other	0.52 (0.23-1.16)	0.213	0.111
Faculty (reference: Commerce, Law & Management)			
Engineering	11.06 (5.80-21.11)	3.647	<0.001*
Health Sciences	1.94 (0.94-4.01)	0.719	0.073
Humanities	0.48 (0.23-1.04)	0.188	0.062
Sciences	3.98 (2.10-7.56)	1.303	<0.001*
Food insecurity			
Mildly food insecure	1.25 (0.66-2.37)	0.408	0.490
Moderately food insecure	0.80 (0.46-1.39)	0.225	0.436
Severely food insecure	1.77 (1.10-2.84)	0.428	0.018*
Mental distress			
Mild	2.36 (1.39-4.01)	0.637	0.001*
Moderate	3.36 (1.90-5.92)	0.971	<0.001*
Severe	3.29 (1.82-5.94)	0.992	<0.001*

*Significance at $p<0.05$.

4.2 Objective 2: Impact of the COVID-19 pandemic on South African universities

The sample for in-depth interviews (IDIs) consisted of 20 students and 10 staff members, while the focus group discussions (FGDs) involved 23 students and 12 staff members. There were 3 student FGDs, each comprising 7 to 9 students, and 2 staff FGDs, with 1 group consisting of 7 support staff members and the other comprising 5 academic staff members (see Table 10).

Table 10: Demographics of IDI and FGD participants

	In-depth interviews		**Focus group discussions**	
	Students	**Staff**	**Students**	**Staff**
Sex				
Male	8	3	10	3
Female	12	7	13	9
Race				
Black African	19	8	20	5
White	1	1	-	5
Indian	-	1	1	-
Coloured	-	-	2	2
Age group				
<22	6	-	6	-
22-23	5	-	5	-
24-30	6	-	4	-
>30	3	10	8	12
Academic or support staff				
Academic	-	2	-	7
Professional/ support staff	-	8	-	5
Undergraduate/ Postgraduate				
Undergraduate	15	-	16	-
Postgraduate	5	-	7	-
Registered full-time or part time				
Full-time	17	-	18	-
Part-time	3	-	5	-

The various forms of qualitative data, including in-depth interviews and focus group discussions, were systematically analysed and integrated to identify recurring patterns. The data revealed several themes, which are organized into three overarching categories. The first theme centred on *Challenges with technology*, encompassing aspects related to data accessibility and connectivity. The second theme, *Pedagogical drawbacks and advantages* addressed topics concerning learning and teaching strategies, workload management, and the effects of the lockdown on education. The final theme, *Multidimensional impact on wellbeing*, encompassed categories related to domestic/ household challenges and mental wellbeing.

4.2.1 Challenges with technology

Findings from the student-focused FGDs and IDIs indicated that the majority of students obtained data access either through the university's monthly data provision plan or by utilizing their personal resources. However, students who primarily relied on the monthly data allocation from the university encountered several challenges. First, during the early stages of ERTL, students using mobile phone providers other than the university's initially selected provider were required to purchase new SIM cards to access data. Second, several students reported that the allocated data was insufficient, leading them to purchase additional data packages to meet their requirements. Lastly, students frequently grappled with poor cell phone reception and intermittent internet connectivity. These issues were partially attributed to frequent power outages, which disrupted both studying and work.

> "the connection one was a problem, it was a problem that cost because now when we started classes on Teams […] you were always late on class, if you have data you have connection issues." Student- Interview 5

> "So, we wouldn't have electricity for a week and then when you log in you've got so much work and you can't manage it. I've missed uhm submission dates, I've missed quizzes, I've missed important announcements […] I never knew when they were happening because, wow, they were probably happening when we didn't have electricity..." Student- Interview 10

4.2.2 Pedagogical drawbacks and advantages

Although there were a few cases where students managed well, the majority faced challenges with the learning environment during lockdown. Students often perceived online learning as

lacking personal touch, found it intimidating and awkward to ask questions during online lectures, and encountered difficulties in arranging one-on-one consultations with their lecturers. The process of securing appointments with lecturers was often time-consuming, and delays in email responses frequently resulted in a mismatch with the current class subject matter by the time students managed to secure a meeting.

> "when you're on campus, there's an in-depth and nuanced dialogue with the students in class and the lecturer which can [be] carried into the lecturer's office, you know for further, um, immediate clarification." Student- Focus Group 3

The impact of the transition to ERTL extended beyond interactions with lecturers. Students also noted that the spontaneous class discussions and debates that were commonplace in traditional, in-person classes could not be effectively recreated on digital platforms. This posed particular challenges for new students, who felt that they had missed out on the immersive experience of becoming a part of Wits' academic culture.

> "The atmosphere [in remote learning] no longer allows you or enables you to engage and critically think. We used to challenge each other in class, challenge each other's ideas and engage and that will also enable others to think and engage." Student- Interview 5

Students expressed uncertainty regarding whether methods like open-book exams effectively evaluated their knowledge. They also raised concerns about the heightened risk of cheating during tests, as the use of communication platforms like WhatsApp enabled discussions about answers during the testing process.

> "Or perhaps in terms of the group chats… there was the problem of cheating, I think it was the business school that caught some pupils cheating and they got in a lot of trouble so that created a lot of anxiety for those of us in these classes because you are scared someone might say something that's considered cheating." Student- Interview 2

The impact of the new learning mode was not universally negative. Academic staff members acknowledged some positive aspects, noting that certain student groups appeared to have a better grasp of complex subjects and performed well in assessments. This improvement was

attributed to students' ability to replay recorded lectures. Students themselves listed having access to lecture recordings as one of the significant advantages of online learning.

> "…We found in any case that they've actually performed better, their understanding seems to be better, on average, then in previous years, which is very interesting and unexpected. And we think it has to do with the fact that they don't have to take lectures, all the information was given to them and they can go over it again and again…" Academic Staff- Focus Group 1

Both staff and student participants expressed concerns about the increased workloads they faced during the lockdown, often resulting in late-night work sessions. Students attributed the heavy workload to academic staff compensating for the absence of practical activities, and lecturers potentially assuming they had more time available due to the lockdown.

> "It was actually a lot. It required well at least a week but then now you were given I think about two days to complete the whole thing, of which at some point came as a mission impossible. But then again, we did it, eish [gosh], we had to." Student- Interview 17

A staff member from the ICT department noted that students would reach out to her for late-night assistance requiring support with their overnight data. Teaching staff members also mentioned that they often worked during weekends and evenings to engage with students, as these were the times when most students were online.

> "As soon as they get your number, they will call you at 10 pm to tell you that they can't access their data and they need to submit stuff." Staff- Interview 10

4.2.3 Multidimensional impact on wellbeing

Numerous factors related to living conditions and overall wellbeing contributed to the challenges of studying and working during the lockdown. This encompassed the scarcity of quiet, physical spaces where both students and staff could work for extended periods of time. Additionally, household and domestic responsibilities, such as childcare and household chores, competed with work and study commitments.

> "I live in a two-room house, not a bedroom, a two-room house, a kitchen and a bedroom which I share with four of my siblings and my mother included so there isn't even space to study." Student- IDI 10

A notable observation from the narratives was the heightened expectations placed on female staff and student participants in terms of caregiving and assuming a more substantial share of household responsibilities.

> "… the support wasn't enough at home since they expect you to do some house chores, you need to clean the house, wash the dishes, while like, when I'm staying at res [residence hall], I know I'm eating at dining hall and I don't have like that time to wash dishes…" Student- Focus Group 1

The participants expressed concern for contracting COVID-19, and they also expressed concerns for the health and wellbeing of their friends and family. One student, who had tested positive for COVID-19, recounted feelings of being inundated with information and harbouring uncertainties about their survival.

> "I feel like it caused a scare because like everyone was going so fast and we were all thinking what if I am next or what about my family?" Student- IDI 3

A few individuals among the staff and student groups also revealed the distressing experience of losing multiple loved ones. They also highlighted the emotional challenges of coping with the absence of proper closure after their loved ones had passed away.

> "The challenge is that we are left with broken hearts because we were not able to help the family out or to attend the funeral." Staff- Interview 12

Both staff and student participants openly discussed their mental wellbeing and at times the complex dynamics around food during the lockdown. They acknowledged several stressors, financial strain, household tensions, concerns about physical violence, and the absence of in-person interaction with peers, which all contributed to feelings of confinement and loneliness. Furthermore, students expressed that inadequate communication from lecturers heightened anxiety among students.

> "… so, I would have to like withdraw money to get food for the household and make sure I go grocery shopping with my grandmother to make sure we get things for the house and like no one would be willing to participate or help out and it was just

> stressful because I am not used to that. I am not used to having to stress over a household of over six people.” Student- Interview 12

Staff participants also raised concerns about the financial stress and hardships that the pandemic had brought into their lives. In particular, cleaning and security staff members mentioned how the pandemic had resulted in job losses for their family members and friends, describing the significant impact this had on their own financial stability. They also discussed the pressure they felt to provide support under these challenging circumstances.

> “... [the pandemic] affected me greatly because I’m the one that used to help them a lot, they used to think that my job is better than theirs. They have thrown everything into my hands, expecting me to buy this and that”. Staff- Interview 12

4.3 Objective 3: Food insecurity, anxiety, and depression symptomology prevalence during the COVID-19 pandemic

4.3.1 Description of the sample

A total of 596 student records formed part of the analytical sample, just over the required target of 595 required to sufficiently power the study. The sample was made up of 65.5% female students and 34.5% male students. Most students were Black (61.4%) and attended quintile 5 (34.6%) and private/ international or other high schools (27.4%). Most were registered in the Faculty of Humanities (31.4%), 39.8% reported being first-generation students and 44.5% were recipients of NSFAS (Table 11).

4.3.2 Description of the sample by student failure

The crude student failure rate among study participants was 14.6% (95% CI: 12.0- 17.7) and the adjusted 16.0% (95% CI: 13.3- 19.2). Significantly higher percentages of failure were noted among male students (18.9%) when compared to female students (12.3%) (p=0.029). In terms of race, Black students had significantly higher rates of failure (20.2%; p<0.001) compared to other races. Students who attended quintile 1, 2 and 3 schools had significantly higher levels of failure compared to other students (ranging from 18.2- 25.0%; p=0.028) (as presented in Table 11).

4.3.3 Description of the sample by student dropout

The crude student dropout rate among study participants was 9.9% (95% CI 7.7- 12.6) and 10.5% (95% CI 8.2- 13.2) when adjusted. Significantly higher percentages of dropout were noted among male students (14.1%) compared to female students (7.7%) (p=0.013) and students who were older in age (p=0.005) (as presented in Table 11).

Table 11: Unadjusted description of the sample by student progression and retention- during the COVID-19 pandemic

	Total sample n (%)	Progression status			Dropout status		p-value
		Progression n (%)	Failure n (%)	p-value	Retained n (%)	Dropped out n (%)	
Sex				0.029*			0.013*
Female	390 (65.5)	342 (87.7)	48 (12.3)		360 (92.3)	30 (7.7)	
Male	206 (34.5)	167 (81.1)	39 (18.9)		177 (85.9)	29 (14.1)	
Race				<0.001*			0.297
Black	366 (61.4)	292 (79.8)	74 (20.2)		326 (89.1)	40 (11.0)	
Chinese	3 (0.50)	3 (100.0)	0 (0.0)		3 (100.0)	0 (0.0)	
Coloured	34 (5.70)	32 (94.1)	2 (5.9)		34 (100.0)	0 (0.0)	
Indian	74 (12.4)	71 (96.0)	3 (4.1)		68 (91.9)	6 (8.1)	
White	119 (20.0)	111 (93.3)	8 (6.7)		106 (89.1)	13 (10.9)	
Age M(SD)**	20 (± 2.3)	20(± 2.3)	20 (±1.80)	0.861	19.8 (± 2.0)	20.1 (± 3.3)	0.005*
High school quintile							0.153
1 (Lowest resourced schools)	33 (5.5)	27 (81.8)	6 (18.2)	0.028*	27 (81.8)	15 (45.5)	
2	56 (9.4)	42 (75.0)	14 (25.0)		46 (81.2)	21 (37.5)	
3	72 (12.1)	58 (80.6)	14 (19.4)		66 (91.7)	16 (22.2)	
4	66 (11.1)	55 (83.3)	11 (16.7)		59 (89.4)	12 (18.2)	
5 (Highest resourced schools)	206 (34.6)	177 (86.0)	29 (14.1)		189 (91.8)	20 (9.7)	
Private/ Int./ Other	163 (27.4)	150 (92.0)	13 (8.0)		150 (92.0)	13 (8.0)	
Faculty				<0.001*			0.714
Commerce, Law & Management	81 (13.4)	71 (87.7)	10 (12.4)		76 (93.8)	5 (6.2)	
Engineering	127 (21.3	91 (71.7)	36 (28.4)		113 (89.0)	14 (11.0)	
Health Sciences	88 (14.8)	82 (93.2)	6 (6.8)		78 (88.6)	10 (11.4)	
Humanities	187 (31.4)	168 (89.8)	19 (10.2)		170 (91.0)	17 (9.1)	
Sciences	113 (19.0)	97 (85.8)	16 (14.2)		100 (88.5)	13 (11.5)	

First generation status				0.079			0.897
First-generation	237 (39.8)	195 (82.4)	42 (17.7)		214 (90.3)	23 (9.7)	
Non-first generation	359 (60.2)	314 (87.5)	45 (12.5)		323 (90.0)	36 (10.0)	
Financial-aid recipient				0.016*			0.734
Yes	265 (44.5)	216 (81.5)	49 (18.5)		240 (90.6)	25 (90.4)	
No	331 (55.5)	293 (88.5)	38 (11.5)		297 (89.7)	34 (10.3)	
Self- reported disability Status				0.671			0.329
Yes	18 (3.0)	16 (88.9)	2 (11.1)		15 (83.3)	3 (16.7)	
No	578 (97.0)	493 (85.3)	85 (14.7)		533 (90.3)	56 (9.7)	

*Age is described using median, Interquartile ranges and the Mann Whitney U test; the chi-square test was used to compare categorical variables to progression and retention status Significance at $p<0.05$.

In terms of COVID-19-related variables, students who reported residing in villages or farms during the lockdown had significantly higher proportions of failure at 26.0% ($p<0.001$) and dropout at 19.2% ($p=0.041$). Additionally, students belonging to large households had significantly higher proportions of failure at 19.7% ($p=0.033$) (Table 12).

Table 12: Unadjusted COVID-19 pandemic-related variables by student progression and retention

	Total sample n (%)	Progression status			Retention status		
		Progress n (%)	Failure n (%)	p-value	Retained n (%)	Dropped out n (%)	p-value
COVID-19 Variables							
Self- reported COVID-19 infection (of participant and/or close friends and family)				0.456			0.209
Yes	46 (7.7)	41 (89.1)	5 (10.9)		39 (84.8)	7 (15.2)	
No	550 (92.3)	468 (85.1)	82 (14.9)		498 (90.5)	52 (9.5)	
Place of residence during lockdown				0.395			0.698
On or off-campus residence	27 (4.5)	26 (96.3)	1 (4.7)		26 (96.3)	1 (4.7)	
With Relatives	40 (6.7)	31 (78.0)	9 (23.0)		20 (95.0)	2 (5.0)	
At home	526 (88.3)	449 (85.4)	77 (14.6)		470 (89.4)	56 (10.6)	
No stable accommodation	3 (0.3)	2 (100.0)	0 (0.0)		2 (100.0)	0 (0.0)	
Other	1 (0.2)	1 (100.0)	0 (0.0)		1 (100.0)	0 (0.0)	
Household size				0.033*			0.323
Living alone	41 (6.9)	38 (92.7)	3 (7.3)		38 (92.7)	3 (7.3)	
2	106 (17.8)	89 (84.0)	17 (16.0)		92 (86.8)	14 (13.2)	
3-4	246 (41.3)	219 (89.0)	27 (11.0)		228 (92.7)	18 (7.3)	
5 or more	203 (34.1)	163 (80.3)	40 (19.7)		179 (88.2)	24 (11.8)	
Household location during lockdown situated in:				<0.001*			0.041*
City/ Suburb	357 (60.0)	324 (90.8)	33 (9.2)		325 (91.0)	32 (9.0)	
Township	121 (20.3)	94 (77.7)	27 (22.3)		112 (92.6)	9 (7.4)	
Town	44 (7.4)	36 (81.8)	8 (18.2)		40 (91.0)	4 (9.1)	

Village/farm	73 (12.3)	54 (74.0)	19 (26.0)		59 (80.8)	14 (19.2)	
Financial stress/ worry				0.813			0.549
Yes	315 (52.9)	268 (85.1)	47 (14.9)		90.8 (286)	29 (9.2)	
No	281 (47.2)	241 (85.8)	40 (14.2)		89.3 (251)	30 (10.7)	
Home circumstances challenging				0.745			0.624
Yes	311 (52.2)	267 (85.9)	44 (14.2)		282 (90.7)	29 (9.3)	
No	285 (47.8)	242 (84.9)	43 (15.1)		255 (89.5)	30 (10.5)	
Limited workspace at home				0.160			0.380
Yes	301 (51.0)	251 (83.4)	50 (16.6)		268 (89.0)	33 (11.0)	
No	295 (50.0)	258 (87.5)	37 (12.5)		269 (91.2)	26 (8.8)	

The chi-square test was used to compare categorical variables to progression and retention status
*Significance at $p<0.05$.

4.3.4 Student failure pre and during the COVID-19 pandemic

When comparing failure rates between the two time periods, a higher failure rate was observed before COVID-19 (23.4%) compared to during COVID-19 (15.6%) (Table 13). The Chi-square test provides strong evidence to suggest that the period relative to COVID-19 (before vs. during COVID) is significantly associated with academic failure rates ($\chi^2(1, N = 1,497) = 17.51$, $p < 0.001$). This suggests that the pandemic period might have had a significant impact on reducing academic failures.

Table 13: Student failure before and during the COVID-19 pandemic

	Total n(%)	Progression status		
		Progress n(%)	Failure n(%)	p-value
Time Period				<0.001*
Before COVID-19 (2019)	901 (60.2)	690 (76.6)	211 (23.42)	
During COVID-19 (2020)	596 (39.8)	509 (85.4)	87 (15.6)	

The chi-square test was used to compare categorical variables to progression and retention status
*Significance at p<0.05.

4.3.5 Prevalence of wellbeing variables- during the COVID-19 pandemic

The crude prevalence of severe food insecurity among participants was 23.0% (95% CI: 19.8- 26.5) and 25.7% (95% CI: 22.3- 29.4) when adjusted (Table 14). The crude prevalence of severe hunger among participants was 3.0% (95 CI: 1.9- 04.7) and 3.4% (95% CI: 2.2- 5.2) when adjusted. In terms of CMDs, the crude prevalence of severe anxiety symptoms was 25.2% (95% CI: 21.8- 28.8) and 25.4% (95% CI: 22.0- 29.1) when adjusted. The crude prevalence of severe depression symptoms was 14.4% (95% CI: 11.8- 17.5) and 14.1% (95% CI: 11.5- 17.1) when adjusted, finally, the crude prevalence of severe mental distress symptoms was 26.5% (95% CI: 23.1- 30.2) and 26.7% (95% CI: 23.3- 30.4) when adjusted.

Table 14: The crude and adjusted prevalence of wellbeing variables- during the COVID-19 pandemic

	Total	**Prevalence**	**Prevalence**
		Crude	Adjusted
		% (95% CI)	% (95% CI)
Food insecurity (HFIA Scale)			
Food secure	253	42.4 (38.5- 46.5)	37.9 (34.1- 41.9)
Mildly food insecure	87	14.6 (12.0- 17.7)	15.2 (12.6- 18.4)
Moderately food insecure	119	20.0 (16.9- 23.4)	21.2 (18.7- 24.7)
Severely food insecure	137	23.0 (19.8- 26.5)	25.7 (22.3- 29.4)

Hunger (HH Scale)			
Little to no hunger	510	85.6 (82.5- 88.2)	83.6 (80.4- 86.4)
Moderate hunger	68	11.4 (9.1- 14.2)	13.0 (10.5- 15.9)
Severe hunger	18	3.0 (1.9- 04.7)	3.4 (2.2- 5.2)
Common Mental Disorders (CMDs)			
Anxiety symptoms (GAD-7)			
Minimal	137	23.0 (19.8- 26.5)	22.7 (19.6- 26.93)
Mild	177	29.7 (26.2- 33.5)	29.4 (25.9- 33.2)
Moderate	132	22.1 (19.0- 25.7)	22.4 (19.2- 26.0)
Severe	150	25.2 (21.8- 28.8)	25.4 (22.0- 29.1)
Depression symptoms (PHQ-9)			
Minimal	90	15.1 (12.4- 18.2)	14.7 (12.1- 17.8)
Mild	162	27.2 (23.8- 30.9)	27.3 (23.8- 31.0)
Moderate	142	23.8 (20.6- 27.4)	23.7 (20.4- 27.3)
Moderate Severe	116	19.5 (6.5- 22.8)	20.2 (17.2- 23.7)
Severe	86	14.4 (11.8- 17.5)	14.1 (11.5- 17.1)
Mental distress (PHQ-ADS)			
Minimal	112	18.8 (15.8- 22.1)	18.2 (15.3- 21.5)
Mild	181	30.4 (26.8- 34.2)	30.7 (27.1- 34.5)
Moderate	145	24.3 (21.0- 27.9)	24.4 (21.2- 28.1)
Severe	158	26.5 (23.1- 30.2)	26.7 (23.3- 30.4)

4.3.6 Description of severe food insecurity and hunger and mental distress

Significantly higher rates of severe food insecurity were found among male students (29.1%) when compared to female students (19.7%) (p=0.010) (Table 15). In terms of race, Black students (33.1%) and Coloured (20.6%) students experienced higher levels of severe food insecurity (p<0.001). The highest levels of severe food insecurity were found among students who attended quintile 1 high schools (54.6%), students who were first generation (35.9%) and students who were recipients of financial aid (36.6%)- all significant at p<0.001.

Black students were the only race group to experience severe hunger (4.9%; p=0.020). The highest levels of severe hunger were found among students who attended quintile 1 high schools (15.2%; p <0.001), and students who were first in their family to attend university (5.1%; p=0.018).

Table 15: Unadjusted description of the sample by severe food insecurity and hunger- during the COVID-19 pandemic

	Total sample n (%)	**Food insecurity and hunger**			
		Severe food insecure n (%)	**p-values**	**Severe Hunger n (%)**	**p-values**
Sex			0.010*		0.695

Female	390 (65.4)	77 (19.7)		11 (2.8)	
Male	206 (34.6)	60 (29.1)		7 (3.4)	
Race			<0.001*		0.020*
Black	366 (61.4)	121 (33.1)		18 (4.9)	
Coloured	34 (5.7)	7 (20.6)		0 (0.0)	
Indian	74 (12.4)	4 (5.4)		0 (0.0)	
White	119 (20.0)	5 (4.2)		0 (0.0)	
Chinese	0.5 (3)	0 (0.0)		0 (0.0)	
Age [M (SD)]	20 (± 2.3)	20.1 (± 2.7)	0.084	21.3 (± 4.6)	0.285
High school quintile			<0.001*		<0.001*
1 (Lowest resourced schools)	33 (5.5)	18 (54.6)		5 (15.2)	
2	56 (9.4)	30 (53.6)		5 (8.9)	
3	72 (12.1)	24 (33.3)		3 (4.2)	
4	66 (11.1)	21 (31.8)		0 (0.0)	
5 (Highest resourced schools)	206 (34.6)	34 (16.5)		4 (1.9)	
Private/ Int./ Other	163 (27.4)	10 (6.1)		1 (0.61)	
Faculty			0.064		0.951
Commerce, Law & Management	81 (13.6)	21 (25.9)		2 (2.5)	
Engineering	127 (21.3)	32 (25.2)		3 (2.4)	
Health Sciences	88 (14.8)	14 (15.9)		3 (3.4)	
Humanities	187 (31.4)	52 (27.8)		7 (3.7)	
Sciences	113 (19.0)	18 (15.9)		3 (2.7)	
First generation status			<0.001*		0.018*
First-generation	359 (60.2)	85 (35.9)		12 (5.1)	
Non-first generation	237 (39.8)	52 (14.5)		6 (1.7)	
Financial aid recipient			<0.001*		
Yes	265 (44.5)	97 (36.6)		13 (4.9)	
No	331 (55.5)	40 (12.1)		5 (1.5)	
Living with a disability			0.074		0.523
Yes	18 (3.0)	1 (5.6)		1 (5.6)	
No	578 (97.0)	136 (23.5)		17 (2.9)	

Age is described using median, Interquartile ranges and the Mann Whitney U test; the chi-square test was used to compare categorical variables to food insecurity and hunger status
*Significance at p<0.05.

Several factors were associated with severe anxiety symptoms (Table 16). Significantly higher rates of severe anxiety symptoms were noted among female students (28.5%) when compared to male students (18.9%) (p=0.011). On race, Coloured (29.4%) and Black students (28.4%) experienced the highest levels of severe anxiety symptoms (p=0.044). The highest levels of

severe anxiety symptoms were noted among students who matriculated from quintile 3 high schools (38.9%; p=0.002) and students who were recipients of financial aid (29.4%).

In terms of severe depression symptoms, significantly higher rates of severe depression symptoms were noted among female students (17.4%) compared to male students (8.7%) (p=0.004), students who attended quintile 2 high schools (25%; p=0.008), as well as students who were financial aid recipients (18.5%; p=0.012).

Several factors were also significantly linked with severe mental distress symptoms, higher rates of severe mental distress symptoms were noted among female students (30.0%) compared to males (19.9%) (p=0.008), students who attended quintile 2 and 3 (both 37.5%; p=0.003) high schools, and students who were recipients of financial aid (32.5%; p=0.003).

Table 16: Unadjusted description of severe common mental disorder symptoms- during the COVID-19 pandemic

	Total sample	**Common mental disorder symptoms**					
		Severe anxiety symptoms	**p-values**	**Severe depression symptoms**	**p-values**	**Severe Mental distress symptoms**	**p-values**
	n (%)	**n (%)**		**n (%)**		**n (%)**	
Sex			0.011*		0.004*		0.008*
Female	390 (65.4)	111 (28.5)		68 (17.4)		117 (30.0)	
Male	206 (34.6)	39 (18.9)		18 (8.7)		41 (19.9)	
Race			0.044*		0.320		0.053
Black	366 (61.4)	104 (28.4)		55 (15.0)		110 (30.1)	
Coloured	34 (5.7)	10 (29.4)		6 (17.7)		8 (23.5)	
Indian	74 (12.4)	18 (24.3)		14 (18.9)		20 (27.0)	
White	119 (20.0)	18 (15.1)		11 (9.2)		20 (16.8)	
Chinese	3 (0.5)	0 (0.0)		0 (0.0)		0 (0.0)	
Age [M (SD)]	20 (± 2.3)	20 (± 2.4)	0.880	20 (± 2.7)	0.387	20 (± 2.3)	0.576
High school quintile			0.002*		0.008*		0.003*
1 (Lowest resourced schools)	33 (5.5)	10 (30.3)		7 (21.2)		11 (33.3)	
2	56 (9.4)	18 (32.1)		14 (25.0)		21 (37.5)	
3	72 (12.1)	28 (38.9)		13 (18.1)		27 (37.5)	
4	66 (11.1)	15 (22.7)		8 (12.1)		16 (24.2)	
5 (Highest resourced schools)	206 (34.6)	55 (26.7)		33 (16.0)		57 (27.7)	
Private/ Int./ Other	163 (27.4)	24 (14.7)		11 (6.8)		26 (16.0)	

Faculty			0.577		0.184		0.506
Commerce, Law & Management	81 (13.6)	19 (23.5)		8 (9.9)		17 (21.0)	
Engineering	127 (21.3)	30 (23.6)		14 (11.0)		33 (26.0)	
Health Sciences	88 (14.8)	18 (20.5)		13 (14.8)		21 (23.9)	
Humanities	187 (31.4)	49 (26.2)		36 (19.3)		51 (27.3)	
Sciences	113 (19.0)	34 (30.1)		15 (13.3)		36 (31.9)	
First generation status			0.302		0.063		0.327
First-generation	359 (60.2)	65 (27.4)		42 (17.7)		68 (28.7)	
Non-first generation	237 (39.8)	85 (23.7)		44 (12.3)		90 (25.1)	
Financial aid recipient			0.032*		0.012*		0.003*
Yes	265 (44.5)	78 (29.4)		49 (18.5)		86 (32.5)	
No	331 (55.5)	72 (21.8)		37 (11.2)		72 (21.8)	
Living with a disability			0.173		0.784		0.080
Yes	18 (3.0)	7 (38.9)		3 (16.7)		8 (44.4)	
No	578 (97.0)	143 (24.7)		83 (14.4)		150 (26.0)	

Age is described using median, Interquartile ranges and the Mann Whitney U test; the chi-square test was used to compare categorical variables to CMD symptoms
*Significance at $p<0.05$.

Several factors introduced by the COVID-19 pandemic were significantly associated with severe food insecurity (Table 17). Higher levels of severe food insecurity were noted among students who lived alone during the pandemic (46.3%), lived in a household situated in a village or farm (41.1%), students experiencing stress due to finances (36.2%) and had limited space to work at home (32.2%) all significant at $p<0.001$. Finally, students reporting challenging home circumstances during the COVID-19 pandemic reported higher levels of severe food insecurity 28.9% ($p<0.001$).

The same factors were significantly associated with severe hunger. Higher levels of severe hunger were noted among students who were living alone (9.8%; $p=0.008$), living in a household situated in a village or farm (9.6%; $p=0.005$), experiencing stress due to finances (5.4%; $p<0.001$) and had limited space to work at home (4.7%; $p=0.019$).

Table 17: Distribution of severe food insecurity and hunger by COVID-19 variables.

	Total sample	**Food insecurity and hunger**

	n (%)	Severe food insecure n (%)	p-value	Severe hunger n (%)	p-value
Self- reported COVID-19 infection (of participant and/or close friends and family)			0.566		0.727
Yes	46 (7.7)	9 (19.6)		1 (2.2)	
No	550 (92.3)	128 (23.3)		17 (3.1)	
Place of residence during lockdown			0.183		0.916
On or off-campus residence	27 (4.5)	7 (57.1)		0 (0.0)	
With Relatives	40 (6.7)	10 (25.0)		2 (5.0)	
At home	526 (88.3)	118 (22.4)		16 (3.0)	
No stable accommodation	3 (0.3)	2 (100)		0 (0.0)	
Other	1 (0.2)	0 (.00)		0 (0.0)	
Household size			<0.001*		0.008*
Living alone	41 (6.9)	19 (46.3)		4 (9.8)	
2	106 (17.8)	33 (31.1)		3 (2.8)	
3-4	246 (41.3)	26 (10.6)		2 (0.8)	
5 or more	203 (34.1)	59 (29.1)		9 (4.4)	
Household location during lockdown situated in:			<0.001*		0.005*
City/ Suburb	357 (60.0)	57 (16.0)		6 (1.7)	
Town	121 (20.3)	41 (33.9)		4 (3.3)	
Township	44 (7.4)	8 (18.2)		1 (2.3)	
Village/farm	73 (12.3)	30 (41.1)		7 (9.6)	
Financial stress/ worry			<0.001*		<0.001*
Yes	315 (52.9)	114 (36.2)		17 (5.4)	
No	281 (47.2)	23 (8.2)		1 (0.4)	
Home circumstances challenging			<0.001*		0.252
Yes	311 (52.2)	90 (28.9)		7 (2.3)	
No	285 (47.8)	47 (16.5)		11 (3.9)	
Limited workspace at home			<0.001*		0.019*
Yes	301 (50.5)	97 (32.2)		14 (4.7)	
No	295 (49.5)	40 (13.6)		4 (1.4)	

The chi-square test was used to compare categorical variables to food insecurity an hunger status
*Significance at $p<0.05$.

Several factors brought about by the pandemic were associated with common mental disorder symptoms, these are analysed in Table 18. Higher levels of severe anxiety symptoms were noted among students who were living alone (29.3%; p=0.003), residing in households situated in towns (32.2%), villages and farms (31.5%; p=0.003), as well as students who reported having limited workspace at home (32.2%; p<0.001).

Several factors were also associated with severe depression symptoms, significantly higher rates of severe depression symptoms were among students living in households of two (19.8%) or alone (19.5%); (p=0.007). Students who experienced financial stress and worry (17.8%) also had significantly higher levels of severe depression symptoms (p=0.014). Finally, students who had limited workspace at home (18.0%) also had significantly higher levels of severe depression symptoms (p=0.014).

Several factors were also significantly linked with severe mental distress, higher rates of mental distress symptoms were noted among students living alone (36.6%; p<0.001), students living in towns (35.5%) and villages and farms (32.9%) (p=0.018). Students who experienced financial stress and worry (33.0%) also had significantly higher levels of severe mental distress symptoms (p<0.001). Finally, students who had limited workspace at home (33.6%) also had significantly higher levels of severe mental distress symptoms (p<0.001). Finally, students reporting challenging home circumstances during the COVID-19 pandemic reported higher levels of severe mental distress 29.9% (p=0.050).

Table 18: Unadjusted distribution of severe common mental disorder symptoms by COVID-19 variables.

	Total sample n (%)	**Common mental disorder symptoms**					
		Severe anxiety symptoms n (%)	**p-value**	**Severe depression symptoms n (%)**	**p-value**	**Severe mental distress symptoms n (%)**	**p-value**
Self- reported COVID-19 infection (of participant and/or close friends and family)			0.392		0.879		0.186
Yes	46 (7.7)	14 (30.4)		7 (15.2)		16 (34.8)	
No	550 (92.3)	136 (24.7)		79 (14.4)		142 (25.8)	

Place of residence during lockdown			0.862		0.508		0.640
On or off-campus residence	27 (4.5)	7 (45.2)		3 (14.3)		6 (28.6)	
With Relatives	40 (6.7)	12 (30.0)		8 (20.0)		12 (30.0)	
At home	526 (88.3)	130 (24.7)		74 (14.1)		139 (26.4)	
No stable accommodation	3 (0.5)	1 (50.0)		1 (50.0)		1 (50.0)	
Household size			0.003*		0.007*		<0.001*
Living alone	41 (6.9)	12 (29.3)		8 (19.5)		15 (36.6)	
2	106 (17.8)	30 (28.30)		21 (19.8)		34 (32.1)	
3-4	246 (41.3)	43 (17.5)		21 (8.5)		43 (17.5)	
5 or more	203 (34.1)	65 (32.0)		36 (17.7)		66 (32.5)	
Household location during lockdown situated in:			0.037*		0.308		0.018*
City/ Suburb	357 (60.0)	75 (21.0)		46 (12.9)		79 (22.1)	
Town	121 (20.3)	39 (32.2)		24 (19.8)		43 (35.5)	
Township	44 (7.4)	13 (29.6)		6 (13.6)		12 (27.3)	
Village/farm	73 (12.3)	32 (31.5)		10 (13.7)		24 (32.9)	
Financial stress/ worry			0.003*		0.014*		<0.001*
Yes	315 (52.9)	95 (30.2)		56 (17.8)		104 (33.0)	
No	281 (47.2)	55 (19.6)		30 (10.7)		54 (19.2)	
Home circumstances challenging			0.099		0.058		0.050*
Yes	311 (52.2)	87 (28.0)		53 (17.0)		93 (29.9)	
No	285 (47.8)	63 (22.1)		33 (11.6)		65 (22.8)	
Limited workspace at home			<0.001*		0.014*		<0.001*
Yes	301 (50.5)	97 (32.2)		5 (18.0)		101 (33.6)	
No	295 (49.5)	53 (18.0)		32 (10.9)		57 (19.3)	

The chi-square test was used to compare categorical variables to CMD symptoms
*Significance at p<0.05.

4.3.7 Regression models

Severe food insecurity and severe hunger: The results of the multivariate logistic regression (Table 19) indicated that financial stress was one of the determinants of severe food insecurity and hunger. Financial stress almost quadrupled the odds of severe food insecurity (OR= 3.87; 95% CI: 2.38- 6.30, p <0.001) and increased the likelihood of severe hunger more than seven-fold (OR= 7.42 95% CI: 1.26- 43.76; p=0.027). Conversely, attending well-resourced high schools (Quintiles 4&5) significantly reduced the likelihood of severe food insecurity (OR= 0.62; 95% CI: 0.38- 1.00, p =0.047) and severe hunger (OR=0.30; 95% CI: 0.94- 0.96,

p =0.042). Other predictors of severe food insecurity included being a recipient of financial aid (OR=1.72; 95% CI: 1.05- 2.82, p =0.030), and a first-generation student (OR=1.60; 95% CI: 1.02- 2.49, p =0.041).

Severe anxiety, depression and mental distress symptoms: The results of the multivariate logistic regression (Table 20) indicate the following: sex was a common determinant with males found to be at reduced risk of severe anxiety symptoms (OR= 0.48; 95% CI: 0.32- 0.72, p<0.001), severe depressive symptoms (OR= 0.33; 95% CI: 0.19- 0.58, p<0.001), and severe mental distress symptoms (OR= 0.46; 95% CI: 0.31- 0.69, p<0.001). Likewise, attending a quintile 4 or 5 high school reduced the likelihood of severe anxiety symptoms (OR= 0.52; 95% CI: 0.32- 0.85, p=0.009), severe depressive symptoms (OR= 0.47; 95% CI: 0.26- 0.87, p=0.016), and mental distress symptoms (OR= 0.56; 95% CI: 0.35- 0.90, p=0.016). Finally, having limited workspace at home almost doubled the likelihood of both severe anxiety symptoms (OR= 1.96 95% CI: 1.28- 3.00, p=0.002) and severe mental distress symptoms (OR= 1.89; 95% CI: 1.24- 2.87, p=0.003).

Table 19: Adjusted logistic regression of determinants of severe food insecurity and hunger during the COVID-19 pandemic

	Severe food insecurity		Severe hunger	
	OR (95% CI)	**p-value**	**OR (95% CI)**	**p-value**
Sex (reference: female)				
Male	1.29 (0.84- 1.99)	0.247	0.72 (0.28- 1.86)	0.496
Financial stress/ worry (reference: No)				
Yes	3.87 (2.38- 6.30)	<0.001*	7.42 (1.26- 43.76)	0.027*
Financial-aid recipient				
Yes	1.72 (1.05- 2.82)	0.030*	0.93 (0.32- 2.71)	0.898
High school quintile category (reference: quintiles 1-3)				
Quintiles 4 or 5	0.62 (0.38- 1.00)	0.047*	0.30 (0.94- 0.96)	0.042*
Private/ Int./ Other	0.30 (0.12- 0.68)	0.004*	0.24 (0.03- 2.17)	0.205
Race (reference: Coloured)				
Black		0.499	0.49 (0.20- 1.20)	0.117
Indian	0.17 (0.04- 0.74)	0.017*	0.56 (0.21- 1.52)	0.256
White	0.26 (0.06- 1.18)	0.080	0.41 (0.14- 1.18)	0.100
First generation status (reference: No)				
Yes	1.60 (1.02- 2.49)	0.041*	1.22 (0.44- 3.41)	0.702
Limited workspace at home (reference: No)				
Yes	1.32 (0.83- 2.09)	0.240	1.52 (0.49- 4.71)	0.464

*Significance at $p<0.05$.

Table 20: Adjusted logistic regression of determinants of severe common mental disorder symptoms during the COVID-19 pandemic

	Severe anxiety symptoms		Severe depression symptoms		Severe mental distress symptoms	
	OR (95% CI)	**p-value**	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Sex (reference: female)						
Male	0.48 (0.32- 0.72)	<0.001*	0.33 (0.19- 0.58)	<0.001*	0.46 (0.31- 0.69)	<0.001*
Financial stress/ worry (reference: No)						
Yes	1.26 (0.83- 1.90)	0.277	1.59 (0.94- 2.69)	0.085	1.57 (1.05- 2.36)	0.030*
Financial-aid recipient						
Yes	0.92 (0.58- 1.46)	0.734	1.50 (0.83- 2.70)	0.176	1.22 (0.79- 1,92)	0.383
High school quintile category (reference: quintiles 1-3)						
Quintiles 4 or 5	0.52 (0.32- 0.85)	0.009*	0.47 (0.26- 0.87)	0.016*	0.56 (0.35- 0.90)	0.016*
Private/ Int./ Other	0.38 (0.19- 0.75)	0.005*	0.28 (0.11- 0.71)	0.007*	0.42 (0.21- 0.81)	0.010*
Race (reference: Coloured)						
Black	0.49 (0.20- 1.20)	0.117	0.33 (0.11- 1.01)	0.052	0.68 (0.26- 1.77)	0.429
Indian	0.56 (0.21- 1.52)	0.256	0.86 (0.26- 2.77)	0.796	0.94 (0.33- 2.64)	0.902
White	0.41 (0.14- 1.18)	0.100	0.65 (0.18- 2.36)	0.511	0.71 (0.24- 2.11)	0.535
First-generation status (reference: No)						
Yes	0.84 (0.55- 1.28)	0.409	1.08 (0.63- 1.83)	0.776	0.79 (0.52- 1.20)	0.264
Limited workspace at home (reference: No)						
Yes	1.96 (1.28- 3.00)	0.002*	1.57 (0.92- 2.69)	0.096	1.89 (1.24- 2.87)	0.003*

*Significance at p<0.05.

4.3.8 Comparisons of the prevalence of food insecurity and common mental disorders before and after COVID-19

In 2019, before the onset of the COVID-19 pandemic, the prevalence of severe food insecurity was 33.8% (95% CI: 30.1- 37.0), which decreased to 25.7% (95% CI: 22.3- 29.4) during 2020 (Table 21). Severe hunger was reported by 4.0% (95% CI: 2.9-5.5) of individuals in 2019 and decreased to 3.4% (95% CI: 2.2- 5.2) in 2020. Regarding mental health symptoms, the prevalence of severe anxiety symptoms increased from 17.5% (95% CI: 15.2-20.1) in 2019 to 25.4% (95% CI: 22.0- 29.1) in 2020. Similarly, severe depression symptoms rose from 10.2% (95% CI: 8.5- 12.5) in 2019 to 14.1% (95% CI: 11.5- 17.1) in 2020. Additionally, severe mental distress symptoms increased from 18.7% (95% CI: 16.3-21.4) in 2019 to 26.7% (95% CI: 23.3-30.4) in 2020.

Table 21: Re-tabulation of the adjusted prevalence of wellbeing variables before and during the COVID-19

	Prevalence in 2019	**Prevalence in 2020**
	Prior to COVID-19	During COVID-19
	% (95% CI)	% (95% CI)
Food insecurity and hunger		
Food insecurity (HFIA Scale)		
Food secure	30.3 (27.4- 33.4)	37.9 (34.1- 41.9)
Mildly food insecure	12.5 (10.5- 14.8)	15.2 (12.6- 18.4)
Moderately food insecure	23.4 (20.7- 26.3)	21.2 (18.7- 24.7)
Severely food insecure	33.8 (30.1- 37.0)	25.7 (22.3- 29.4)
Hunger (HH Scale)		
Little to no hunger	79.4 (76.6-81.9)	83.6 (80.4- 86.4)
Moderate hunger	16.7 (14.4-19.2)	13.0 (10.5- 15.9)
Severe hunger	4.0 (2.9-5.5)	3.4 (2.2- 5.2)
Anxiety symptoms (GAD-7)		
Minimal	30.0 (27.1-33.1)	22.7 (19.6- 26.93)
Mild	33.2 (30.2-36.3)	29.4 (25.9- 33.2)
Moderate	19.3 (16.9-22.1)	22.4 (19.2- 26.0)
Severe	17.5 (15.2-20.1)	25.4 (22.0- 29.1)
Depression symptoms (PHQ-9)		
Minimal	19.3 (16.8- 22.0)	14.7 (12.1- 17.8)
Mild	34.5 (31.4- 37.6)	27.3 (23.8- 31.0)
Moderate	22.7 (20.1- 25.5)	23.7 (20.4- 27.3)
Moderate Severe	13.3 (11.2- 15.7)	20.2 (17.2- 23.7)
Severe	10.2 (8.5- 12.5)	14.1 (11.5- 17.1)

Mental distress symptoms (PHQ-ADS)		
Minimal	26.0 (23.3- 29.0)	18.2 (15.3- 21.5)
Mild	34.4 (34.4- 37.6)	30.7 (27.1- 34.5)
Moderate	20.8 (18.3- 23.6)	24.4 (21.2- 28.1)
Severe	18.7 (16.3-21.4)	26.7 (23.3- 30.4)

4.4 Objective 4: Individual and combined effect of food insecurity, anxiety, and depression on students' academic outcomes during the COVID-19 pandemic

4.4.1 Regression models

Student dropout: The multivariate regression model (Table 22) revealed that being male significantly increased the odds of dropout almost three-fold (OR= 2.70; 95% CI: 1.48-4.89; p =0.001). Being moderately food insecure more than doubled the odds of dropout (OR=2.50; 95% CI: 1.12-5.55, p=0.025). The model showed borderline significance for dropout risk among students who resided in homes located in villages or farms during the pandemic (p=0.053). Severe mental distress increased the likelihood of dropout more than seven-fold (OR=7.08; 95% CI: 2.67-18.81, p<0.001).

Table 22: Adjusted multivariate logistic regression of determinants of student dropout during the COVID-19 pandemic

	OR (95% CI)	**Standard error**	**p-value**
Sex (reference: Female)			
Male	2.70 (1.48- 4.89)	0.82	0.001*
Financial-aid recipient (reference: No)			
Yes	0.59 (0.31-1.14)	0.20	0.117
Residence during lockdown situated in: (reference: City/ Suburb)			
Township	0.64 (0.29-1.45)	0.27	0.288
Town	0.93 (0.27-3.24)	0.59	0.913
Village/farm	2.14 (0.99 odds 4.63)	0.84	0.053
Self- reported COVID-19 infection (of participant and/or close friends and family) (reference: No)			
Yes	2.10 (0.83-5.36)	1.00	0.119
Working from home challenging (reference: No)			
Yes	0.64 (0.35-1.17)	0.20	0.147
Food insecurity (reference: Food secure)			
Mildly food insecure	0.98 (0.36- 2.68)	0.50	0.975
Moderately food insecure	2.50 (1.12- 5.55)	1.02	0.025*
Severely food insecure	1.09 (0.46- 2.58)	0.48	0.838
Mental distress (reference: Minimal)			
Mild	1.14 (0.41- 3.22)	0.60	0.802

Moderate	1.39 (0.48- 4.01)	0.75	0.546
Severe	7.08 (2.67-18.81)	3.53	<0.001*

*Significance at p<0.05.

Student failure: The regression model (Table 23) revealed that having a household size of 5 or more individuals more than quadrupled the odds (OR=4.20; 95% CI: 1.12-15.79, p=0.034). Further to this, pursuing studies in engineering also increased the likelihood of failure (OR=2.89; 95% CI: 1.57-5.34, p=0.001).

Table 23: Adjusted multivariate logistic regression model of determinants of student failure during the COVID-19 pandemic

	OR (95% CI)	**Standard error**	**p-value**
Sex (reference: Female)			
Male	1.11 (0.68-1.81)	0.28	0.674
Race (reference: Coloured)			
Black	4.90 (0.87-27.7)	4.33	0.072
Indian	0.62 (0.07- 5.23)	0.67	0.662
White	1.38 (0.20-9.44)	1.36	0.741
Home circumstances challenging (reference: No)			
Yes	0.74 (0.46-1.18)	0.18	0.204
Household size (Reference: 1)			
2	3.31 (0.84-13.04)	2.32	0.087
3-4	3.27 (0.85-12.54)	2.24	0.084
5 or more	4.20 (1.12-15.79)	2.84	0.034*
Faculty (Reference: Humanities)			
Engineering	2.89 (1.57-5.34)	0.91	0.001*
Health Sciences	0.74 (0.28-1.97)	0.37	0.546
Commerce, Law and Management	0.90 (0.39-2.07)	0.38	0.813
Sciences	1.58 (0.78-3.21)	0.57	0.204

*Significance at p<0.05.

Chapter 5: Discussions and Conclusions

This PhD, conducted using one of the largest university student samples on the African continent, aimed to address four specific questions that collectively explored the impact of mental health and food security on student success during the COVID pandemic.

These four questions represent efforts to further our understanding of the prevalence of common mental disorders and food insecurity before and after the COVID-19 pandemic; to gain insights on the impact of the pandemic on common mental disorders and food insecurity in a South African higher education institution; and to attempt to understand the intricate interactions of these three key variables: food security status, mental health status, and academic success.

In the following pages, I discuss the main findings from this research, addressing these questions and presenting some strengths and potential limitations that should be considered when interpreting the results. Concluding remarks, that critically reflect on the main points, are included at the end of each subsection of this chapter. These are followed by the final Chapter, Chapter 7: Research Implications.

5.1 Academic success

A crucial insight from the literature review was that a singular assessment method cannot offer a comprehensive understanding of student academic performance. Consequently, in this study, academic success was evaluated through two distinct approaches. The first approach involved assessing student failure rates and progression, while the second approach focused on examining retention rates and dropout rates. An important finding likely to have considerable impact on academic success before and during the COVID-19 pandemic was that students living at home during studies increased from 29% in 2019 to 88% in 2020 due to the lockdown directive. In addition to this, students were introduced to a novel pedagogical approach in 2020, emergency remote teaching and learning (ERTL), to ensure that learning continued under lockdown.

5.1.1 Failure levels before and during the COVID-19 pandemic

A closer look at student failure between the two timeframes indicates a reduction in adjusted failure rates, from 23.4% (95% CI: 20.7- 26.3) in 2019 to 14.6% (95% CI: 12.0- 17.7) in 2020.

There is strong evidence that suggests that the COVID-19 pandemic may have played a role in reducing academic failure rates ($\chi^2(1, N = 1{,}497) = 17.51$, $p < 0.001$). Findings of reduced failure rates align with results from literature citing improved progression rates among university students sector-wide in South Africa and the rest of the world (Iglesias-Pradas et al., 2021; Whitelaw et al., 2023). There is limited quantitative evidence that has sought to understand the drivers of the reduced failure rates in 2020. In the section below I attempt to explain this phenomenon using qualitative findings from the present study as well as supporting literature.

5.1.2 Qualitative insights on lower rates of academic failure

The qualitative research conducted in this study offers insights into the reduced failure rates, primarily proposing that the shift in teaching methods could be a contributing factor. In the findings under *Objective 2*, teaching staff acknowledged that students seemed to have a better grasp of complex content during ERTL. The feedback from students themselves indicated the benefits of being able to access and replay lecture recordings, as well as the flexibility introduced by ERTL. Other studies also reported observations of increased student engagement with readings and improvement in the understanding of concepts, which is believed to contribute to improved scores in formal assessments (Bekker & Carrim, 2021). These observations align with the Cb-model proposed by Sailer, Schultz-Pernice, and Fischer (2021), which attributes learner outcomes to a variety of factors when utilizing technology. These Cb-model factors include institutional and infrastructural factors, digital skills, as well as the attitude of those involved in teaching and learning (Iglesias-Pradas et al., 2021; Sailer et al., 2021).

5.1.3 Determinants of failure before and during the COVID-19 pandemic

In both time points there is the consistent finding that race (being Black) and attending lower quintile high schools are significant determinants of student failure. Furthermore, being registered at the Faculty of Engineering was a significant factor impacting failure both before COVID-19 (OR= 11.06; 95% CI: 5.80- 21.11; p<0.001) and during COVID-19 (OR= 2.89; 95% CI: 1.57- 5.34; p<0.001)- albeit with lower odds during COVID-19. Although these findings may be influenced by a smaller sample during the pandemic, they also generally align with lower levels of student failure noted during the pandemic. These results are also consistent with earlier research indicating that students pursuing studies in science, technology, engineering, and mathematics (STEM) face challenges with the curriculum across various

institutions (Case et al., 2013). Despite a growing enrolment in STEM fields over time in South Africa, these courses consistently result in the lowest success and graduation rates across universities (Stats SA, 2019a).

What is interesting is that food insecurity and CMDs were significant determinants of failure before the COVID-19 pandemic, as evidenced by findings in Table 9, and not during the pandemic (Table 21). Manuscript 1 (Wagner et al., 2021), a research output emanating from this work using 2019 data, provides further detail on how food insecurity with hunger may increase the odds of failure. Manuscript 2 (Wagner et al., 2022), also using pre-COVID-19 data, provides evidence indicating that the increasing severity of depression may increase the odds of failure. Several other factors had a significant impact on student failure during the COVID-19 pandemic, including living in a household with many individuals as well as residing in a village or farm. The qualitative findings, supported by literature, highlight the burden of domestic responsibility amid lockdown, particularly the ceaseless demands of cleaning, cooking and caregiving, and their detrimental effects on student learning (Beach et al., 2021; Wade et al., 2021). Having a large family size would have substantially increased the burdens of these responsibilities, encroaching even more on study time.

5.1.4 Dropout rates before and during the COVID-19 pandemic

Dropout rates between the two time points show an increase from 5.5% (95% CI: 4.2- 7.2) in 2020 to 10.5% (95% CI: 8.2- 13.2) in 2021. These findings align with sector trends in South Africa indicating confirmed dropout rates as high as 25% in certain institutions in 2021 (Branson & Whitelaw, 2023). In terms of international literature, research studying dropout intention report increases from 9.6% in 2016 to 13.0% in 2020 also aligning with the results of this work (Pertegal-Felices et al., 2022). The following section delves into the current study's findings regarding the factors influencing dropout and contrasts them with existing literature.

5.1.5 Determinants of dropout before and during the COVID-19 pandemic

The determinants of dropout between the two time points under study varied. Faculty, financial aid status, and race were significant pre-pandemic, while being male (OR= 2.70; 95% CI: 1.48- 4.89; $p<0.001$), moderate food insecurity status (OR= 2.50; 95% CI: 1.12- 5.55; $p=0.025$) and severe mental distress symptoms (OR= 7.08; 95% CI: 2.67- 18.81; $p<0.001$) were important determinants of dropout during the pandemic. This suggests that the COVID-19 pandemic added additional complexity, as evidenced by the findings of various global studies that

acknowledge the pandemic's contribution to increased dropout rates (Branson & Whitelaw, 2023; Koopmann et al., 2023; Savio et al., 2022). It is plausible that higher dropout rates impacted the progression rates (discussed above), as the departure of weaker students may have resulted in a remaining cohort of academically stronger individuals.

Literature, as well as the findings of Objective 2 (Wagner, Masango, et al., 2024), emphasize that, beyond the well-documented factors impacting dropout rates, students in remote areas encountered additional challenges in fully engaging in ERTL during the COVID-19 pandemic compared to their counterparts in more urban settings (Branson & Whitelaw, 2023; Themane & Mabasa, 2022). These challenges stemmed from unreliable internet connections and unpredictable power supply leading to class absences, an important precursor of dropout (Aina et al., 2022; Motala & Menon, 2020; Themane & Mabasa, 2022). Further to this, the current research reported high levels of severe food insecurity (25.7%; 95% CI: 22.3- 29.4) and severe mental distress symptoms (26.7%; 95% CI: 23.3- 30.4). There was evidence that moderate food insecurity as well as severe mental distress symptoms significantly increased the likelihood of student dropout, all of which disproportionally affected students in remote settings. Elevated levels of moderate food insecurity (often associated with lower socio-economic status (Institute of Medicine, 2011)) and severe mental distress symptoms, during the COVID-19 pandemic, could exacerbate inadequate classroom participation by impairing concentration and diminishing cognitive functioning. These factors may have a detrimental impact on the learning experience and could potentially be reflected in dropout rates (Sorhaindo & Feinstein, 2006; Taras, 2005).

Overall, the findings highlight the convoluted impact of the COVID-19 pandemic on student academic success. With the key findings being a reduction in failure rates, possibly due to pedagogical shifts, while concurrently noting higher levels of dropout possibly due to structural challenges, particularly in remote areas. These structural challenges disproportionately impacted students from lower socioeconomic backgrounds and were further exacerbated by high levels of food insecurity and mental distress.

5.1.6 Concluding remarks

This research hypothesized that increases in food insecurity and CMDs, as well as the introduction of ERTL due to the COVID-19 pandemic, would result in overall declines in student progression and increases in dropout rates. The research findings noted an increase in

student progression alongside increases in student dropout, presenting conflicting patterns of academic success when employing multiple measures. These findings highlight the potential linearity and simplicity of the initial assumptions and illustrate the complexity of academic success and the limitation of using a single measure to assess it. The research findings also strongly indicate that the COVID-19 pandemic is likely a critical factor driving both the improved progression rates and the increased dropout rates.

While acknowledging the complexity of student academic success, and that this research does not control for all possible determinants and predictors, it is still possible to distil important lessons especially as institutions move towards blended learning approaches as well as to prepare for future disruptions. Leveraging technology introduces innovation and flexibility that can complement both teaching and learning. As shown in this study, increasing virtual access to course content and study material may positively impact the passing rate. However, it is important to consider structural barriers that hinder the inclusion of certain student groups, particularly in our context, as these may effectively erase any gains from teaching and learning innovations. Challenges such as connectivity issues and unreliable power supply, coupled with food insecurity and CMDs, are significant considerations that impact the learning experience, with important implications for academic success in its various forms.

5.2 Food insecurity and hunger

This research project measured food insecurity as well as hunger, two concepts that are inherently intertwined (Institute of Medicine, 2011). It is important to again mention that some data for this research was collected in 2019, before COVID-19 when most students resided in university residences and also during COVID-19 when most students resided at home.

5.2.1 Food insecurity and hunger levels before and during the COVID-19 pandemic

The results indicate that the adjusted prevalence of food security improved over the two time points from 30.3% (95% CI: 27.4- 33.4) in 2019 before the COVID-19 pandemic, to 37.9% (95% CI: 34.1- 41.9) 2020 during the COVID-19 pandemic. Levels of severe food insecurity improved from 33.8 (95% CI: 30.1- 37.0) to 25.7% (95% CI: 22.3- 29.4). Levels of hunger also improved, from 20.6% in 2019 to 16.4% in 2020, with severe hunger reducing from 4.0% (95% CI: 2.9- 5.5) to 3.4% (95% CI: 2.2- 5.2).

Explanations for these improvements include that students' food practices, as well as their eating habits, change when they are at home (Davitt et al., 2021; Papadaki et al., 2007; van den Berg & Raubenheimer, 2015). Comparable studies internationally attributed decreases in food insecurity and hunger during the COVID-19 pandemic to students returning home and benefiting from pooled resources and reduction in the consumption of unhealthy foods as well as alcohol (Davitt et al., 2021; Owens et al., 2020; Soldavini et al., 2021). Studies conducted in South Africa validate findings on reduced hunger levels, by suggesting that students who live with their parents have the lowest risk of hunger (van den Berg & Raubenheimer, 2015).

Financial mismanagement has also been previously identified as an important cause of food insecurity among university students (Papadaki et al., 2007; Sabi et al., 2018). In this instance, students have been reported to prioritise other commitments including clothing and remittances over food (Mendes-Da-Silva et al., 2012; Soldavini et al., 2021). It is for this reason that South African literature has highlighted, with concern, the possible impact of the prevalent practice of universities discontinuing catering services in university residences, opting instead to transform them into non-catered residences to improve their affordability (Munro & Msimango, 2023).

Given the above, it is plausible that being at home positively impacted students financially by mitigating additional expenses and exposing students to better food and eating practices.

5.2.2 Determinants of severe food insecurity and hunger before and during the COVID-19 pandemic

In cases of severe food insecurity and hunger, the results of this research provide interesting insights. Firstly, socio-demographic variables that were statistically significant for severe food insecurity and severe hunger remained the same, generally, before COVID-19 as well as during the COVID-19 pandemic. These variables include sex, race, high school quintile and being a first-generation student. This was expected as previous research carried out in South Africa and internationally has identified the same variables as important determinants of food insecurity and hunger (Kassier & Veldman, 2013; Munro et al., 2013; Rudolph et al., 2018; Sabi et al., 2018; van den Berg & Raubenheimer, 2015). Secondly, in addition to these variables, COVID-19 related variables were significantly associated with severe hunger, these included: household size, village/farm residence and limited workspace for students to learn. Financial stress almost quadrupled the odds of severe food insecurity (OR= 3.87; 95% CI: 2.38- 6.30; p<0,001) and increased the odds of severe hunger by a factor of 7 (OR= 7.42; 95% CI: 1.26-43.76; p=0.027).

Manuscript 5 (Wagner, Wagner, et al., 2024) discusses several interesting findings relating the risk of food insecurity and hunger to these COVID-19 variables. The first is household size, the current research indicates that students living alone have the highest risk of hunger, the second highest hunger levels were among students living in households of five individuals or more (Table 17). Increased household size, although very complex, is generally thought to increase the risk of food insecurity and hunger (Stats SA, 2023a; van den Berg & Raubenheimer, 2015). However, in the case of the current research, as well as previous literature (Davitt et al., 2021), in addition to large family size, students who live alone also show significantly higher levels of food insecurity and hunger, again, attributing this to eating practices. Finally, Manuscript 5 (Wagner, Wagner, et al., 2024) uncovers the implications of severe food insecurity on student learning, namely increased levels of student dropout. The manuscript, supported by literature, argues that severe food insecurity and hunger impacts on concentration and cognitive function which leads to poor learning experiences (Sorhaindo & Feinstein, 2006), potentially culminating in decisions to dropout.

5.2.3 Concluding remarks

This research hypothesized that levels of food insecurity among university students would increase due to the financial hardships introduced by the COVID-19 pandemic. However, findings suggest that, although the levels of food insecurity and hunger remained high among

university student populations during the COVID-19 pandemic, there was a clear decline when compared to figures before the pandemic. Food and eating practices at home may have reduced food insecurity levels, which is further explored in Manuscript 4. The characteristics of those experiencing severe food insecurity and severe hunger were also studied, with these findings reiterating the link between financial stress and heightened risk of severe food insecurity and hunger.

These findings warrant further inquiry, particularly the contribution of food practices and eating behaviours to food insecurity among university students who reside in university residences. This research could provide initial insights into the notably high prevalence of food insecurity observed among these students.

5.3 Common mental disorders (CMDs)

This research project measured CMDs: anxiety, depression, and mental distress before and during the COVID-19 pandemic. Important findings related to determinants of CMD severity and CMDs' interactions with food insecurity and academic success during the two time points are outlined in the sub-sections below.

5.3.1 CMDs before and during the COVID-19 pandemic

The prevalence of CMDs worsened over time. The prevalence of severe anxiety symptoms increased from 17.5% (95% CI: 15.2- 20.1) in 2019 to 25.4% (95% CI: 22.0- 29.1) in 2020. Severe depression symptoms increased from 10.2% (95% CI: 8.5- 12.5) to 14.1% (95% CI: 11.5- 17.1) and severe mental distress symptoms from 18.7% (95% CI: 16.3- 21.4) to 26.7% (95% CI: 23.3- 30.4) between the two time periods. Moreover, increases in symptoms of CMDs were observed across various races, sex, and school quintiles. These findings align with findings from other South African institutions noting high levels of depression (35%) and anxiety (46%) during the pandemic when compared to periods before COVID-19 (Visser & Law-van Wyk, 2021).

5.3.2 Determinants of severe CMDs during the COVID-19 pandemic

When considering those with severe CMDs, race, being Black or Coloured, and being from a poorer high school quintile, particularly quintile 1–3 high schools, significantly increased the likelihood of severe mental disorder symptoms at both time points. These findings were expected as the relationship between race and mental disorders among university students in South Africa is well documented, and the heightened levels of depression and anxiety among Black and Coloured students is consistently reported (Bantjes et al., 2023). Furthermore, studies have also identified low socio-economic status (of which quintile can be used as a proxy) as an important predictor of CMDs (Croock et al., 2023; Othieno et al., 2015).

However, the COVID-19 pandemic introduced several challenges that likely increased mental disorder risk. During the COVID-19 pandemic being female appeared to increase the risk of CMDs when compared to being male. This finding aligns with work from another South African institution which found that female students were at higher risk for anxiety and depression during the pandemic (Visser & Law-van Wyk, 2021). Findings from the qualitative component of the current research highlight the additional pressure placed on female students, in terms of caregiving, and them taking on the greater share of household responsibilities.

Literature highlights that these additional responsibilities led to higher levels of disruption, distress, and poor mental health among female caregivers (Beach et al., 2021; Wade et al., 2021). Attending to these responsibilities, while undertaking a full university schedule may have caused additional distress.

Household size data presented interesting findings. The qualitative component highlighted that living alone was a source of mental distress. This is supported by literature which highlights the emotional distress brought about by a lack of in-person contact during the COVID-19 pandemic (Bain et al., 2023; Beach et al., 2021). In contrast, living in a household with five or more people was associated with anxiety (Table 18). This qualitative data highlights the challenges of sharing small spaces with many individuals and emphasises the scarcity of workspaces, another variable significantly related to CMDs during the pandemic and likely to directly impact on academic outcomes.

5.3.3 Qualitative insights on increasing rates of CMDs

When triangulating with qualitative data, variables that were significantly linked with mental distress symptoms in the quantitative data also emerged in discussions with students and are further detailed in Manuscript 3 (Wagner, Masango, et al., 2024). According to the qualitative work, factors that had an emotional toll included struggles with isolation and confinement, poor experiences at home that made it difficult to work or study (also reflected in the quantitative analyses), the need to constantly balance university obligations with home responsibilities, financial stress due to job loss (also reflected in the quantitative analyses), the emotional toll of being infected with the COVID-19 virus, or having family and friends that were seriously ill, and grief due to the passing of family and friends. These findings are consistent with qualitative findings from similar studies (Badaru et al., 2022; Fouche & Andrews, 2022; Laher et al., 2021; Themane & Mabasa, 2022). These studies describe the emotional toll of the constant fear of contracting the COVID-19 virus, debilitating grief, as well as bouts of depression and social anxiety, all while contending with new modes of learning (ERTL) (Bain et al., 2023; Laher et al., 2021; Landa et al., 2021; Nyar, 2021; Themane & Mabasa, 2022).

5.3.4 Implications of CMDs on academic outcomes and food insecurity

Manuscript 5 (Wagner, Wagner, et al., 2024) highlights the contribution of CMDs, together with food insecurity, on student dropout. This manuscript highlights that students who are both food insecure and experiencing mental distress symptoms are at significantly greater risk of dropping out. The mechanisms leading to dropout have been described by Eisenberg,

Golberstein, and Hunt (2009) who posit that the symptoms linked to depression and anxiety, such as decreased energy and challenges in sustaining attention, affect non-cognitive abilities that include persistence and motivation.

This lack of motivation and persistence is further compounded by poor concentration and lethargy, due to intermittent access to nourishing food, a hallmark symptom of moderate and severe food insecurity (Sabi et al., 2020; Sorhaindo & Feinstein, 2006). These findings are aligned with work from South America which found that early in the pandemic, 38% of students reported economic distress (related to food insecurity risk) as a key motive to dropout, while dropout motives related to mental distress symptoms increased as the pandemic progressed, reaching 40% in 2021 (Savio, Galantini, and Pachas 2020). Further evidence exists linking poor family resources as well as an inability to cope with low resilience, and ultimately heighted risk for dropout, further corroborating the findings from the current study (Pertegal-Felices et al. 2022).

5.3.5 Concluding remarks

The current study hypothesized that the mental toll of the COVID-19 pandemic would result in increased levels of CMDs among university students. A significant increase in the prevalence of CMDs during the COVID-19 pandemic was observed and is found to have been influenced by various intricate factors including grief, job loss and confinement. Consequently, mental wellbeing emerged as one of the most adversely affected aspects of student life during the pandemic, supported by both quantitative and qualitative findings. The crucial link between student mental wellbeing and academic outcomes was clearly observed, with the interaction between CMD and food insecurity substantially increasing the likelihood of student dropout.

Chapter 6: Strengths and limitations

This PhD study possesses several merits. First, as far as I am aware, no prior research in South Africa has investigated the relationship between academic success, food insecurity, and CMDs during the COVID-19 pandemic. This study addresses a significant knowledge gap and contributes to the development of strategies HEIs can consider in cases of future disruptions. These strategies could potentially reduce levels of CMDs and food insecurity and ultimately improve student success. Secondly, the study population was diverse in terms of race, making it close to the South African higher education sector. Nevertheless, it is crucial to acknowledge several limitations when interpreting the results of this research. The observed prevalence and interactions between student success, food insecurity, and CMDs cannot be solely attributed to the pandemic. They also reflect South Africa's history of segregation, evident in the disproportionate nature of certain trends. Furthermore, in accordance with the study's inclusion criteria, only students in their first year of study participated in this study, meaning that students surveyed in 2019 were different to those surveyed in 2020. Lastly, potential bias may have been introduced through self-selected sampling or self-reporting. To mitigate potential selection bias, I applied weighting to the findings based on the underlying student population.

Further limitations arise from the modelling strategy. It is important to highlight the drawbacks of the backward stepwise selection method as it may lead to unstable models and overfitting, especially in smaller datasets. As highlighted by (Heinze & Dunkler, 2017) variable selection based on statistical significance alone can also invalidate traditional inferential tools such as p-values and confidence intervals, leading to biased effect estimates. However, the approach also has a number of advantages, including reducing multicollinearity by eliminating redundant predictors that are highly correlated with others (Neter et al., 1996). Backward stepwise selection also simplifies the model and makes it more interpretable, particularly in datasets with numerous variables (Fox, 2015).

Moreover, the interpretation of adjusted effect sizes in the models may fall into what is known as the "Table 2 fallacy", which involves treating all adjusted coefficients as independent predictors (Westreich & Greenland, 2013). This can be misleading particularly if confounders and effect modifiers are not properly distinguished (Bandoli et al., 2018; Westreich & Greenland, 2013) and may lead to overinterpretation of results or the erroneous conclusion that certain variables are causally linked to the outcomes, when they may simply be correlated.

Additionally, while the findings point to significant associations between certain demographic factors and outcomes like food insecurity and severe hunger, these results must be interpreted with caution. The associations identified do not imply causality and are subject to the limitations of observational data, where unmeasured confounding variables might influence the observed relationships. Further research incorporating more robust statistical techniques, such as penalized regression models or causal inference approaches, may be necessary to confirm these findings and offer more precise estimates.

Chapter 7: Research Implications

The global landscape of higher education underwent significant upheaval during the COVID-19 pandemic, with changes as a result of the pandemic likely to have lasting effect. While history would suggest that pandemics will occur again in the future; disruptions to higher education can manifest in various forms, including violent student protests (a frequent occurrence in South Africa), economic downturns, and political instability, all of which have the potential to adversely affect groups of university students. These disruptions are likely to have repercussions on economic aspects, such as food insecurity, as well as on the mental wellbeing of university students. The results of this PhD can aid in charting a course through these disruptions – whether the disruption is a pandemic or something more common.

Partly as a response to the challenges posed by the COVID-19 pandemic, new approaches to delivering higher education, including hybrid models, are being explored. In light of the current study, it becomes crucial to consider economic, social and mental health factors when designing these models. Identifying ways to facilitate remote learning for students that address epistemological access challenges while maintaining inclusivity and connectedness is likely to contribute positively to academic success.

This research provided fascinating insights on student food insecurity, mental health, and their success during COVID-19. A number of findings were unexpected, including the decrease in failure rates and food insecurity levels. These findings raise new questions on epistemological access challenges as well as food and eating practices during disruptions. This presents opportunities to institute research that investigates these topics further.

Further research can:

1. Explore trends in CMDs post-pandemic and with the introduction of new pedagogies.

2. There is also a need to understand specific measures that higher education institutions can adopt to improve the food security and mental wellbeing of the student population.
3. Finally, investigations into the evolving higher education landscape, new delivery models and how these can be designed in ways that address epistemological access challenges during times of disruption are critical.

Acknowledgements

This project has been as challenging as it has been rewarding.

I owe my utmost gratitude to my supervisor and friend, Prof Francesc Xavier Gómez-Olivé, who gave me his time, expertise, and support since the start of my PhD journey. Xavier is a talented Clinician-Scientist and an equally exceptional mentor. He has shown me unwavering support, through the change of co-supervisors and PhD topics. Through this PhD journey, Xavier has empowered me to take full scientific control and ownership of my project. As a result, I am confident in my skills and ability as I prepare for my next chapter. Thank you, Xavier, I have learnt so much from you and hope I can one day support my own students in the same way you have shown support to me.

I would also like to acknowledge and thank my co-supervisor, Prof Unathi Kolanisi, for her patience, time, and positive energy. I met Prof Kolanisi in 2011 at UKZN, when she was Dr Unathi. A decade and many accolades later, Unathi has not lost the ability to connect and relate with young people. She is a leader in her field, who is dynamic and in her prime, she prioritises her students selflessly dedicating her Sundays to supporting them. Unathi, I am grateful for your support and encouragement.

My supervisors had never met before being in my supervisory team, they have also never met in person, however, they worked together as though they were friends and colleagues for many years. Thank you to you both.

I would also like to thank my colleagues and friends. Most of all I want to thank my family- mom, dad, sister, my husband, Ryan, and son, Jack.

When reflecting on the life of my parents and grandparents, a life of agony and limited opportunity, I am grateful to God for allowing my mom and dad to charter a different reality for their children, changing our legacy forever and for the better. I am so proud that my PhD adds something new to our lineage.

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Phase I- Self-administered online survey

Study information document

STUDY INFORMATION DOCUMENT
Study title: Impact of COVID-19 on Teaching, Learning and Wellbeing

Dear Student,

I am conducting research on the effects of the COVID-19 pandemic on the general wellbeing of students. Research is a process used in seeking new knowledge. In In this study we want to learn if and how COVID-19 has impacted on mental health, food security as well as academic outcomes.

I am inviting you to take part in the research study. Your involvement will entail participating in a self-administered online survey, which will take you approximately 10-25 minutes to complete. The online survey allow me to gauge the impact that COVID-19 has had on student mental health and wellbeing.

The online survey will take place in a zero-rated platform. There will be no personal cost or risk to you if you participate in this project. You will not receive any direct benefits from participating and there are no disadvantages or penalties if you choose not to participate. Contact details of mental health services, as well COVID-19 information will be clearly depicted on each page of the online survey, as well as at the end of the survey.

You are free to choose whether or not you want to take part in this study and all information you will provide will be kept strictly confidential. All data collected from this research project will be stored in encrypted files on secure servers.

Your participation is voluntary. You can withdraw your consent at any time without further explanation, and without any adverse consequences. A unique identifier will be used to extract some of your data, including biographic data, from the university's database and data collected in previous studies for linkage.

If you have any questions about this research, feel free to contact us on the details listed below.

UNIQUE Link to survey: [survey-link]
If the link above does not work, try copying the link below into your web browser: [survey-url]
This link is unique to you and should not be forwarded to others.

Contact details
PhD Student: Fezile Mdluli, -505309@students.wits.ac.za/ 011 717 1163

Supervisor: Prof F Gomez-Olive, F.Gomez-OliveCasas@wits.ac.za/ 011 717 2385

Contact details of HREC administrator and chair – for reporting of complaints / problems

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg ("Committee"). A principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.

If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

Thank you for reading this Study Information Sheet.

March 2021

Participant consent sheet



PARTICIPANT CONSENT SHEET

Impact of COVID-19 on teaching, learning and wellbeing

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;
2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.

Contact details
PhD Student: Fezile Mdluli, -505309@students.wits.ac.za/ 011 717 1163
Supervisor: Prof F Gomez-Olive, F.Gomez-OliveCasas@wits.ac.za/ 011 717 2385

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Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Survey

	Questions	Choices, Calculations, OR Slider Labels
1	Record ID	
2	Gender	0, Female | 1, Male
3	Age	
4	Race	1, African | 2, Chinese | 3, Coloured | 4, Indian | 5, White
5	Faculty	Humanities | 2, Commerce, Law and Management | 3, Environment and the Built Environment | 4, Science | 5, Health Sciences
6	Student type	1, UG | 2, PG
7	I tend to bounce back quickly after hard times	1, Strongly Disagree | 2, Disagree | 3, Neutral | 4, Agree | 5, Strongly Agree
8	I have a hard time making it through stressful events	5, Strongly Disagree | 4, Disagree | 3, Neutral | 2, Agree | 1, Strongly Agree
9	It does not take me long to recover from a stressful event	1, Strongly Disagree | 2, Disagree | 3, Neutral | 4, Agree | 5, Strongly Agree
10	It is hard for me to snap back when something bad happens	5, Strongly Disagree | 4, Disagree | 3, Neutral | 2, Agree | 1, Strongly Agree
11	I usually come through difficult times with little trouble	1, Strongly Disagree | 2, Disagree | 3, Neutral | 4, Agree | 5, Strongly Agree
12	I tend to take a long time to get over set-backs in my life	5, Strongly Disagree | 4, Disagree | 3, Neutral | 2, Agree | 1, Strongly Agree
13	BRS calculation	sum([brs_1]+[brs_2]+[brs_3]+[brs_4]+[brs_5]+[brs_6])/6
14	When were you diagnosed (year)?	
15	Has anybody in your immediate family ever been treated or hospitalized for anxiety, depression, alcohol or drug abuse, or other such problems, or had any such problems but did not seek treatment?	
16	How would you rate your overall mental health today?	Very poor | | Excellent
17	Is your mental health better, worse or about that same as it was one year ago?	1, Better | 2, Worse | 3, Same
18	a. Little interest or pleasure in doing things	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
19	b. Feeling down, depressed, or hopeless	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
20	c. Trouble falling or staying asleep, or sleeping too much	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
21	d. Feeling tired or having little energy	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
22	e. Poor appetite or overeating	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
23	f. Feeling bad about yourself- or that you are a failure or have let yourself or family down	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day

24	g. Trouble concentrating on things, such as reading the newspaper or watching television	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
25	h. Moving or speaking slowly that other people could have noticed? Or the opposite- being so fidgety or restless that you have been moving around a lot more than usual	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
26	i. Having little or no interest in associating with others	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
27	j. Thoughts that you would be better off dead or hurting yourself in some way	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
28	phq_calculation	sum([phq_1]+[phq_2]+[phq_3]+[phq_4]+[phq_5]+[phq_6]+[phq_7]+[phq_8]+ [phq_9])
29	How difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	1, Not difficult at all | 2, Somewhat difficult | 3, Very difficult | 4, Extremely difficult
30	1. Have you wished you were dead or wished you could go to sleep and not wake up?	1, Yes | 2, No
31	2. Have you had any actual thoughts of killing yourself?	1, Yes | 2, No
32.	3. Have you been thinking about how you might do this?	1, Yes | 2, No
33	4. Have you had these thoughts and had some intention of acting on them?	1, Yes | 2, No
34	5. Have you started to work out or worked out the details of how to kill yourself? Do you intend to carry out this plan?	1, Yes | 2, No
35	6. Have you ever done anything, started to do anything, or prepared to do anything to end your life (lifetime)?	1, Yes | 2, No
36	6b. Was this within the past 3 months?	1, Yes | 2, No
38	a. Feeling nervous, anxious or on edge	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
39	b. Not being able to stop or control worrying	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
40	c. Worrying too much about different things	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
41	d. Trouble relaxing	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
42	e. Being so restless that it's hard to sit still	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day

43	f. Becoming easily annoyed or irritable	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
44	g. Feeling afraid as if something awful might happen	0, Not at all | 1, Several days | 2, More than half the days | 3, Nearly every day
45	gad_calculation	sum([gad_1]+[gad_2]+[gad_3]+[gad_4]+[gad_5]+[gad_6]+[gad_7])
46	How difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	1, Not difficult at all | 2, Somewhat difficult | 3, Very difficult | 4, Extremely difficult
47	Are there issues relating to learning under lockdown/during the pandemic that you wish to raise?	
	END OF SURVEY. PLEASE CLICK SUBMIT	

Phase II- Key informant interviews

Information Sheet IDI

STUDY INFORMATION DOCUMENT
Study title: Impact of COVID-19 on Teaching, Learning and Wellbeing

Dear Key informant,

I am doing research on the effects of the COVID-19 pandemic on the general wellbeing of students. Research is a process used in seeking new knowledge. I am interested mainly on how COVID-19 it has impacted on student food security, mental health and their academic outcomes. I have identified you as a person that has expert knowledge, especially of how the current situation has impacted on student academic success. As part of this research, I invite you to participate in an in-depth interview

Your involvement will entail participating in a an in-depth interview that will take between 45 mins to 1 hour. The interview will be conducted online on Microsoft Teams (or another suitable online platform) at a time suitable for you. Where necessary, you will be provided with a reasonable amount of data (1 GB), so you should not incur any personal costs.

There is no risk to you in participating in this study. You will not receive any direct benefits from participating and there are no disadvantages or penalties if you choose not to participate. Your participation is voluntary. You can withdraw your consent at any time without further explanation, and without any adverse consequences. All data collected from this research project will be kept strictly confidential stored in encrypted files on secure servers.

I would also like to audio record the interview. The audio recordings will be safely stored and will not be identified with your personal information. The results of this study will be used for scientific purposes. You will not be personally named in any publication. Although there are no direct benefits for you from being in the study, we anticipate that your input will help us to understand the extent of the impact COVID-19 has had on students.
Your involvement in this study is greatly appreciated. If you are happy to take part in the study, please read and sign the attached consent form.

Contact details
Fezile Mdluli, -505309@students.wits.ac.za/ 011 717 1163
Prof F Gomez-Olive, F.Gomez-OliveCasas@wits.ac.za/ 011 717 2385
Contact details of HREC administrator and chair – for reporting of complaints / problems

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg (“Committee”). A principal function of this

Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.

If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

Thank you for reading this Study Information Sheet.

March 2021



PARTICIPANT CONSENT SHEET

Impact of COVID-19 on teaching, learning and wellbeing

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;
2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.

Contact details
PhD student: Fezile Mdluli, -505309@students.wits.ac.za/ 011 717 1163
Supervisor: Prof F Gomez-Olive, F.Gomez-OliveCasas@wits.ac.za/ 011 717 2385

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Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Informed Consent IDI (Audio)



CONSENT FORM FOR AUDIO RECORDING OF STUDY PARTICIPATION
Impact of COVID-19 on teaching, learning and wellbeing

I hereby consent to audio recording of the interview.

I understand that:

- The recording will be stored in a secure location (a locked cupboard or password protected computer) with restricted access to the researcher and the research supervisor.
- The recording will be transcribed and any information that could identify me will be removed,
- The recordings will be erased within either (a) two (2) years of the publication of the research findings, or (b) six (6) years, if no publications arise from this research
- Anyone wishing to access this information in the future will first have to obtain the approval of the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg
- Direct quotes from my interview, without any information that could identify me, may be cited in the research report or other write-ups of research.

Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Witnessed by:
Name of Witness: _____
Signature: _____
Date: _____

12.2.3 Interview Guide

1. Universities have had to become more creative in how they teach due to the current COVID-19 pandemic. How did the university facilitate and support students during the transition to learning remotely?
   Probes: Access to devices and data/ online assessments/ flexibility

2. What changes, if any, have been implemented by your faculty in addition to the university wide policies?

3. What are some of the key challenges that came with these changes?

4. Is there anything that worked well (even better than contact learning)?

5. What has the feedback from students been like?
6. Compared with success trends from previous years, how has the COVID-19 pandemic impacted on student success rates (progression and attrition)?

7. What can you attribute this trend in success rates to?
   Probes: Students dedication/ university support and policies / or lack thereof

Phase III- Qualitative work with students

Information Sheet IDI



STUDY INFORMATION DOCUMENT
Study title: Impact of COVID-19 on Teaching, Learning and Wellbeing

Dear Student,

I am doing research on the effects of the COVID-19 pandemic on the general wellbeing of students. Research is a process used in seeking new knowledge. I am interested mainly on how COVID-19 it has impacted on student food security, mental health and their academic outcomes. As part of this research, I invite you to participate in an in-depth interview

Your involvement will entail participating in a an in-depth interview that will take between 45 mins to 1 hour. The interview will be conducted online on Microsoft Teams (or another suitable online platform) at a time suitable for you. Where necessary, you will be provided with a reasonable amount of data (1 GB), so you should not incur any personal costs.

There is no risk to you in participating in this study. You will not receive any direct benefits from participating and there are no disadvantages or penalties if you choose not to participate. Your participation is voluntary. You can withdraw your consent at any time without further explanation, and without any adverse consequences. All data collected from this research project will be kept strictly confidential stored in encrypted files on secure servers.

I would also like to audio record the interview. The audio recordings will be safely stored and will not be identified with your personal information. The results of this study will be used for scientific purposes. You will not be personally named in any publication. Although there are no direct benefits for you from being in the study, we anticipate that your input will help us to understand the extent of the impact COVID-19 has had on students.

Your involvement in this study is greatly appreciated. If you are happy to take part in the study, please read and sign the attached consent form.

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Thank you for reading this Study Information Sheet.

March 2021



PARTICIPANT CONSENT SHEET

Impact of COVID-19 on teaching, learning and wellbeing

8. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;
9. I was given time to read it, or had it read to me, in the language I best understand;
10. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
11. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
12. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
13. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
14. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.

Contact details
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Supervisor: Prof F Gomez-Olive, F.Gomez-OliveCasas@wits.ac.za/ 011 717 2385

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Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Informed Consent IDI (Audio)

CONSENT FORM FOR AUDIO RECORDING OF STUDY PARTICIPATION

Impact of COVID-19 on teaching, learning and wellbeing

I hereby consent to audio recording of the interview.

.

I understand that:

- The recording will be stored in a secure location (a locked cupboard or password protected computer) with restricted access to the researcher and the research supervisor.
- The recording will be transcribed and any information that could identify me will be removed,
- The recordings will be erased within either (a) two (2) years of the publication of the research findings, or (b) six (6) years, if no publications arise from this research
- Anyone wishing to access this information in the future will first have to obtain the approval of the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg
- Direct quotes from my interview, without any information that could identify me, may be cited in the research report or other write-ups of research.

Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Witnessed by:
Name of Witness: _____
Signature: _____
Date: _____

12.3.4 Interview Guide

1. If you are comfortable, can you tell us a little about your family?
   Probes: Where do you live? How big is your family? Where do you get financial support?

2. How has COVID-19 impacted you and your family?
   Probes: COVID-19 infections/ job security/ financial impact

3. How did COVID-19 affect your food intake?
   Probes: Eating patterns/ frequency/ portion sizes/ preferences

4. What do you understand food security to be?
   Probes: Reflecting on your current situation, what would it mean to be food secure?

5. Did the COVID-19 pandemic impact you in other ways, such as emotionally?
   Probes: What were the triggers?
   Probes: Did your mental status impact food intake?

6. How did you deal with this emotional impact?

7. Reflecting on your current situation, what would it mean to be mentally healthy?

8. How has COVID-19 impacted on how you learn?

9. How has learning in the current environment has impacted on your academic outcomes

12.3.5 Information Sheet FGD

STUDY INFORMATION DOCUMENT
Study title: Impact of COVID-19 on Teaching, Learning and Wellbeing

Dear Student,

I am doing research on the effects of the COVID-19 pandemic on the general wellbeing of students. Research is a process used in seeking new knowledge. I am interested mainly on how it has impacted food security as well as mental health. As part of this research, I invite you to participate in a focus group discussion.

Your involvement will entail participating in a focus group discussion, together with 4-6 other students. It will take 45 minutes to 1 hour, The interview will be conducted online on Microsoft Teams (or another suitable online platform) at a time suitable for you. Where necessary, you will be provided with a reasonable amount of data (1 GB), so you should not incur any personal costs.

There is no risk to you in participating in this study. You will not receive any direct benefits from participating and there are no disadvantages or penalties if you choose not to participate. Your participation is voluntary. You can withdraw your consent at any time without further explanation, and without any adverse consequences. Given the nature of focus group discussions (having multiple participants), anonymity cannot be guaranteed, however the data collected from this research project will be kept strictly confidential stored in encrypted files on secure servers.

I would also like to audio record the interview. The audio recordings will be safely stored and will not be identified with your personal information. The results of this study will be used for scientific purposes. You will not be personally named in any publication. Although there are no direct benefits for you from being in the study, we anticipate that your input will help us to understand the extent of the impact COVID-19 has had on students.

Your involvement in this study is greatly appreciated. If you are happy to take part in the study, please read and sign the attached consent form.

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Thank you for reading this Study Information Sheet.

March 2021

Informed Consent_FGD



PARTICIPANT CONSENT SHEET

Impact of COVID-19 on teaching, learning and wellbeing

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2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I understand that given the nature of focus group discussions, anonymity cannot be guaranteed
8. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.

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Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Informed Consent_FGD audio

CONSENT FORM FOR AUDIO RECORDING OF STUDY PARTICIPATION

Impact of COVID-19 on teaching, learning and wellbeing

I hereby consent to audio recording of the focus group discussion.

I understand that:

- The recording will be stored in a secure location (a locked cupboard or password protected computer) with restricted access to the researcher and the research supervisor.
- The recording will be transcribed and any information that could identify me will be removed,
- The recordings will be erased within either (a) two (2) years of the publication of the research findings, or (b) six (6) years, if no publications arise from this research
- Anyone wishing to access this information in the future will first have to obtain the approval of the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg
- Direct quotes from my interview, without any information that could identify me, may be cited in the research report or other write-ups of research.

Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Witnessed by:
Name of Witness: _____
Signature: _____
Date: _____

12.3.8 FGD Guide

1. What have been the some of the challenges that COVID-19 has introduced to university students?
   Probe: How have these challenges affected your daily life

2. Has the nature of challenges changed overtime as the pandemic progresses?

3. How have you coped with these challenges?
   Probe: On both negative and positive coping strategies/ mechanisms

4. Have these challenges impacted on your learning?
   Probe: What has this impact been?

5. What kind of support, if any, has the university provided?
   Probe: Have you made use of this support? Was it sufficient?

6. Do you think this has had impact on your academic achievements/marks?
   Probe: What has the impact been

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Appendices

Appendix A

Validation analysis of the Household Food Insecurity Access Scale (HFIAS)

Methodology

Study setting

The study was conducted at the University of the Witwatersrand, Johannesburg (Wits). Wits is the top-ranked university in Sub-Saharan Africa and ranked in the top 1% globally (Business Tech, 2022). Wits spans five campuses, has 5 faculties and 34 schools that accommodate its roughly 40 000 registered students (Wits, 2021). Students registered for undergraduate programmes make up roughly 60% of the student body (Wits, 2019b, 2020b).

Study design and period

The study utilised a mixed methods approach which began with a pilot study in August 2020 comprising of the HFIAS tool, followed by focus group discussions with those who completed the survey to refine the questionnaire tool and to ensure that it was relevant to the context. The main study followed which comprised of two rounds of data collection. The first survey was administered in September 2020 (Round 1) and a repeat survey (Round 2) followed 1 week later. The repeated survey was employed to assess the reproducibility of the HFIAS tool.

Study population and sampling

The pilot survey targeted a random sample of 200 students. The inclusion criterium was: registered students who were 18 years of age or older. Students who did not meet the inclusion criterium were not invited to participate in the study.

Round 1 of data collection targeted the entire Wits student population. The inclusion criterium was registered students who were 18 years of age or older. Students who did not meet the inclusion criterium were not invited to participate in the study. Round 2 of data collection was limited to students who had completed Round 1 at the end of the first week of data collection. Only complete records (i.e., with complete Round 1 and Round 2 data) were included in the statistical analyses.

Data collection

Procedure

Pilot- Data collection began by identifying eligible individuals using the inclusion criterium and retrieving their email addresses from the central university database. They were then sent an email with the details of the pilot study and requested to respond via email if they were interested in participating. Participants who completed the survey were then invited to participate in focus group discussions (FGDs). A detailed account of the FGDs is recorded in the *Face validity* section.

Face Validity

Participants in the pilot study were requested to take note of their thoughts as they completed the survey to help identify ways to improve it and take note of the amount of time it took to complete the survey.

The nine HFIAS questions were discussed in 4 FGDs comprising a total of 11 participants. Each question was read aloud and participants were requested to respond on how they understood the question. A discussion on the aim of the questions, and where relevant, how the question can be improved for clarity and relevance followed. Following the focus group discussions, suggestions were collated and changes to the questionnaire were actioned. This is the questionnaire that was then used for Round 1 and 2 of data collection.

Round 1 of data collection utilised the refined HFIAS tool which was the outcome of the pilot. Data collection for Round 1 began by identifying eligible individuals using the inclusion criteria and retrieving their email addresses from the central university database. Participants were sent a recruitment email which detailed all study information as well as a unique link to the survey. The survey was hosted on the Research Electronic Data Capture (REDCap) web application (Harris et al., 2019). Round 2- one week later, participants who completed the HFIAS in Round 1 were invited to complete the same survey in Round 2.

Measures

Food insecurity

The HFIAS tool, described in section 3.2.4.

Demographic variables

The study included socio-demographic factors including age group (categorised as 18-24, 25-35, and 36 and above), race (categorised as White, Coloured, Black African, Chinese and Indian), sex (categorised as either female or male), whether their homes were located in urban or rural areas (categorised as urban or rural).

Ethical clearance

Ethical approval was received from the University Human Research Ethics Committee (Non-medical) (H20/06/22) as well the University of the Witwatersrand Human Research Ethics Committee (HREC) (Non-Medical) (M1900627). Written permission was received from the Office of the Registrar to conduct the study.

Data analysis

Statistical analysis was undertaken using Stata 18.0 (StataCorp, College Station, TX).

Factor analysis

An exploratory analysis was conducted on the nine items, using Horn's parallel analysis (PA) to determine the number of factors to retain. PA is a Monte Carlo- based simulation method that compares observed eigen- values with that obtained from uncorrelated normal variables.

Validation

The validity of the nine-item food insecurity assessment tool was based on the following: The first criterion is the value of the Cronbach's alpha, which is a measure for internal consistency. Additionally, the reproducibility between the first and second HFIAS scores (HFIAS overtime) was estimated by means of a paired t-test.

Results

Face validity (Pilot)

I individually addressed all nine questions with 11 student participants involved in the FGDs to assess clarity, and understandability, and to ensure there was no misinterpretation. The nine questions were presented to the students, and their responses were documented. Subsequently, I inquired about the student's comprehension of each question.

For example:

"… the first question is: did you worry that you would not have enough food? That's the first question, do you think that question is clear? Like when you hear that question, what comes to your mind?" Facilitator, FGD 1

Their understanding of the question was compared with the primary aim of the question, and in instances where there were discrepancies, a discussion followed on how the questions could be best framed for clarity as well as contextual relevance. Together with student participants, the questions were rephrased and examples were added where necessary.

Characteristics round 1 and 2 participants

The study group was diverse in terms of age, with the majority falling within the 18-24 years age group, comprising 66.4% of the participants. A substantial portion, 24.8%, belonged to the 25-35 years age category, while those aged 36 and above constituted 8.8% of the total participants.

Table 1: Sample characteristics of survey participants

Variable	Category	Frequency	Percent
Age group	18-24 years	318	66.4
	25-35 years	119	24.8
	36 and above	42	8.8
Sex	Male	172	35.9
	Female	306	63.9
	Unknown	1	0.2
Race	Black	322	67.2
	Chinese	2	0.4
	Coloured	21	4.4
	Indian	52	10.9
	White	82	17.1
Urban/ Rural	Rural	61	15.0
	Unknown	9	2.2
	Urban	337	82.8
Food insecurity levels	Food Secure	188	40.2
	Mild food insecurity	72	15.4
	Moderate food insecurity	93	19.9
	Severe food insecurity	115	24.6

The study participants were mostly Black (67.2%) followed by White participants (17.1%). A significant proportion of participants (82.8%) resided in urban areas, while 14.99% were in rural locations, and 2.2% had an unknown residence status. Considering disability status, a minority of participants (5.4%) reported having a disability, while the majority (94.6%) indicated not having a disability. Exploring the impact of the COVID-19 pandemic on

household income, a range of responses emerged. Approximately 2.56% of participants reported an increase in household income, 30.6% noted no change, and a majority of 54.5% experienced a decrease. A notable portion, 12.4%, expressed uncertainty regarding the impact on household income. In terms of levels of food insecurity, 40.2% of participants reported being food secure, and 24.6% were severely food insecure.

Responses to the nine HFIAS items

Affirmative responses for the items ranged from 4.9% for item 9, Did *you go a whole day without eating anything because there was not enough food*, to 27.7% for item 2, *Did you eat just a few kinds of foods, day after day due to lack of resources?* (Table 2). In rural settings, affirmative responses for the items ranged from 6.8% for item 8, *Did you go to sleep at night hungry because there was not enough food?*, to 45.8% for item 4, *Did you eat fewer meals in a day because there was not enough food?*.

Table 2: Affirmative responses to items on the Household Food Insecurity Access Scale (HFIAS) in urban and rural settings

			Total		Rural		Urban	
HFIAS Questions			**Freq.**	**Percent**	**Freq.**	**Percent**	**Freq.**	**Percent**
	Did you worry that you would not have enough food?	No	359	76.7	39	66.1	254	77.2
Q1		Yes	109	23.3	20	33.9	75	22.8
	Did you eat just a few kinds of foods, day after day due to lack of resources?	No	328	70.1	34	57.6	238	72.3
Q2		Yes	140	29.9	25	42.4	91	27.7
	Did you eat food that you would have preferred not to eat because of a lack of r	No	344	73.5	38	64.4	249	75.7
Q3		Yes	124	26.5	21	35.6	80	24.3
	Did you eat fewer meals in a day because there was not enough food?	No	357	76.3	32	54.2	260	79.0
Q4		Yes	111	23.7	27	45.8	69	21.0
	Did you eat a smaller meal than you felt you needed because there was not enough	No	383	81.8	38	64.4	271	82.4
Q5		Yes	85	18.2	21	35.6	58	17.6
	Did you eat fewer meals in a	No	373	79.7	39	66.1	268	81.5
Q6		Yes	95	20.3	20	33.9	61	18.5

	day because there was not enough food?							
Q7	Was there ever no food at all in where you live because there were not resources	No	425	90.8	53	89.8	296	90.
		Yes	43	9.2	6	10.1	33	10.03
Q8	Did you go to sleep at night hungry because there was not enough food?	No	440	94.0	55	93.2	307	93.3
		Yes	28	6.0	4	6.8	22	6.7
Q9	Did you go a whole day without eating anything because there was not enough food	No	446	95.3	54	91.5	313	95.1
		Yes	22	4.7	5	8.5	16	4.9
		Total	468	100.0	59	100.0	329	100.0

Exploratory analysis

A factor analysis (varimax rotation) of the nine HFIAS questions resulted in two main factors for both urban and rural samples. In fact, the analysis resulted in nine factors, though the PA indicated retaining two factors.

Table 3: Factor analysis (varimax rotation) of the nine HFIAS questions

Component	Eigenvalue	Difference	Proportion	Cumulative
1	6.26854	5.12769	0.6965	0.6965
2	1.14085	0.72726	0.1268	0.8233
3	0.41359	0.11957	0.0460	0.8692
4	0.29402	0.05778	0.0327	0.9019
5	0.23624	0.02264	0.0262	0.9281
6	0.21360	0.03122	0.0237	0.9519
7	0.18238	0.03833	0.0203	0.9721
8	0.14405	0.03732	0.0160	0.9881
9	0.10673	.	0.0119	1.0000

Eigenvalues indicate the amount of variance explained by each component in the factor analysis. Two factors seem to be more influential in explaining the variance in the data, they have eigenvalues greater than 1. Factor 1 explains a significant amount (69.65%) of the total

variance while factor 2 explains an additional 12.68% of the variance, contributing to a cumulative proportion of 82.33%.

Table 4: Factor loadings for rotated component matrix responses by home location

	Total		Urban		Rural	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Q1	-0.0818	-0.1283	0.0067	-0.1129	-0.0901	-0.1129
Q2	0.5670	0.2087	-0.0536	0.0508	0.3241	0.0508
Q3	-0.6977	-0.2027	-0.0298	0.0089	-0.6456	0.0089
Q4	0.0685	0.0760	-0.1503	0.0141	-0.0542	0.0141
Q5	0.3492	-0.6111	0.2179	-0.6527	0.1559	-0.6527
Q6	-0.1421	0.6827	0.2290	0.7119	0.3742	0.7119
Q7	-0.0727	0.0504	-0.8263	0.0075	-0.4413	0.0075
Q8	-0.1076	-0.1868	0.3239	-0.1666	0.2965	-0.1666
Q9	0.1458	0.1269	0.2933	0.1542	0.1419	0.1542

Factor loadings help identify which variables are most strongly related to each component and contribute most to explaining the variance in the data. Overall, the first factor loaded most highly on Q3 (-0.6977) and Q 6 (0.682). In urban areas factors 1 and 2 loaded highly on Q6 and Q7 of the HFIAS while these loaded highly on Q3 and Q6 of the scale. Factors 1 and 2 together explained 79.6% and 83.5% of the nine questions' combined variance for rural and urban samples, respectively.

Internal consistency

Round 1: For all items (q1 to q9), the alpha coefficients are slightly higher in the urban setting compared to the rural setting (Table 5). This suggests that, in Round 1, the internal consistency of the items is generally higher among urban participants. The overall test scale in Round 1 also has a higher alpha coefficient in the urban setting (0.9466) compared to the rural setting (0.9364). Round 2: Similar to Round 1, in Round 2, alpha coefficients for individual items and the overall test scale are generally higher in the urban setting compared to the rural setting.

Table 5: Internal consistency (Cronbach's alpha) by rounds of data collection and home location

	Rural				**Urban**			
	Round 1		**Round 2**		**Round 1**		**Round 2**	
Item	Obs	alpha	Obs	alpha	Obs	alpha	Obs	alpha
q1	61	0.9309	59	0.9222	329	0.9385	337	0.9426
q2	61	0.9270	59	0.9278	329	0.9389	337	0.9451
q3	61	0.9289	59	0.9180	329	0.9375	337	0.9437
q4	61	0.9295	59	0.9211	329	0.9392	337	0.9430

q5	61	0.9240	59	0.9183	329	0.9353	337	0.9419
q6	61	0.9218	59	0.9202	329	0.9355	337	0.9425
q7	61	0.9279	59	0.9270	329	0.9426	337	0.9489
q8	61	0.9347	59	0.9289	329	0.9445	337	0.9503
q9	61	0.9348	59	0.9308	329	0.9488	337	0.9537
Test scale		**0.9364**		**0.9517**		**0.9466**		**0.9517**

Across both rounds, urban settings consistently show higher alpha coefficients for individual items and the overall test scale compared to rural settings. The alpha coefficients for the test scale indicate good to excellent internal consistency in both rural and urban settings in both rounds. The higher alpha coefficients in the urban setting suggest that the scale items may have better reliability or consistency among urban participants. It may be essential to explore potential reasons for the observed differences, such as variations in participant characteristics or response patterns between rural and urban settings.

Food Insecurity over time (reproducibility)

The overall HFIAS score did not change across the two rounds of data collection (Table 6). The HFIAS scores for the first and second round of data collection were 0.57 (CI: 0.5004-0.6320 and 0.58 (CI: 0.5010-0.6416), respectively. This p-value (0.5919) is higher than 0.05, suggesting that there is not enough evidence to reject the null hypothesis that the mean difference is zero. In other words, the observed difference is not statistically significant.

Table 6: Paired t-tests, total sample

Variable	Obs	Mean	Std. err	Std dev.	95% CI	
HFIAS_R1	468	.5662393	.0334742	.7241582	.5004606	.6320181
HFIAS_R2	468	.5759734	.0334249	.7230901	.5102917	.6416551
diff	468	-.0097341	.0181463	.3925647	-.0453926	.0259244

Pr(|T| > |t|) = 0.5919

In the rural group (Table 8), the mean scores were higher compared to the urban group at both time points (Table 7). The p-value associated with the paired t-test is 0.7606. This p-value is higher than 0.05, suggesting that there is not enough evidence to reject the null hypothesis that the mean difference is zero. Hence, a conclusion can be made that the observed difference is not statistically significant.

Table 7: Paired t-tests, urban home location

	Urban					
Variable	Obs	Mean	Std. err	Std dev.	95% CI	
HFIAS_R1	329	.5336035	.0403485	.7318557	.454229	.612978

HFIAS_R2	329	.5521783	.0406445	.7372242	.4722216	.6321351
diff	329	-.0185748	.0224663	.4075011	-.0627709	.0256213

Pr(|T| > |t|) = 0.7606

The p-value associated with the paired t-test is 0.4090 (Table 8). This p-value is higher than 0.05, suggesting that there is not enough evidence to reject the null hypothesis that the mean difference is zero, hence a conclusion can be made that the observed difference is not statistically significant.

Table 8: Paired t-tests, rural home location

	Rural					
Variable	Obs	Mean	Std. err	Std dev.	95% CI	
HFAIS_R1	59	.873823	.1033897	.7941511	.6668661	1.08078
HFAIS_R2	59	.8568738	.1011529	.7769702	.6543943	1.059353
diff	59	.0169492	.0553645	.4252631	-.093875	.1277733

Pr(|T| > |t|) = 0.4090

HFIAS item response

Table 9: HFIAS differential item functioning round 1

Round 1					
Item	chi2	Prob.	Odds ratio	95% CI	
Q1_new	2.38	0.1228	0.5390	0.2700	1.0763
Q2_new	4.13	0.0421*	0.5218	0.2829	0.9624
Q3_new	2.33	0.1271	0.5516	0.2804	1.0853
Q4_new	16.84	<0.001*	0.2362	0.1207	0.4619
Q5_new	10.22	0.0014*	0.3200	0.1530	0.6694
Q6_new	6.56	0.0104*	0.3591	0.1705	0.7565
Q7_new	0.02	0.8865	1.4060	0.3619	5.4617
Q8_new	0.12	0.7286	1.0050	0.2436	4.1454
Q9_new	.	.	.	.	.

*Significance at p<0.05.

Items Q1_new, Q3_new, Q7_new, and Q8_new do not show evidence of Differential Item Functioning based on the chi-square tests. Items Q2_new, Q4_new, Q5_new, and Q6_new show evidence of Differential Item Functioning, suggesting that the probability of responding to these items differs between urban and rural.

Table 10: HFIAS differential item functioning round 2

Item	Chi2	Prob.	Odds ratio	95% CI	
q1_new	2.18	0.1398	0.5382	0.2622	1.1046
q2_new	10.37	0.0013*	0.3381	0.1803	0.6340

q3_new	8.82	0.0030*	0.3718	0.1983	0.6973
q4_new	6.15	0.0131*	0.4084	0.2083	0.8008
q5_new	0.43	0.5125	0.6674	0.2856	1.5600
q6_new	0.94	0.3335	0.6327	0.2990	1.3391
q7_new	0.51	0.4771	0.5588	0.1880	1.6607
q8_new	0.53	0.4681	0.5270	0.1603	1.7325
q9_new	0.41	0.5220	0.5505	0.1685	1.7991

*Significance at $p<0.05$.

For q1_new, q5_new, q6_new, q7_new, q8_new, and q9_new, there is no strong evidence of Differential Item Functioning. For q2_new, q3_new, and q4_new, there is evidence of Differential Item Functioning, as indicated by statistically significant chi-square tests. The odds ratios suggest differences in the odds of a particular response between groups (urban and rural).

Appendix B

Ethical clearance certificate

Appendix C

Original manuscripts

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R49 Ms F Mdluli

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M210712

NAME: **(Principal Investigator)**	Ms F Mdluli
DEPARTMENT:	School of Public Health Medical School University
PROJECT TITLE:	*A nexus of student food (in)security, common mental disorders and academic success in the midst of the COVID-19 pandemic*
DATE CONSIDERED:	2021/07/30
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Professor F Xavier Gómez-Olivé
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2021/09/28

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **July** and therefore reports and re-certification will be due in the month of **July** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

Date

Original Manuscripts

I. **Wagner, F**., Kaneli, T. and Masango, M. 2021. Exploring the Relationship Between Food Insecurity with Hunger and Academic Progression at a Large South African University. South African Journal of Higher Education 35 (5), 296-309. (2021) https://doi.org/10.20853/35-5-4099

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript and responding to the reviewers' comments.

II. **Wagner, F**., Wagner, RG., Kolanisi, U., Makuapane, LP., Masango, M. and Gómez-Olivé, FX. The relationship between depression symptoms and academic performance among first-year undergraduate students at a South African university: a cross-sectional study. BMC Public Health 22 (2067), 1-9. (2022). https://doi.org/10.1186/s12889-022-14517-7

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript, responding to the reviewers' comments, and seeking partial funding for publication costs.

III. **Wagner, F**., Masango, M., Moch, S., Krull, G., Wagner, RG., Dison, L. and Grayson, D. Challenges of teaching and learning under lockdown at Wits University: implications for the future of blended learning. Progressio, 1-18 (2024). https://doi.org/10.25159/2663-5895/14226

Student's contribution to the manuscript: Research conceptualisation and design, Study project management including coordination of data collection and management (including cleaning and data analysis), writing of the manuscript, and responding to the reviewers' comments.

IV. **Wagner, F**., Kolanisi, U., Wagner, RG., Makuapane, LP., Masango, M. and Gómez-Olivé, FX. Impact of returning home on university student hunger during South African

Covid-19 lockdown. (Under review; Journal: Food Security. First outcome- Major revision. Manuscript revised and resubmitted)

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript and responding to the reviewers' comments.

V. **Wagner, F.**, Wagner, RG., Makuapane, LP., Masango, M., Kolanisi, U. and Gómez-Olivé, FX. Mental distress, food insecurity and university student dropout during the COVID-19 pandemic in 2020: Evidence from South Africa. Frontiers in Psychiatry 15 (1336538), 1-10. (2024). https://doi.org/10.3389/fpsyt.2024.1336538

Student's contribution to the manuscript: Research conceptualisation, design of the study, data collection and management (including cleaning and data analysis), writing of the manuscript and responding to the reviewers' comments.

EXPLORING THE RELATIONSHIP BETWEEN FOOD INSECURITY WITH HUNGER AND ACADEMIC PROGRESSION AT A LARGE SOUTH AFRICAN UNIVERSITY

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ABSTRACT

Food insecurity has been recognized as one of the key challenges currently affecting students in higher education. However, there has been limited research in South African higher education that has sought to understand the relationship between food insecurity and student success. The current study defined student success as a student meeting the requirements to progress from one year of study to another. The study aimed to understand the relationship between food insecurity and student academic progression. Further to this, it aimed to understand the prevalence of food insecurity, and the characteristics of students most likely to progress. This study was carried out at a large South African university and targeted at the entire 2019 first-time, first year undergraduate student cohort (n=5 356). All eligible students were invited via email to participate in a self-administered, online cross-sectional survey. The Household Food Insecurity Access Scale (HFIAS) was used to measure student food insecurity. Data were linked to the end of the year academic progress outcomes, which indicated whether or not students had met the requirements to progress to the following year of study. The survey was completed by 1 612 students, giving a 30 per cent response rate. Overall, nearly a quarter of the students (23%) were found to be experiencing food insecurity with hunger, with 5 per cent experiencing severe hunger. A retention rate of 94 per cent was recorded, and a little over 70 per cent of participants progressed to the second year of study. Student academic progression was found to be significantly associated with food security status (p<0.001), as well as first generation status (p=0.007) and home location (p<0.001) in the bivariate analysis. Further to this, a multivariate analysis revealed that students experiencing little to no hunger were almost twice as likely to progress to the next year of study when compared to those experiencing food insecurity with hunger (Odds Ratio

[OR]=1.876; 95% Confidence Interval [CI]: 1.454-2.418; p<0.001). The results of this study demonstrated that food insecurity with hunger was negatively associated with student academic progression. This is one of the first, and largest, South African studies to demonstrate this relationship. This work advocates for students experiencing food insecurity with hunger to be prioritised in university student support programmes, such as food security interventions, as this may improve student success.

Keywords: food insecurity, academic progression, student success, hunger, higher education institutions, South Africa, university

INTRODUCTION

Food insecurity among students is a growing concern in South African Higher Education Institutions (HEI's). Studies conducted in the past few years have reported alarming rates of food insecurity (Munro et al. 2013; Sabi et al. 2019; Van den Berg and Raubenheimer 2015; Rudolph et al. 2018; Kassier and Veldman 2013).

Food insecurity is often erroneously thought to be synonymous with hunger (Forman et al. 2018). Food insecurity is certainly related to hunger, however, hunger, refers to a physical feeling and is described by the Food and Agriculture Organisation (FAO) as "an uncomfortable or painful sensation caused by insufficient food energy consumption" (FAO 2008, 3). Unlike hunger, food insecurity is not a physical feeling, but is rather a term that is used to describe insufficient access to food that is nutritious, safe, and meeting special dietary requirements (FAO 1996). Therefore, food insecurity heightens the risk of hunger.

Research studies conducted to-date in HEI's have consistently identified students' socio-economic status as a critical contributor to food insecurity (Munro et al. 2013; Sabi et al. 2018; 2019; Van den Berg and Raubenheimer 2015; Rudolph et al. 2018; Kassier and Veldman 2013). These studies have found that students who are recipients of funding from the National Student Financial Aid Scheme (NSFAS) are at heightened risk of being food insecure when compared to students not receiving NSFAS support (Munro et al. 2013). The NSFAS targets its funding primarily at students coming from working class and poor families (NSFAS 2020).

As a result of the increasing number of students receiving NSFAS funding year on year (NSFAS 2018, 22), HEI's are becoming increasingly accessible to students from low income households, which have a higher likelihood of being severely food-insecure. Such students may lack secure and sufficient financial resources for food. According to research, even though this group of students receives NSFAS support, they are still at a higher risk of food insecurity compared to their peers who do not receive assistance (Sabi et al. 2019; Munro et al. 2013).

International literature exploring links between food insecurity and academic outcomes exists. The prevalence of food insecurity in HEI's is generally lower in the United States of

America (USA) when compared to South Africa, with food insecurity rates ranging from 19 per cent to 35 per cent reported in some studies (Van den Berg and Raubenheimer 2015; El Zein et al. 2019; Morris et al. 2016). Similar to South Africa, students found to be food insecure were likely to be receiving financial support through loan facilities (Morris et al. 2016) and were likely to be Black or Hispanic (El Zein et al. 2019).

In their conceptual framework, Sorhaindo and Feinstein (2006, 6), reported that nutrition can impact: 1) cognition – including attention span, memory, concentration; 2) behaviour – including increased aggression and hyperactivity, and 3) physical development – including reduced body mass index and impaired motor skills. Food insecurity especially with hunger, is known to have compounded adverse effects on student learning and wellbeing; students who are hungry often exhibit psychosomatic symptoms, including depression, dizziness, headaches and irritability (Pickett, Michaelson, and Davison 2015, 529), which may lead to poor concentration and low content uptake during learning.

Gaining insights on the links between student food insecurity and student success is imperative, as it is unclear whether the food insecurity of students contributes to South African HEI's continued struggle with low student success rates. The South African Department of Education and Training's (DHET) cohort analyses report released in 2019 suggests that 71 per cent of the student cohort enrolled for 3 year degrees in the 2015 student cohort failed to graduate in minimum time (DHET 2019a, 57). As a result, the Department has called for more research to be conducted by HEI's to understand the possible contributors to the persisting low success rates.

In order to determine the impact of food insecurity on student success, there is a need to define what is meant by student success in the context of this article. Although there is no agreed upon definition of student success, there is consensus that student success represents concepts of student retention, progression and throughput (Cele 2021, 57). In this article, the definition of student success was limited only to student academic progression. Student academic progression was defined as a "student progressing from one academic level to the next" (Nettles et al. 1999, 61). A student was determined as "successful" if they have met the requirements to progress from year of study one to year of study two.

PROBLEM STATEMENT AND RESEARCH QUESTIONS

Despite the pervasiveness of food insecurity in South African HEI's, its effects on student success is still not well understood. Current evidence coming from studies conducted in South African HEI's suggests that students perceive food insecurity as negatively impacting their ability to learn (Sabi et al. 2019); however, there has been limited work that has objectively

explored the relationship between food insecurity and student academic progress in the South African context. A limited understanding of the impact of food insecurity on student success means that HEI's are unable to give students the support they need.

This study therefore aimed to answer the following questions: What is the relationship between food insecurity and student success? What is the prevalence of food insecurity among first year undergraduate (UG) students in a large South African university? What are the characteristics of students who are likely to progress academically?

METHODS

Study setting and design

This study was carried out at a large South African university, with data collected over 6 weeks starting in September 2019. In 2019, the student body of the university was made up of approximately 40 000 students, of which 37 per cent were postgraduate students and 55 per cent were female. This study focused on the entire first-time entering first year UG student cohort, which made up 13 per cent of the student population (5 356). The study was incorporated into the online, self-administered First Year Student Satisfaction Survey targeted at the same first year population.

Study participants and recruitment

Students were eligible to participate if they were UG, first-time entering first year students in 2019, over the age of 18 years and enrolled as full-time students. All eligible students were recruited via email, with each email containing a unique link directing them to the online survey.

Data collection tools

The Household Food Insecurity Access Scale (HFIAS) was used to measure food insecurity. The tool was adapted so it would be applicable to both students living in the university residence context as well as those that may have been living off-campus. The HFIAS is a standardised 9-item scale with international applicability (Coates, Swindale, and Bilinsky 2007), and includes a 3-item Household Hunger Scale (HHS) (Ballard et al. 2011). Following data collection, reports from the university data warehouse were extracted using individual identifiers of those that completed the survey. Oracle's OBIEE software (California, USA) was used to extract these reports which contained student demographic information, as well as student academic progress outcomes.

Measuring student academic progression

At the end of each academic year and based on their academic performance, each student registered at the university and pursuing an academic programme, is assigned a progress code. Academic progression was defined as a student in year of study 1 (YOS 1) meeting all the requirements to advance to year of study 2 (YOS 2). Respondents' progress codes were therefore grouped the into two categories: 1) Progression to YOS 2 and 2) No Progression to YOS 2.

Data collection and analyses

Survey data were collected using Research Electronic Data Capture (REDCap) hosted at the University of the Witwatersrand, Johannesburg (Harris et al. 2019; 2009). Data from REDCap were merged with reports from OBIEE and analysed using STATA SE 14 (StataCorp LLC).

Ethical considerations

The study received ethical clearance from the University of the Witwatersrand Human Research Ethics Committee (HREC) (Medical), Clearance Certificate (M210712), as well as (Non-medical), Clearance Certificate (H18/09/17). In addition, permission was received from the Office of the Registrar to conduct the study.

RESULTS

Of the participants invited to respond, 30 per cent (1 612 students) completed the survey. Table 1 presents the demographics of students who participated in the survey. The age distribution ranged from 18 to 39 years, with a median of 19 years. Students participating in the study were mostly South African (94%), female (62%), in terms of race, were mostly African (75%), and most were studying towards a qualification in the humanities faculty (31%). Most students described the location of their homes as being in the City or Suburb (44%) or in the Township (32%), with 45 per cent receiving financial support from NSFAS and 48 per cent being first in their family to go to university.

Table 2 shows that 73 per cent of the students were food insecure. Food insecurity was distributed among those that were mildly food insecure (11%), moderately food insecure (24%) and severely food insecure (38%). Of the students participating in the study, 77 per cent experienced little to no hunger, 18 per cent experienced moderate hunger and 5% experienced severe hunger. An analysis of food insecurity together with hunger revealed that nearly a quarter of the students were experiencing food insecurity with hunger (23%).

Table 1: Demographic attributes of students participating in the study

Demographic tables (n = 1 612)	n	%
Gender:		
Female	1 003	62
Male	609	38
Race:		
African	1 206	75
Chinese	7	0
Coloured	44	3
Indian	164	10
Unknown	10	1
White	181	11
Nationality:		
South African	1 508	94
International	104	6
Faculty:		
Faculty of Commerce, Law & Management	265	16
Faculty of Engineering and the Built Environment	298	19
Faculty of Health Sciences	253	16
Faculty of Humanities	500	31
Faculty of Science	296	18
Home Location:		
Rural Village or Farm	345	21
Informal Settlement	47	3
Township	517	32
City/ Suburb	703	44
NSFAS Bursary:		
Yes	723	45
No	889	55
First-Generation Status:		
Yes	781	48
No	831	52

Table 2: Distribution of food insecurity and hunger prevalence among students

Food Security and Hunger Status	n	%
HFIA Scale:		
Food Secure	431	27
Mildly food insecure	186	11
Moderately food insecure	386	24
Severely food insecure	609	38
Total	***1612***	***100***
Hunger Scale:		
Little to no hunger	1236	77
Moderate hunger	296	18
Severe hunger	80	5
Total	***1612***	***100***
Food Security and Hunger:		
Food secure	431	27
Food insecure without hunger	805	59
Food insecure with hunger	376	23
Total	***1612***	***100***

Results presented in Figure 1 compare the progression and retention rates of the study participants to the entire first-time entering first year UG student cohort of 2019. In terms of progression, a higher percentage of study participants (72%) progressed compared to the entire

first year UG student cohort (66%). Furthermore, the student retention rate suggested that study participants had a slightly higher retention rate (94%) when compared to the first year UG student cohort (90%).

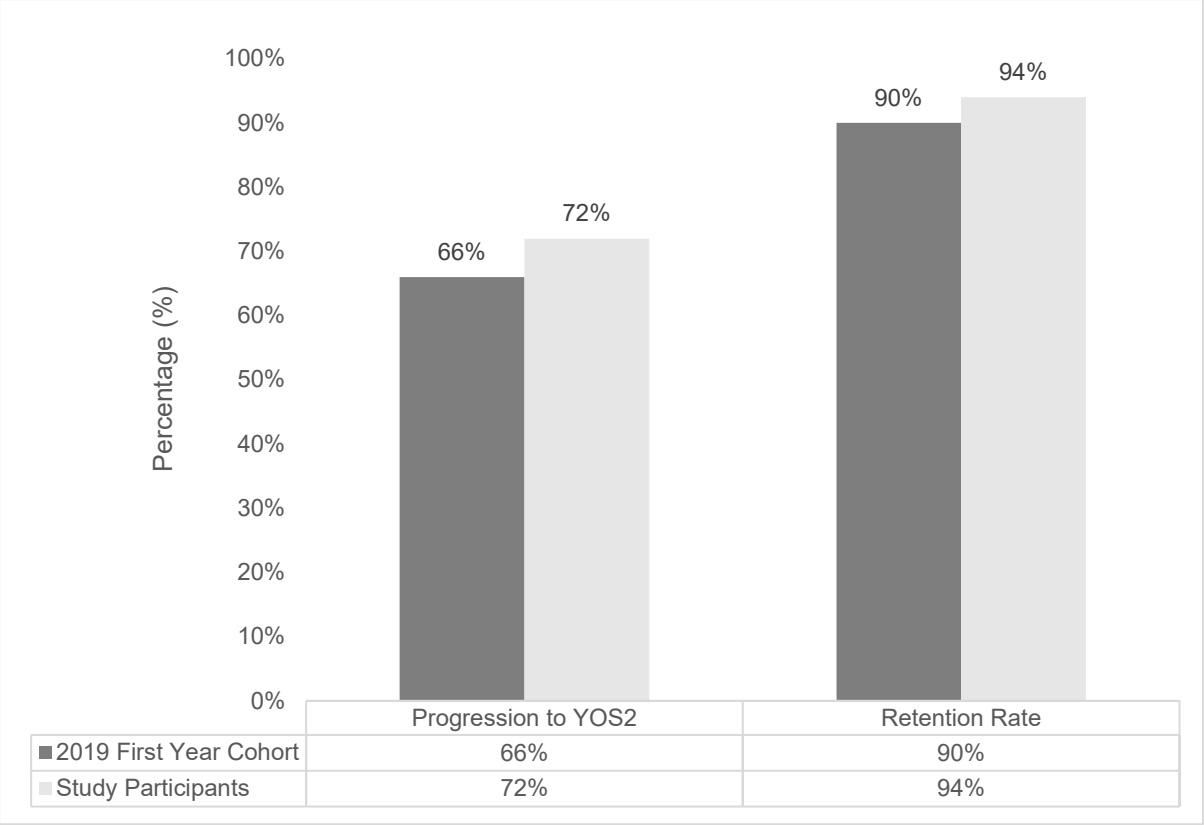


Figure 1: Progression and retention rates of study participants when compared to the entire 2019 first year UG student cohort.

The chi-square test of independence was used to determine the nature of the relationship between student retention (whether or not a student re-registered in the subsequent year, 2020) and a number of variables. Results in Table 3 indicate that only gender (p=0.005) and working for pay (p=0.019) were significant in their association with student retention, and all the other variables including food security status and hunger were not significant.

Table 3: Chi-square test of independence for student retention and socio-demographic variables

Variable	X^2	*p*
Food security status	3.987	0.263
Hunger status	3.556	0.169
Race	0.947	0.967
Gender	7.928	0.005
Home location	2.428	0.488
Working for pay	5.491	0.019
NSFAS funded	2.023	0.155
First generation status	0.2778	0.598

The chi-square test of independence was used to determine the nature of the relationship between student progression and a number of variables. Table 4 shows that food security status, hunger status, race, gender and home location were significant (p<0.001) in their association with student progression. Whether or not a student was first in their family to attend university (first generation status) was also significant (p=0.007).

Table 4: Chi-square test of independence for student progression to YOS 2 and socio-demographic variables

Variable	X^2	*p*
Food security status	53.2443	<0.001
Hunger status	43.943	<0.001
Race	38.32	<0.001
Gender	16.432	<0.001
Home location	43.411	<0.001
Working for pay	0.254	0.615
NSFAS funded	0.078	0.790
First generation status	7.397	0.007

Student progression had several significant associations. A multivariate analysis was then performed to ascertain the combined effect of the variables of interest, which were food security status, hunger status, race, gender, home location and first-generation status, on the student progression outcome. Table 5 summarises the logistic regression model results.

Table 5: Backward stepwise regression of factors associated with student progression to YOS 2 (multivariate analysis)

Variable of Interest	Progression to YOS 2 (%)	No Progression to YOS 2 (%)	Odds Ratio (95% CI)	*p*-value
Gender:				
Male	404 (66)	205 (34)	1	
Female	759 (76)	244 (24)	1.381 (1.096 - 1.739)	0.006
Hunger Status:				
Hunger	221 (59)	155 (41)	1	
Little to no hunger	942 (76)	294 (24)	1.876 (1.454 - 2.418)	<0.001
Race:				
African	828 (69)	378 (31)	1	
Chinese	7 (100)	0	-	
Coloured	32 (73)	12 (27)	0.946 (0.470 - 1.907)	0.887
Indian	128 (78)	36 (22)	1.091 (0 .704 - 1.693)	0.696
White	161 (89)	20 (11)	2.510 (1.485 - 4.241)	0.001
Race unknown	7 (70)	3 (30)	0.900 (0.227 - 3.566)	0.881
Home Location:				
Rural Village or Farm	208 (60%)	137 (40%)	1	
Informal Settlement	32 (68%)	15 (32%)	1.407 (0.727 - 2.721)	0.311
Township	365 (71%)	152 (29%)	1.541 (1.150 - 2.064)	0.004
City/ Suburb	558 (79%)	145 (21%)	1.743 (1.255 - 2.419)	0.001

The variables of interest demonstrated a relationship with student progression on their own (Table 4). However, in the multivariate regression several variables which were found significant in the bivariate analysis were no longer significant (Table 5).

The multivariate model suggests that students experiencing little to no hunger (OR= 1.876; 95% CI 1.454-2.418; $p<0.001$) were almost twice as likely to progress to the next year of study when compared to those experiencing food insecurity with hunger (Table 5). This group of students was likely to be white (OR=2.510; 95% CI 1.485 - 4.241; $p=0.001$), female (OR=1.381; 95% CI 1.096 - 1.739; $p=0.006$) and students whose homes were located in the City/Suburb (OR=1.743 95% CI 1.255 - 2.419; $p=0.001$).

DISCUSSION

Food insecurity has been recognized as one of the key challenges currently affecting students in higher education (Munro et al. 2013; Sabi et al. 2019; Van den Berg and Raubenheimer 2015; Rudolph et al. 2018; Kassier and Veldman 2013). South Africa has over 1 million students in its HEI's (DHET 2019b, 3). The government continues to implement policies that are targeted at previously disadvantaged groups (NSFAS 2018). This has resulted in HEI's having demographics similar to the one presented in Table 1, where most students, similar to those who participated in this study, are African and female (DHET 2019b, 11; Moses, Van Der Berg, and Rich 2017, 23).

In the current study, the prevalence of food insecurity was found to be 73 per cent, with almost a quarter of these students (23%) experiencing food insecurity with hunger, and 5 per cent experiencing severe hunger (Table 2). These prevalence figures are slightly lower than those published by another South African study which reported food insecurity prevalence as high as 84 per cent when using a multi-item measure of food insecurity, with 60 per cent of the students experiencing food insecurity with hunger (Van den Berg and Raubenheimer 2015). On the other hand, the food insecurity findings from the current study were comparatively high when compared to those presented by Rudolph et al. (2018), who reported food insecurity with hunger at 7 per cent. The discrepancy can be attributed to 1) the two studies targeted different populations, with the current study focusing only on first-time entering first year UG students and Rudolph et al. (2018) focusing on the entire UG cohort; 2) the data was collected in different years, with data for this study collected in late 2019, and Rudolph et al. (2018) in the previous years; and 3) difference in approaches with this study targeting the entire cohort and reaching 30 per cent of first-time entering students and Rudolph et al. (2018) whose sample reached 1 per cent of the population of interest (first year UG students).

The first year of study is widely regarded as crucial to a student's academic performance

(Nelson, Duncan, and Clarke 2009). As such, poor experiences during this year have been linked with a higher likelihood of student dropout, hence the often low retention rates and low progression rates in the first year of study (Nelson, Duncan, and Clarke 2009). The retention rates of 94 per cent for the study participants (Figure 1) were slightly higher than the national averages reported by the DHET, (2019a, 57) which indicated drop-out rates of 12–13 per cent (i.e., retention rates of 88–87%) for study programmes that were 3 years and longer. This could be attributed to the responsive support programmes provided to the first year students by this university. It is worth noting that students that were not retained may have enrolled in other institutions. The progression rate of participants reported in this study was 72 per cent (Figure 1), there are limited studies that have explored the year to year progression rates of students (Robinson 2004); however, reports from the DHET (2019a, 57–81) indicate that only 29–38 per cent of graduates complete in minimum time.

When exploring the relationship between food insecurity and student success, student retention was found to not be associated with food security status and hunger (Table 3). In addition, the bivariate analysis indicated that only gender and working for pay were significant in their association with student retention. However, student academic progression was found to be significantly associated with food security status (Table 4). To our knowledge, the current study is one of the first in South Africa that has found significant links between food security and student progression.

Similar studies conducted in the USA have also found clear links between student food insecurity and their academic outcomes. These studies have shown that food insecure students have a higher likelihood to perform poorly academically and take longer to graduate when compared to food secure students (El Zein et al. 2019; Morris et al. 2016). Food insecure students were also shown to have a higher likelihood of scoring lower grade point averages (GPA's) when compared to their food secure counterparts (El Zein et al. 2019; Morris et al. 2016). Furthermore, students experiencing food insecurity were more likely to experience higher levels of stress, had an increased likelihood of experiencing poor sleep and inconsistent eating patterns when compared to their food secure counterparts (El Zein et al. 2019).

In addition to food security status, student academic progression was found to be significantly associated with first generation status and home location in the bivariate analysis (Table 4). Other South African studies had similar findings, these studies found that being a first generation student (Van den Berg and Raubenheimer 2015) and originating from a township (Rudolph et al. 2018) predicted food insecurity. According to (Selesho 2012; Wilson-Strydom 2010), students who are first generation have more difficulty integrating into their new university environment. This suggests that success may improve when students have the

support of someone who has been in university. The area which the student is from, including the location and socio-economic status of their communities, has been shown to be a risk factor, with students from some provinces (e.g., Gauteng) and areas (e.g., upmarket areas such as Suburbs and Cities) thought to have a higher likelihood of success (Hundermark 2018). Students from low-income families face financial difficulties, such as difficulties obtaining funds to pay university fees, food, housing, and other requirements such as clothing; these students have been found to be more stressed during their studies (Bojuwoye 2002).

In the current study, the multivariate analysis revealed that students experiencing little to no hunger were almost twice as likely to progress to the next year of study when compared to those experiencing food insecurity with hunger (Table 5). Students experiencing little to no hunger were likely to be white, female with homes were located in the City/Suburb. These results are in agreement with the findings reported in other studies. Studies carried out in South African HEI's, which have generally aimed to investigate the predictors of food insecurity in student populations, have found that African students who are male (Van den Berg and Raubenheimer 2015; Rudolph et al. 2018), pursuing undergraduate studies (Van den Berg and Raubenheimer 2015), and those on extended programmes, in particular (Munro et al. 2013), are more likely to be food insecure.

Unlike in the bivariate analysis, general food security status was found not to be significant in the regression model (Table 5). However, hunger status, which denotes a more severe kind of food insecurity, remained a strong predictor of student progression as demonstrated in the multivariate analysis. The Hunger Scale (Ballard et al. 2011) classifies individuals as experiencing food insecurity with hunger, based on their experience of any (or all) of the following:

(i) "having no food, of any kind in the house, to eat because of lack of resources to get food";
(ii) "going to bed hungry because there was not enough food"; and
(iii) "going a whole day and night without eating anything because there was not enough food".

This suggests that students who experienced food insecurity with hunger, answering "yes" to the questions above, were less likely to progress when compared with students that did not experience hunger, irrespective of their food security status.

LIMITATIONS

The current study used the HFIAS to measure student food insecurity. This tool measures food security and hunger over the past 30 days. Other studies, with similar aims have used these tools (Kassier and Veldman 2013), and we assume that the results reflect the food security status of

a student in a typical month.

The socio-economic status of students was not directly measured in the study; however, home location was used as a proxy. Future work exploring the best indirect measure of a students' socio-economic status is warranted.

CONCLUSION

The findings from this study demonstrate that food insecurity with hunger is adversely associated with student academic progression. Students experiencing little to no hunger, irrespective of their food security status, had a higher likelihood of progressing academically, when compared to those who experience food insecurity with hunger. To our knowledge, this is one of the first and largest South African study to demonstrate this relationship. Food insecurity with hunger and its relationship with student success, especially during the first year of study, should be considered as a priority by HEI's.

This work advocates for students experiencing food insecurity with hunger to be prioritised in university student support programmes, such as food security interventions, as this may improve student success. The findings of the current study can be used to inform the formulation of university policies when addressing the challenge of food insecurity with hunger among students.

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RESEARCH Open Access

The relationship between depression symptoms and academic performance among first-year undergraduate students at a South African university: a cross-sectional study

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Abstract

Background: South African universities face a challenge of low throughput rates, with most students failing to complete their studies within the minimum regulatory time. Literature has begun to investigate the contribution of well-being, including mental health, with depression among students being one of the most common mental disorders explored. However, locally relevant research exploring associations between depression and academic performance has been limited. This research hypothesizes that the presence of depression symptoms, when controlling for key socio-demographic factors, has an adverse impact on student academic outcomes and contributes to the delay in the academic progression of students.

Methods: The study used a cross-sectional design. Data were collected in 2019 from first-time, first-year undergraduate students using a self-administered online questionnaire. In total, 1,642 students completed the survey. The Patient Health Questionnaire-9 (PHQ-9) was used to screen for depression symptoms. Data on students' academic performance were obtained from institutional records. Bivariate and multivariate regression analyses were used to examine associations between depression symptoms and academic performance.

Results: Most participants (76%) successfully progressed (meeting the requirements to proceed to the second year of university study). Of the participants, 10% displayed symptoms of severe depression. The likelihood of progression delay (not meeting the academic requirements to proceed to the second year of university study) increased with the severity of depression symptoms. Moderate depression symptoms nearly doubled the adjusted odds of progression delay (aOR = 1.98, 95% CI: 1.30-3.00, $p = 0.001$). The likelihood of progression delay was nearly tripled by moderate severe depression symptoms (aOR = 2.70, 95% CI:1.70–4.36, $p < 0.001$) and severe depression symptoms (aOR = 2.59, 95% CI:1.54–4.36, $p < 0.001$). The model controlled for field of study, financial aid support as well as sex and race.

Conclusion: Higher levels of depression symptoms among first-year university students are associated with a greater likelihood of progression delay and may contribute to the low throughput rates currently seen in South African

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universities. It is important for students, universities and government departments to recognize student mental wellness needs and how these can be met.

Keywords College students, Depression, Higher education institution, Mental health, Progression

Background

Mental illness is a public health priority, affecting as much as 47% of the population at some point in their lifetime [1]. Literature has identified university students as a group that is particularly vulnerable to mental illness [2–6]. A review on depression among university students reported that depression prevalence ranged between 6 and 54% among university students [6]. Depression is a disorder that can affect one's overall functioning. Symptoms of depression can often include a lack of a positive outlook, high levels of anxiety, irregular sleeping patterns and reduced concentration [4, 7]. The high prevalence of depression among university students is concerning and justifies a need to understand how depression and academic success in this population may be associated.

There is no agreed-upon definition for academic success or failure, but there is consensus that, traditionally, student academic success is represented by student retention, progression and improved throughput; while academic failure can be described as the lack of retention, progression or throughput [8–10]. In the South African context, universities are faced with low throughput rates, meaning that only a small percentage of students obtain their qualifications within the minimum stipulated times. This is largely due to progression delay, a consequence of students not meeting the academic requirements to progress from one academic year to the next [9]. These delays in progression are particularly significant in the South African context, where more than half of the population lives in poverty and most young people are unemployed [11, 12]. In this context, unemployment is lowest among those with tertiary qualifications [12] and thus delays in acquiring qualifications can be devasting for students coming from poor homes, who are often expected to support their families financially upon graduation. It is therefore imperative that university student success is prioritised.

Several studies have explored factors and determinants of throughput and student success [13–16]. These studies found that the determinants of student success are complex, identifying high school academic achievement [13, 17], family background [15] and the students' ability to integrate into the different aspects of university life, including social communities and teaching and learning [14] as key determinants of academic success.

In addition to these traditional determinants, research has begun to explore the contribution of well-being, including mental health, as a potential contributor to student academic performance. This emerging research suggests that university students suffering from common mental disorders, especially anxiety and depression, are likely to perform poorly when compared to students without mental disorders [2, 3, 18]. A study among university students in the United States of America (USA), found that depression was not only linked to a lower grade point average (GPA), but also an increased likelihood of attrition [2]. Findings from a longitudinal cohort study in the United Arab Emirates (UAE) found that higher levels of depression predicted lower GPA scores both at baseline and follow-up [19]. Work carried out in South Africa found that students with major depressive disorder as well as those with attention deficit hyperactivity disorder (ADHD) had a higher probability of academic failure [3]. Research conducted in Australian universities found students often attributed their academic failure to poor mental health, including conditions such as anxiety and depression [20]. Evidence from students in Nigeria found depression to be inversely linked to perceived poor academic performance [21].

South African literature on depression and associations between depression and academic failure among university students has started to emerge [3, 22, 23]. However, findings from these studies have been based predominantly on White study participants, making it difficult to generalize these findings to more heterogenous student populations since White students are in minority in the South African higher education sector. Given this, the current research aims to close this knowledge gap while considering other important factors, such as financial aid and field of study, which may impact on progression delay. We hypothesize that the presence of depression symptoms has adverse effects on student academic outcomes and contributes to progression delay in a diverse South African university student population. The main aim of the current study was therefore to investigate the extent to which depression symptoms, when controlling for key demographic and socio-economic factors, predicted student progression delay.

Methods

The current study took place in a large research-intensive South African university. In 2019, the headcount student enrolment was around 41,000, with international students making up 9% of the student population. Female students made up 55% of the student population, and the majority of South African students attending the university were Black African (61%). The student population is

Table 1 Descriptive summary of characteristics by participants and non-participants

Variable	Non-Participants (n = 3 553)	Participants (n = 1 642)	*p-value*
Sex (%)			< 0.001
Female	1 952 (55%)	1 040 (63%)	
Male	1 600 (45%)	602 (37%)	
Sex not recorded	1 (0%)	0 (0%)	
Race (%)			< 0.001
Black African	2 288 (64%)	1 178 (72%)	
Chinese	18 (0%)	7 (0%)	
Coloured	150 (4%)	50 (3%)	
Indian	499 (14%)	198 (12%)	
White	565 (16%)	196 (12%)	
Unknown	33 (1%)	13 (1%)	
Age (%)			0.001
18	835 (24%)	462 (28%)	
19	2 025 (57%)	905 (55%)	
≥20	693 (19%)	275 (17%)	
Reporting as disabled or having special needs (self-reported) (%)			0.873
Yes	101 (3%)	45 (3%)	
No	3 452 (97%)	1 597 (97%)	
High school quintile(%)			0.007
1	205 (6%)	113 (7%)	
2	316 (9%)	172 (10%)	
3	517 (15%)	269 (16%)	
4	403 (11%)	200 (12%)	
5	1 215 (34%)	534 (33%)	
Other	897 (25%)	354 (22%)	
Generation status (%)			< 0.001
1st generation student	1 476 (42%)	779 (47%)	
2nd generation or more	2 077 (58%)	863 (53%)	
Field of study (%)			0.147
Commerce, Law and Management	556 (16%)	243 (15%)	
Engineering	804 (23%)	334 (20%)	
Health Sciences	509 (14%)	252 (15%)	
Humanities	956 (27%)	485 (30%)	
Science	728 (20%)	328 (20%)	
NSFAS financial aid support recipient (%)			< 0.001
Yes	1 455 (41%)	799 (49%)	
No	2 098 (59%)	843 (51%)	

culturally diverse, with the university having three official languages, English, IsiZulu and Sesotho.

Sample

The current research targeted the entire cohort of 2019 first-time, first-year undergraduate students (n=5,912). The inclusion criteria to participate in this research, which was used to extract the sample, was as follows: being 18 years of age or older; being a first-time, first-year undergraduate student; studying full-time; completion of the Biographic Questionnaire [16], which is a baseline survey at intake; pursuing either a professional bachelor's degree (a programme that is generally four years or longer) or a general bachelor's degree (generally a three-year programme); and being assigned progress codes at the end of the 2019 academic year. All students provided informed consent prior to participating in the study. Students not meeting the inclusion criteria were excluded.

All students meeting the inclusion criteria were invited to participate in the study (n=5,195). Students could only complete the survey once they had given informed consent. A total of 1,648 participants (32%) completed the survey. Six participants were not assigned progress codes at the end of the 2019 academic year, the possible reasons for this include students deregistering or awaiting the outcome of appeals. The six records were removed from the analysis, leaving a total analysis sample of 1,642 participants.

A comparison between study participants and those who did not participate in the study (non-participants) (Table 1) shows that non-participants were significantly older (X^2 (2, N=5 195)=14.95, p=0.001), more likely to be male ((45% vs. 37%); X^2 (1, N=5 195)=32.31, p<0.001), less likely to be Black African ((64% vs. 72%); X^2 (5, N=5 195)=28.87, p<0.001), and were significantly more likely not to be receiving financial aid ((59% vs. 51%); X^2 (1, N=5 195)=27.17, p<0.001). The participant group was significantly more likely to be from high school quintiles 1–4, and significantly more likely to be first-generation students ((47% vs. 53%); X^2 (1, N=5 195)=15.91, p<0.001). There were no differences in disability status or field of study.

In the analysis sample (Table 1) most study participants were female (63%), Black African (72%), between the ages of 18 and 39 (median 19 years), non-first-generation students (53%), attended high school quintile 5 (33%) and reported having no special needs (98%).

Instruments

Depression the Patient Health Questionnaire-9 (PHQ-9) was used to screen for depression symptoms using a two-week recall period [24]. The PHQ-9 has been validated and determined to give accurate accounts of the prevalence of depression symptoms [25]. Responses to each of the questionnaire items were rated on a four-point Likert scale, ranging from 0 (not at all) to 3 (nearly every day) [25]. Participants' responses were summed and designated to one of five categories for the PHQ-9 (that is a PHQ-9 score of 0–4 denoting minimal depression symptoms; 5–9 denoting mild depression symptoms, 10–14 denoting moderate depression symptoms, 15–19 denoting moderate-severe depression symptoms, and 20–27

denoting severe depression symptoms), these categories have been used in other studies [26].

Covariates potentially influencing academic performance associations were identified in literature and included in the models. These covariates included: race (coded as Black African, Chinese, Coloured, Indian, White or Unknown), sex (coded as male or female), first-generation status (coded as 1st generation student for those first in their family to go to university), and 2nd generation or more (coded for those with family members who had attended university). A self-reported account of disability status was also included (coded as 'yes' for participants with self-reported disabilities and/or special needs, or 'no' for participants with no disabilities and/or special needs). Other covariates included field of study (coded as Commerce, Law and Management, Engineering, Health Sciences, Humanities, or Science), and financial aid from the National Student Financial Aid Scheme (NSFAS) (coded as 'yes', for those who were funded, or 'no' for those who did not receive funding).

Anxiety Anxiety symptoms were measured using the GAD-7 questionnaire [27] which is a seven-item tool used to screen for anxiety symptoms. Like the PHQ-9, the GAD-7 uses a two-week recall period. Responses to each of the questionnaire items were rated on a four-point Likert scale, ranging from 0 (not at all) to 3 (nearly every day). Participants' responses were summed and designated to one of four categories for the GAD-7 (with severity scores as follows: a score of 0–4 denoting minimal anxiety, 5–9 denoting mild anxiety, 10–14 denoting moderate anxiety and 15–21 denoting severe anxiety), these categories have been used in other studies [26, 27].

Students' main source of general support was also included as a variable from the question: *While you are at university, who will be providing you with general support?* Participants had the following response options: Both parents, Single parents, Grandparent(s) or, Guardian(s), Other family and/or friends(s), Spouse/partner, No support. General support, in this instance, means the support given to students in general, without any particular sub-divisions.

High school socio-economic quintile was also included. South African public schools are allocated quintile categories to reflect the socio-economic status of communities surrounding the schools. Quintile 1 represents the poorest communities and quintile 5 the wealthiest [17]. In addition to the high school quintiles 1–5, was the category 'other'. The 'other' category included participants from non-public high schools (private and international high schools).

Academic performance progress codes assigned to each student at the end of the academic year were dichotomized as (i) those meeting the requirements to proceed to the second academic year of study (successful progression) and (ii) those who did not meet the academic requirements to proceed to the second year of study (progression delay). This definition has been previously used to define academic success (here defined as 'successful progression') and academic failure (here defined as 'progression delay') in similar work in South Africa [3, 28].

Procedure

Following ethics approval, as well as written permission from the university registrar, all first-time, first-year undergraduate student email addresses were extracted from the university database using the inclusion criteria stated above. Students were then invited to participate in the study via an email with a unique link to the survey. Students could only complete the survey after consenting (by clicking that they consented to take part in the study). Data collection, which took place over six weeks between July and August 2019, was in the form of a self-administered online questionnaire, which was hosted on the Research Electronic Data Capture (REDCap) web application [29]. Academic performance data (for the 2019 academic year) were requested from the university for students who completed the survey, this performance data was then linked to survey data.

Data analysis

Data were cleaned and analyzed using STATA (version 14; College Station, Texas, USA). Frequency and descriptive analyses were performed for demographic and mental health variables. Categorical variables were reported using percentages and continuous variables were reported using the median and interquartile ranges (IQR). The Mann-Whitney U test was used to compare continuous variables, while the chi-square test was used to compare categorical variables with student progression. Variables included in the logistic regression model, which used adjusted odds ratios (aOR) as a test statistic, were selected using a forwards and backwards stepwise regression, with a cut-off of $p \leq 0.20$ used for inclusion in the model. Significance was defined at an p-value < 0.05 level in all analyses.

Results

As shown in Table 2, a total of 76% of students progressed successfully, while 24% experienced progression delay. A higher proportion of male students (31%) experienced progression delay, compared to female students (21%). Black African students and students from quintile 1 high schools had the highest proportion of progression delay at 27% and 33% in their respective groupings. In terms of field of study, students registered for programmes in the humanities had the lowest proportion of progression

Table 2 Descriptive summary of characteristics of the sample

Variable	Successful Progression (n = 1240)	Progression Delay (n = 402)	*p-value*
Academic performance (%)	1 240 (76%)	402 (24%)	
Sex (%)			< 0.001
Female	823 (79%)	217 (21%)	
Male	417 (69%)	185 (31%)	
Race (%)			< 0.001
Black African	856 (72%)	322 (27%)	
Chinese	7 (100%)	0 (0%)	
Coloured	40 (80%)	10 (20%)	
Indian	156 (79%)	42 (21%)	
White	170 (87%)	26 (13%)	
Unknown	11 (85%)	2 (15%)	
Age in years (IQR)	19 (18–19)	19 (18–19)	0.355
Reporting as disabled or having special needs (self-reported) (%)			0.486
Yes	32 (71%)	13 (29%)	
No	1 208 (76%)	389 (24%)	
High School Quintile(%)			< 0.001
1	76 (67%)	37 (33%)	
2	118 (69%)	54 (31%)	
3	182 (68%)	87 (32%)	
4	143 (72%)	57 (29%)	
5	432 (81%)	102 (19%)	
Other	289 (82%)	65 (18%)	
Generation status (%)			0.061
1st generation student	572 (73%)	207 (27%)	
2nd generation or more	688 (77%)	195 (23%)	
Field of study (%)			< 0.001
Commerce, Law and Management	212 (87%)	31 (13%)	
Engineering	164 (49%)	170 (51%)	
Health Sciences	216 (86%)	36 (14%)	
Humanities	434 (89%)	51 (11%)	
Science	214 (65%)	114 (35%)	
NSFAS Financial aid support recipient (%)			0.784
Yes	601 (75%)	198 (25%)	
No	639 (75%)	204 (24%)	

Age is described using median, Interquartile ranges and the Mann Whitney U test; the chi-square test was used to compare categorical variables to progression

delay at 11%. There were significant differences between progression delay in the distribution by sex (X^2 (1, N = 1 642) = 20.07, $p < 0.001$), race (X^2 (5, N = 1 642) = 23.06, $p < 0.001$), high school quintile (X^2 (5, N = 1 642) = 34.89, $p < 0.001$) and field of study (X^2 (4, N = 1 642) = 228.20, $p < 0.001$).

In terms of mental health, the prevalence of severe anxiety symptoms was found to be 18% and severe depression symptoms was 10%. As shown in (Table 3) 29% of participants with severe anxiety symptoms experienced progression delay and 30% of participants with severe depression symptoms experienced progression delay. Finally, 27% of participants who listed having no general support experienced progression delay. The bivariate analysis indicated a high correlation between depression (X^2 (4, N = 1 642) = 22.79, $p < 0.001$), anxiety symptoms (X^2 (3, N = 1 642) = 12.25, $p = 0.007$) and progression.

Table 3 Summary of mental health and social support variables of the sample

Variable	Successful Progression (n = 1 240)	Progression Delay (n = 402)	*p-value*
Anxiety symptoms severity			0.007
Minimal	383 (80%)	93 (20%)	
Mild	398 (76%)	126 (24%)	
Moderate	246 (72%)	94 (28%)	
Severe	213 (71%)	89 (29%)	
Depression symptoms severity			< 0.001
Minimal	241 (83%)	49 (17%)	
Mild	430 (78%)	118 (22%)	
Moderate	300 (72%)	114 (28%)	
Moderate severe	161 (69%)	74 (31%)	
Severe	108 (70%)	47 (30%)	
Main source of general support			0.056
Both parents	619 (78%)	171 (22%)	
Single parents	350 (74%)	124 (26%)	
Grandparent(s) or guardian(s)	146 (69%)	65 (31%)	
Other family and/or friends(s)	58 (74%)	20 (26%)	
Spouse/ partner	11 (92%)	1 (8%)	
No support	56 (73%)	21 (27%)	

The multivariate logistic regression (Table 4) showed that being enrolled in the Engineering field of study increased the likelihood of progression delay more than nine-fold (adjusted odds ratio (aOR) = 9.33, 95% CI: 6.35–13.72, $p < 0.001$) and of Science more than four-fold (aOR = 4.23, 95% CI: 2.88–6.22, $p < 0.001$). Furthermore, experiencing moderate depression symptoms increased the adjusted odds of progression delay almost two-fold (aOR = 1.98, 95% CI: 1.30-3.00, $p = 0.001$), while moderate severe symptoms of depression increased the likelihood of progression delay almost three-fold (aOR = 2.70, 95% CI:1.70–4.30, $p < 0.001$). Severe depression symptoms also increased the odds of progression delay almost three-fold (aOR = 2.59, 95% CI:1.54–4.35, $p < 0.001$). An increase in the severity of depression symptoms was also found to lead to a higher likelihood of progression delay. Anxiety symptoms did not meet the threshold to be included in the final model.

Two variables, high school quintile (quintile 5 and other) and receiving financial aid from the National Student Financial Aid Scheme (NSFAS), decreased the odds of progression delay. Participants who completed Grade

Table 4 Logistic regression model used to calculate the predictors of academic performance

Variable	aOR (95% CI)	*p*-value	Standard error
Sex			
Female	ref		
Male	1.10 (0.84–1.45)	0.464	0.152
Field of Study			
Humanities	ref		
Engineering	9.33 (6.35–13.72)	< 0.001	1.834
Health Sciences	1.56 (0.99–2.52)	0.057	0.378
Commerce, Law and Management	1.17 (0.71–1.90)	0.541	0.291
Science	4.23 (2.88–6.22)	< 0.001	0.831
Race[a]			
Black African	ref		
Coloured	0.93 (0.42–2.06)	0.867	0.377
Indian	0.96 (0.62–1.47)	0.846	0.211
White	0.62 (0.37–1.03)	0.065	0.161
Major depression disorder symptom severity			
Minimal	ref		
Mild	1.40 (0.93–2.11)	0.103	0.291
Moderate	1.98 (1.30-3.00)	0.001	0.421
Moderate severe	2.70 (1.70–4.30)	< 0.001	0.639
Severe	2.59 (1.54–4.36)	< 0.001	0.688
High school quintile			
1	ref		
2	0.87 (0.49–1.53)	0.621	0.250
3	1.11 (0.66–1.87)	0.695	0.296
4	0.83 (0.49–1.50)	0.579	0.244
5	0.50 (0.30–0.85)	0.010	0.135
Other	0.47 (0.26–0.83)	0.009	0.136
NSFAS financial aid support recipient			
No	ref		
Yes	0.67 (0.26–0.83)	0.007	0.100

[a] Chinese and unknown race categories were dropped due to low number and/or zero exposure in the control population. This table provides adjusted Odds Ratios (aOR) and 95% CI formatted as "OR (lower CI-upper CI)" for each result of logistic regression

12 in well-resourced high schools (high school quintile 5), and those whose high school was classified as 'Other' (private and international high schools) were also significantly less likely to experience progression delay (aOR=0.50, 95% CI:0.30–0.85, p=0.01) and (aOR=0.47, 95% CI:0.26–0.83, p=0.009), respectively. Participants who received financial aid support from the NSFAS were also significantly less likely to experience progression delay (aOR=0.67, 95% CI:0.26–0.83, p=0.007).

Discussion

The prevalence of severe anxiety symptoms was 18% and severe depression symptoms was 10%, when using standardized tools. These findings on anxiety and depression corroborate a recent South African study that found a 21% prevalence of generalized anxiety disorder and 14% prevalence of major depressive disorder among first-year university students when using a 12-month recall [3]. Findings from international literature vary with studies reporting depression and anxiety levels as high as 54% and 66%, respectively [6]. It is important to stress that the current study presents findings for anxiety and depression symptoms and not major depressive disorder or generalised anxiety disorder.

Findings from our study suggest that depression symptoms are predictive of progression delay, confirming the hypothesis underpinning this study. In fact, results indicate that moderate depression symptoms increased the odds of progression delay almost two-fold and that moderate severe and severe depression symptoms increased the adjusted odds of progression delay by three-fold. These findings align with both South African literature, which found that students experiencing major depressive disorder were almost four times more likely to perform poorly [3] and international literature from the USA and the UAE which associated low GPA scores with depression [18, 19]. Anxiety symptoms were not significant in their association with progression delay in the logistic regression, also a common finding [19, 30, 31].

Common mental disorders may affect academic performance in a number of ways. One way is class attendance, which is an important contributor to academic success [30]. Evidence from universities in Australia and Jordan found that students experiencing common mental disorders, including depression, on average had higher levels of class absenteeism compared to students not experiencing mental disorders [20, 32]. In their work, Eisenberg et al., (2009) conceptualize the impact of poor mental health on academic performance. In it they emphasize the potential impact of mental illness, including depression, in the acquisition of cognitive skills [2]. Depression symptoms, such as having low energy and difficulty concentrating [2, 7, 30], impact on non-cognitive skills that include persistence and motivation, which have a direct effect on cognitive function and thus the acquirement of knowledge. The presence of depression impacts on these non-cognitive skills resulting in low academic productivity, leading to potentially lower skill acquisition as reflected by lower scores [2].

It is also important to note the potential bi-directionality of the above trend. It is plausible that academic failure, including progression delay, may increase the risk of depression symptoms [2]. Other literature investigating depression, academic achievement and absenteeism, has acknowledged this [32]. Furthermore, findings from Nigeria, for instance, report that students experiencing academic failure often report feelings of anger, shame, disappointment and hopelessness [33, 34]. Research has

also highlighted the compounding effects of academic failure, including the additional financial stress of having to re-register and also the time commitment due to increased workloads, all which can have significant implications on mental health [34].

The current research also found that 24% of the first-time, first-year undergraduate university students experienced progression delay during a single year at a large South African tertiary institution. These levels are consistent with findings from a similar study which found academic failure to be 26% among first-year South African university students in the Western Cape province [3]. These findings are difficult to compare with international literature that typically measures academic performance using GPA. In terms of student success, variables such as sex, race, high school quintile and field of study have been well documented as predictors of academic success [13, 17, 35] and in the current research, these were also found to significantly impact academic performance. The results of our study on sex and race are supported by other research findings, both in South Africa and internationally, which indicate that female students often outperform their male counterparts [3, 30], and that White students often attain the highest academic scores [13, 30].

The results indicated that financial aid (NSFAS) as well as attending well-resourced high schools (quintile 5 and other) protected against progression delay. These findings are in line with literature that has demonstrated that students from well-resourced schools perform better academically than students from poorer schools [17]. Furthermore, studies have found that students with a financial need who receive financial aid were more likely to be academically successful when compared to their counterparts without any state funding [15, 36].

Students registered in the field of study of Engineering had a probability of progression delay nine times higher than Humanities where 89% of students successfully progressed, while students registered in the Science field had an increased likelihood of progression delay by a factor of four. These findings correspond with previous research that suggests that students enrolled in science, technology, engineering and mathematics (STEM) fields, across institutions, grapple with the curriculum [37]. In fact, although enrolment in the STEM field have increased over time in South Africa, they account for the lowest university success and graduation rates [38].

Our findings highlight the important relationship between student mental health and academic progression, suggesting that student mental health should be recognized as a critical component of academic performance at universities. As such, universities should consider making provisions for mental wellness resources on campus, and build institutional cultures that promote mental wellness. However, mental health is a public health issue, and it is unreasonable to expect universities to be the sole drivers of change. We believe that the student voice is essential to reconciling the roles of both universities and the health care system in improving student academic performance.

Conclusion

We present original findings from a study involving first-time, first-year undergraduate students at a large South African university. Although the generalizability of the findings may be limited, our data builds on a growing body of literature demonstrating the negative impact that depression symptoms have on student academic performance, through delayed student progression and ultimately potentially low student throughput rates. It is important for students, universities as well as government departments to recognize the impact of mental health on student performance and work together to identify student's mental health needs and how these can be met. Holistic student support programmes offered by universities should work towards fully incorporating student mental wellness activities. The current study has a number of strengths, including: a large study population; being carried out at an institution with a diverse student population; and experiencing a high response rate (32%) when compared to similar studies. To our knowledge, this is one of the largest studies, in terms of the sample size and response rate, on the African continent to explore the relationship between depression symptoms and academic performance. Studies using similar methodological approaches typically achieve response rates between 8 and 13% [3, 22, 23].

However, a number of limitations should also be considered when interpretating the results. The PHQ-9 is used as a screening tool for depression symptoms and is not a diagnostic clinical tool. The PHQ-9 has, however, been validated and determined to give accurate accounts of the prevalence of depression [25]. The current study was carried out at a single university, with differences delineated between study participants and non-participants, which limits the generalizability of the current findings. Furthermore, bias could have been introduced due to self-selected sampling. Finally, the cross-sectional nature of the study limits establishment of causality.

The students who participated in the current study have subsequently been invited to participate in similar research during the initial COVID-19 pandemic years (2020–2021) and the first "post-COVID-19 year" (2022). This follow-up study will help us understand the impact of the COVID-19 pandemic on the mental health of these South African students.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-022-14517-7.

Supplementary Material 1

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Authors' contributions
FW, RGW and MM conceptualized the research and UK, FXG-O and FW determined the scope of the manuscript. FW, LM and MM collected the data and FW and LM analysed the data. FW drafted the first version of the manuscript, which was critically reviewed by all other authors, who then approved the final version for submission.

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Data availability
The data that support the findings of this study are available from the University Registrar of the University of the Witwatersrand, Johannesburg, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the corresponding author upon reasonable request and with permission of the University Registrar of the University of the Witwatersrand, Johannesburg.

Declarations

Ethical approval and consent to participate
The study received ethical clearance from the University of the Witwatersrand Human Research Ethics Committee (HREC) (Medical), as well as the University of the Witwatersrand Human Research Ethics Committee (HREC) (Non-Medical), Clearance Certificates H181144; M1900627, respectively. Permission was received from the Office of the Registrar to conduct the study. All methods were carried out in accordance with the relevant guidelines and regulations. All experimental protocols were approved by a the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg. Participants were provided with the information sheet in the body of the invitation email, and were only invited to complete the survey following consent. Informed consent was obtained from all subjects. Participants were also provided with contact information for psychological counselling services available to them.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Mental distress, food insecurity and university student dropout during the COVID-19 pandemic in 2020: evidence from South Africa

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Background: Student dropout has been a key issue facing universities for many years. The COVID-19 pandemic was expected to exacerbate these trends; however, international literature has produced conflicting findings. Limited literature from Africa has investigated the impact of COVID-19 on student dropout trends, despite the documented devastation, including increased risk of food insecurity and mental distress, caused by the pandemic.

Objective: This work seeks to understand the impact of food insecurity and mental distress on student dropout during the COVID-19 pandemic.

Methods: Using a cross-sectional research design, first-year undergraduate students from a large South African university were recruited via email to participate in a survey between September and October 2020. The Household Food Insecurity Access Scale (HFIAS) was used to measure food insecurity and the Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS) was used to measure mental distress. Multivariate regression was used to investigate factors associated with student dropout.

Results: The student dropout rate was 10.5% (95% CI: 8.2-13.2). The prevalence of severe food insecurity was 25.7% (95% CI: 22.3-29.4) and the prevalence of severe mental distress symptoms was 26.7% (95% CI: 23.3-30.4). Dropout rates and levels of food insecurity were highest among students residing in remote areas during the lockdown at 19.2% and 43.6%, respectively. The multivariate logistic regression revealed that being male increased the probability of dropout almost three-fold (odds ratio (OR) = 2.70; 95% CI: 1.48-4.89, p =0.001)). Being moderately food insecure increased the odds of dropout more than two-fold (OR=2.50; 95% CI:1.12-5.55, p=0.025), and experiencing severe mental distress symptoms increased the odds of dropout seven-fold (OR=7.08; 95% CI:2.67-18.81, p<0.001).

Conclusion: While acknowledging that various factors and complexities contribute to student dropout, the increased vulnerability to food insecurity and mental distress, stemming from issues such as widespread job losses and isolation experienced during the pandemic, may have also had an impact on dropout. This work reiterates the importance of directing additional support to students who are food insecure and those who are experiencing mental distress in order to mitigate university student dropout.

KEYWORDS

universities, college, attrition, depression, anxiety, Africa

1 Introduction

University student dropout and retention rates are commonly used in higher education to describe the enrolment status of students following admission into an academic programme (1). Student dropout, or attrition, captures the decline in the number of students initially enrolled in an academic programme, while retention represents the count of students who continue to re-enroll in the program in subsequent years until completion (1, 2).

Considerable efforts have focused on monitoring and understanding student dropout rates, particularly in the first year of study which typically has the highest dropout rates ranging from 8-21% (3, 4). A comprehensive review of empirical literature classifies dropout determinants into five categories (4): i. *student demographic factors*- with being a male student increasing dropout probability (5), ii. *family background*- with lower socio-economic status increasing the likelihood of dropout (6), iii. *academic and social integration*- with greater ties to peers and institutional commitment reducing dropout rates (7), iv. *institutional factors*- with large class sizes increasing dropout rates (8) and v. *labour market trends* – with employability prospects having mixed impact on student dropout. The contribution of psychosocial and wellbeing variables, such as mental health and food security, on student dropout trends have generally been underexplored.

Recently, there has been general concern about the negative impact of COVID-19 on student dropout. A study from Europe reported a significant increase in dropout rates, especially among students with children and disabilities (9). A study from South America reported higher levels of dropout, citing economic and mental challenges related to the pandemic as key factors (1). In South Africa, preliminary analysis conducted using national data from the South African Department of Higher Education (DHET) early in the pandemic indicated increased dropout rates when compared to the previous years, with a significantly larger increase of dropout among those not receiving financial aid (2.8%) (10). While these findings cannot be solely attributed to factors related to the pandemic, they do justify further exploration of the factors that might have influenced student dropout during the pandemic.

South African higher education's response to the COVID-19 pandemic forced students to move back home to environments that were often unconducive for learning (11, 12). Students were expected to adopt a new and complex mode of learning which required computer hardware and connectivity (12, 13)). Many students faced realities of job and income loss (3, 13, 14). They were also anxious about contracting COVID-19, with some falling ill, some having to be primary caregivers, and others grieving for those who had passed away (3).

Several studies have reported on the impact of COVID-19 on students' food security (13–15). Literature has identified job loss as a key contributor to student food insecurity during the pandemic (13, 16, 17). Studies also noted increased levels of mental distress among university students, triggered by the move to online learning, poor home environments, financial concerns as well as anxiousness precipitating from isolation and confinement due to lockdown (11, 18).

Preceding the onset of the COVID-19 pandemic, scholarly investigations unveiled robust connections between food insecurity, mental distress, and student progression (19, 20). The pandemic and subsequent lockdown heightened these risks by i) amplifying the threat of food insecurity through loss of livelihoods, ii) inducing mental distress through experiences of grief, isolation, and uncertainty among students, and iii) ushering in a novel mode of remote teaching and learning that imposed constraints on certain student groups. It is expected that the interplay of these factors would negatively influence student dropout rates. The current study, therefore, aims to understand the impact of food insecurity and mental distress on university student dropout during the COVID-19 pandemic in South Africa.

This study is informed by Tinto's interactionalist theory on student departure (7). Social and academic integration are critical elements in Tinto's theory. Academic integration is conceptualised as intra-curricular interactions between students and university staff, as well as their peers. Social interaction is defined as the extent to which students feel connected to and involved in the social life of the university community. Tinto posits that a student's choice to discontinue their university enrolment unfolds through a

complex series of experiences. Tinto's theory acknowledges the role of both socio-economic factors as well as factors contributing to isolation rather than integration, as critical factors influencing student departure decisions. Drawing from Tinto's theory, the confluence of financial strain (and resulting impact of food insecurity), coupled with mental distress, some of which emanated from feelings of isolation, despondency and loneliness during the COVID-19 pandemic, created a precarious environment for students, potentially leading to a decision to dropout.

2 Materials and methods

2.1 Study context

The research was conducted at an urban South African university with ~41,000 students enrolled in 2020. The student body was majority female (55%) with most students (60%) enrolled for undergraduate studies. Among those enrolled, the largest population group was Black, accounting for 61% of all students. Generally, the student population represented all population groups and all official languages of South Africa.

In March 2020, the university suspended all contact activities and advised students to vacate university residences following the declaration of a nationwide state of disaster by the South African government in response to the COVID-19 pandemic (21). The South African lockdown was characterized by a 5-level alert system aimed at managing the spread of the virus (22). Alert level 5 was the most stringent and mandated residence confinement. Alert level 1, the least strict, was implemented during periods of low COVID-19 transmission (22). During the lockdown, the university's academic programme continued online. The national state of disaster was officially lifted on April 5, 2022 (23).

2.2 Sample

The current research forms part of a larger, cross-sectional survey that sought to understand the impact of COVID-19 on the student population. The primary focus of the present analysis is on a specific group of students where dropout has traditionally been highest, namely first year students. As such, the inclusion criteria were: first-time entering, first-year students who were enrolled in full-time undergraduate programmes, aged 18 years and older and had biographical information on the university's system. Students who did not meet these criteria were not included in the analysis.

2.3 Data collection

Data collection occurred between September and October 2020, coinciding with South Africa's COVID-19 lockdown alert levels 2 and 1. After obtaining ethical clearance and approval from the university registrar, a list of email addresses belonging to individuals who met the inclusion criteria was compiled. Recruitment for the study began by sending out emails to these individuals. Upon agreeing through an online consent process, participants proceeded to complete a self-administered online survey hosted on the Research Electronic Data Capture (REDCap) platform (24). The 2021 registration status of all study participants was used to assess dropout.

2.4 Variables and measures

2.4.1 Food insecurity

The Household Food Insecurity Access Scale (HFIAS) was administered in English and used to assess food insecurity among students. The HFIAS consists of nine items, with responses to each item captured in one of three categories: i. rarely (once or twice in the past four weeks), ii. sometimes (three to ten times in the past four weeks), and iii. often (more than ten times in the past four weeks). The HFIAS utilizes an algorithm that classifies food security status into four categories: food secure, mildly food insecure, moderately food insecure and severely food insecure. These categories have been used in similar studies (20, 25).

The HFIAS is one of the most predominantly used tools to measure food insecurity among South African university students (20, 25–27). The HFIAS tool has been found to have satisfactory reproducibility and validity in studies among university students. Validation studies among university students reported good internal consistencies, with Cronbach α values ranging from 0.920 in Germany, 0.750 in Lebanon, and 0.916 among South African university students (26, 28, 29). The current study yielded a good internal consistency of 0.950.

2.4.2 Mental distress

The Patient Health Questionnaire Anxiety and Depression Scale (PHQ-ADS), a composite scale, was used to measure mental distress. The PHQ-ADS combines the sum scores of the PHQ-9 as well as the Generalized Anxiety Disorder-7 (GAD-7). The PHQ-9 is a self-report questionnaire containing nine-items and requires participants to reflect on several depressive symptoms. The GAD-7, also a self-report questionnaire, contains seven items used to screen for anxiety symptoms. Both the PHQ-9 and GAD-7 use a two-week recall period. They were administered in English with responses captured in four categories i. not at all, ii. several days, iii. more than half the days, and iv. nearly every day. The PHQ-ADS, a combination of the PHQ-9 and GAD-7 tools, has a scale from 0-48, with cutoffs: 0–10, denoting minimal mental distress; 11–20, denoting mild mental distress; 21–30, denoting moderate mental distress; and 31–48, denoting severe mental distress. These cutoffs have been used in similar studies (30, 31).

The PHQ-9 has been used extensively in university settings both in South Africa, and other parts of the world (32–35). Validation studies have found the PHQ-9 to have good construct validity and reliability. Validation studies among university students reported internal consistencies of α=0.85 in Nigeria, α=0.83 in South Africa and α=0.84 in Iran (36–38). The PHQ-9 was also found to have good test-retest reliability (r=0.894, $p<0.001$) and displayed good convergence with the GAD-7 and PHQ-ADS at 0.751 and 0.934, respectively, and both significant at $p<0.001$

(31, 36b). The current study yielded a good internal consistency of 0.871.

The GAD-7 is regularly used to ascertain levels of generalised anxiety among students (32, 33; 35, 39). Validation studies have found the GAD-7 to have good construct validity and reliability. Validation studies among university students reported good internal consistencies, with Cronbach α values ≥ 0.85 in studies taking place in the United States of America, 0.903 among Spanish students and 0.892 among South African university students (32, 40, 41). The GAD-7 also displayed good convergent validity with the PHQ-9 and PHQ-ADS with coefficients ≥0.75 (30). The current study yielded a good internal consistency of 0.913.

2.4.3 Student dropout

Using official university records, students participating in this research who were enrolled in 2020 but failed to re-enroll at any time in the year 2021 were defined as having dropped out. Students who re-enrolled were described as 'retained'. As such, in the current study, dropout status was a binary variable reflecting: 1) those who dropped out or, 2) those who were retained. This definition of dropout is aligned with definitions found in earlier literature (2).

2.4.4 Socio-demographic variables

Variables included in this research were: self-identified sex (male or female), population group (Black, White, Coloured, Indian and Chinese), first-generation status (yes or no) referring to individuals who were first in their family to attend university, whether participants were recipients of financial aid (yes or no), subject area participants were enrolled in (Commerce, Law & Management, Engineering, Health Sciences, Humanities and Sciences), as well as high school quintile (1-5 and other ['other' referring to participants who matriculated outside of the South African public system]). The school quintile variable is used in South Africa to classify public schools based on the socio-economic conditions of the communities they serve. Quintile 1 schools are found in low-resource areas, while quintile 5 schools are in the most affluent communities (42).

2.4.5 COVID-19 and lockdown related variables

This research also aimed to capture factors relating to COVID-19 and the subsequent lockdown. The variable 'Self-reported COVID-19 infection' sought to understand if research participants and/or their close friends and family had ever been infected with the COVID-19 virus. Responses were categorized as 'yes' for those who had been infected and 'no' for those who had never been infected. Data on the location of the participant's residence during lockdown was also captured and coded as 'City/Suburb,' 'Township,' 'Town,' or 'Village/Farm'. The variable 'income disruption' captured whether household income during this period: 'increased', 'decreased', 'remained the same', or was 'unknown'. The final three variables captured whether 'working from home', having 'limited workspace at home' as well as general 'home circumstances' were challenging during this time, to which responses were captured as either 'yes' or 'no'.

2.5 Statistical analyses

The data underwent cleaning and analysis using STATA software (version 17; College Station, Texas, USA). Descriptive analyses were conducted on all variables, and proportions and 95% confidence intervals (95% CI) were reported, as appropriate. To compare categorical variables related to dropout, the chi-square test was utilized, while the Mann-Whitney U test was employed to compare the continuous age variable. To account for differences between the sample and the population, data were weighted based on sex and population group before calculating prevalence and constructing the logistic regression model. A forward and backward stepwise regression, with a inclusion cut-off of p-value ≤ 0.20 used to identify variables included in the final logistic regression model (43). Statistical significance was defined at a p-value ≤ 0.05 for all analyses.

3 Results

A total of 5,684 students fulfilled the study's inclusion criteria and were invited to take part in this study. Of those invited, 12.8% (726) participated. Records with no data in the variables of interest were removed from the sample, forming an analytical sample of 596 (10.5%) of the entire student sample and 82% of those who participated).

3.1 Sample characteristics

The crude student dropout rate among study participants was 9.9% (95% CI: 7.7-12.6) and the weighted 10.5% (95% CI: 8.2-13.2). Significantly higher percentages of dropout were noted among male participants when compared to female participants (14.1% versus 7.7%, respectively; p=0.013). Black (11.0%) and White (10.9%) (Table 1) participants had the highest proportions of dropout. Dropout levels were lowest for students who attended quintile 5 high schools (9.7%) and schools falling in the 'other' category (8.0%), with students who dropped out being significantly older (p=0.005).

3.2 COVID-19 and lockdown factors impacting on wellbeing

A higher proportion of dropout (15.2%) was noted amongst participants who reported being infected with COVID-19 or knew of close friends and family members who had been infected; however, this association was not statistically significant (Table 2). Participants whose residence during the time of the survey was in a village or farm had a higher dropout rate (19.2%; p=0.041). In terms of the impact of COVID-19 and lockdown on income, those who reported an increase in income during this time reported proportionally lower levels of dropout (6.3%), compared to those reporting a decrease (10.1%) or no change in income (9.9%); this association was not significant.

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TABLE 1 Unweighted sample socio-demographic characteristics by dropout status.

	Total sample n=596	Dropout status		p-value
		Retained	Dropped out	
	% (n)	% (n)	% (n)	
Sex				0.013*
Female	65.5 (390)	92.3 (360)	7.7 (30)	
Male	34.6 (206)	85.9 (177)	14.1 (29)	
Population group				0.297
Black	61.4 (366)	89.1 (326)	11.0 (40)	
Chinese	0.50 (3)	100.0 (3)	0.0 (0)	
Coloured	5.70 (34)	100.0 (34)	0.0 (0)	
Indian	12.4 (74)	91.9 (68)	8.1 (6)	
White	20.0 (119)	89.1 (106)	10.9 (13)	
Age M(SD)**	20 (± 2.3)	19.8 (± 2.0)	20.1 (± 3.3)	0.005*
High school quintile				0.153
1 (Lowest resourced schools)	5.5 (33)	81.8 (27)	45.5 (15)	
2	9.4 (56)	81.2 (46)	37.5 (21)	
3	12.1 (72)	91.7 (66)	22.2 (16)	
4	11.1 (66)	89.4 (59)	18.2 (12)	
5 (Highest resourced schools)	34.6 (206)	91.8 (189)	9.7 (20)	
Other (International or private high schools)	98.8 (163)	92.0 (150)	8.0 (13)	
Subject area				0.714
Commerce, Law & Management	13.4 (81)	93.8 (76)	5 (6.2)	
Engineering	21.3 (127)	89.0 (113)	11.0 (14)	
Health Sciences	14.8 (88)	88.6 (78)	11.4 (10)	
Humanities	31.4 (187)	91.0 (170)	9.1 (17)	
Sciences	19.0 (113)	88.5 (100)	11.5 (13)	
First-generation status				0.897
First-generation	39.8 (237)	90.3 (214)	9.7 (23)	
Non-first generation	60.2 (359)	90.0 (323)	10.0 (36)	
Financial-aid recipient				0.734
Yes	44.5 (265)	90.6 (240)	9.4 (25)	
No	55.5 (331)	89.7 (297)	10.3 (34)	
Self- reported disability Status				0.329
Yes	3.0 (18)	83.3 (15)	16.7 (3)	
No	97.0 (578)	90.3 (533)	9.7 (56)	

*Significance at p<0.05 (p-values represent frequency differences between dropout and retention).
** Age described by median values, standard deviation, and the Mann-Whitney U test.

3.3 Food insecurity and mental distress by dropout

The prevalence of severe food insecurity among participants was 25.7% (95% CI: 22.3-29.4) (Table 3). Students reporting food insecurity were significantly more likely to dropout (p=0.046). Furthermore, students living in a village or a farm during lockdown had significantly higher rates of severe (43.6%) and moderate food insecurity (32.8%) compared to students living in the city or suburbs (17.7% and 17.4%, respectively; p<0.001).

TABLE 2 Unweighted COVID-19 and lockdown factors with an impact on participants' wellbeing by dropout status.

	Total sample n=596	Dropout status		p-value
		Retained	Dropped out	
	% (n)	% (n)	% (n)	
Self- reported COVID-19 infection (of participant and/or close friends and family)				0.209
Yes	7.7 (46)	84.8 (39)	15.2 (7)	
No	92.3 (550)	90.5 (498)	9.5 (52)	
Residence during lockdown situated in:				0.041*
City/Suburb	60.0 (357)	91.0 (325)	9.0 (32)	
Township	20.3 (121)	92.6 (112)	7.4 (9)	
Town	7.4 (44)	91.0 (40)	9.1 (5)	
Village/farm	12.3 (73)	80.8 (59)	19.2 (14)	
Income disruption				0.879
Decrease	48.0 (286)	89.9 (257)	10.1 (29)	
Remain the same/unknown	49.3 (294)	90.1 (265)	9.9 (29)	
Increase	2.7 (16)	93.8 (15)	6.3 (1)	
Working from home challenging				0.836
Yes	6.9 (361)	90.3 (326)	9.7 (35)	
No	17.8 (235)	89.8 (211)	10.2 (24)	
Home circumstances challenging				0.624
Yes	52.2 (311)	90.7 (282)	9.3 (29)	
No	47.8 (285)	89.5 (255)	10.5 (30)	
Limited workspace at home				0.380
Yes	51.0 (301)	89.0 (268)	11.0 (33)	
No	50.0 (295)	91.2 (269)	8.8 (26)	

*Significance at $p<0.05$ (p-values represent frequency differences between dropout and retention).

The prevalence of severe mental distress symptoms was 26.7% (95% CI: 23.3-30.4), with significant differences between the severity of mental distress symptoms and student dropout ($p< 0.001$), generally showing higher levels of dropout in students with greater depressive symptomology.

3.4 Factors associated with dropout

The multivariable regression model (Table 4) revealed that being male increased the probability of dropout almost three-fold (odds ratio [OR] = 2.70; 95% CI: 1.48-4.89; p=0.001). Being moderately food insecure more than doubled the odds of dropout (OR=2.50; 95% CI: 1.12-5.55, p=0.025). Severe mental distress increased the likelihood of dropout more than seven-fold (OR=7.08; 95% CI: 2.67-18.81, $p<0.001$).

4 Discussion

Student dropout is a key challenge faced by higher education institutions worldwide (4). Literature affirms that the determinants of dropout are intricate and greatly influenced by context (6). The COVID-19 pandemic added an additional complexity, as evidenced by the findings of various studies across the world acknowledging its contribution to increased dropout rates (1, 9). The current study found a dropout rate of 10.5% (95% CI: 8.2-13.2) during the COVID-19 pandemic, a slight increase from the 10% dropout rate cited in pre-COVID-19 research at the same institution of the current work (20). It also found that being a male student and being older was significantly linked with dropout, a finding aligned with literature (4, 44). However, closer inspection of the current work reveals that students residing in villages or farms during the lockdown had dropout rates of closer to 20%, nearly double the

TABLE 3 Population-weighted food insecurity and mental health categories of study participants by dropout status.

	Prevalence	Dropout status		p value
		Retained	Dropped out	
	% (95% CI)	%	%	
Food insecurity				0.046*
Food secure	37.9 (95% CI: 34.1-41.9)	92.6%	7.4%	
Mildly food insecure	15.2 (95% CI: 12.6-18.4)	91.9%	8.1%	
Moderately food insecure	21.2 (95% CI: 18.7-24.7)	82.5%	17.5%	
Severely food insecure	25.7 (95% CI: 22.3-29.4)	89.3%	10.7%	
Mental distress				<0.001*
Minimal	18.2 (95% CI: 15.3- 21.5)	93.7%	6.3%	
Mild	30.7 (95% CI: 27.1- 34.5)	94.1%	5.9%	
Moderate	24.4 (95% CI: 21.2-28.1)	93.3%	6.7%	
Severe	26.7 (95% CI: 23.3-30.4)	78.0%	22.0%	

*Significance at p<0.05 (p-values represent frequency differences between dropout and retention); data presented as values weighted for sex and population group.

average, pre-pandemic rate. Literature emphasizes that, beyond the well-documented factors impacting dropout rates, students in remote areas encountered additional challenges in remote learning during the COVID-19 pandemic compared to their counterparts in different regions. These challenges stemmed from unreliable internet connections and unpredictable power supply leading to class absences, an important precursor of dropout (4, 45).

Further to this, the current study reported high levels of severe food insecurity (25.7%; 95% CI: 22.3-29.4) and severe mental distress (26.7%; 95% CI: 23.3-30.4), together with evidence that moderate food insecurity (OR=2.50; 95% CI: 1.12-5.55, p=0.025) as well severe mental distress (OR=7.08; 95% CI: 2.67-18.81, p<0.001) significantly increased the likelihood of student dropout. Again, it was students residing in villages or on farms during the pandemic that were most affected, with 43.6% of these students reporting severe food insecurity. It is also important to highlight that those students with moderate food insecurity had the highest rate of dropout at 17.5% (p=0.046). It is possible that these students may not have qualified for social support programs, as priority is often given to students who are severely food insecure and those grappling with hunger (46). The elevated levels of severe food insecurity and mental distress may reinforce poor classroom participation due to impaired concentration and reduced cognitive functioning, both impacting negatively on the learning experience and reflected in dropout rates (47, 48).

The data presented suggests an intriguing link between food insecurity, mental distress, and dropout rates amid the COVID-19 pandemic. Both food insecurity and mental distress have been demonstrated to affect academic outcomes directly as well as through interactions with each other (27, 49, 50). However, the current findings demonstrate how these dynamics may have evolved during the COVID-19 pandemic, which fostered isolation rather than the integration advocated for by Tinto. While noting the multifactorial nature of student dropout, it is plausible that the challenges some students faced with remote learning could have contributed to their dropout. Furthermore, the heightened risk of food insecurity and mental distress because of challenges including mass job loss and isolation due to the pandemic, may have also had a potential impact on dropout. These findings are aligned with work from South America which found that 38% of students reported economic distress (related to food insecurity risk) as a key motive to dropout early in the pandemic, while dropout motives related to mental distress increased over time reaching 40% in 2021 (1). There is also evidence linking poor family resources as well as an inability to cope with low resilience, and ultimately heighted risk for dropout, further corroborating the findings from the current study (51).

Tinto's theory highlights the crucial role of student integration into the social and academic aspects of university life, arguing that successful integration reduces the likelihood of dropout. The current study takes into consideration the consequences of the COVID-19 pandemic on academic activities, recognizing its impact on student learning, as well as the pandemic's effects on socio-economic conditions, including food insecurity, and mental distress risk (11, 13, 16). These impacts have negative consequences on the social and academic integration that Tinto highlights as important. Remote learning, exacerbated by issues including inadequate connectivity and intermittent power supply as reported in the literature, emerges as a substantial hindrance to the integration between students and the academic environment. Our research embraces Tinto's work by highlighting that food insecurity and mental distress also perpetuate social isolation arising from the mental toll of physical distancing and economic devastation of the pandemic, thereby leading to higher levels of dropout. This work therefore identifies these factors as important contributors to the complexity of students' experiences and decision-making processes during the pandemic. This research suggests that food insecurity and mental distress, during the COVID-19 pandemic, intersect with Tinto's core concept of integration. It enriches our understanding of the nuanced dynamics and interplay between these factors and student dropout.

TABLE 4 Population-weighted multivariate logistic correlates to dropout among study participants.

	OR (95% CI)	Standard error	p-value
Sex			
Female	ref		
Male	2.70 (1.48- 4.89)	0.82	0.001*
Financial-aid recipient			
No	ref		
Yes	0.59 (0.31-1.14)	0.20	0.117
Residence during lockdown situated in:			
City/Suburb	ref		
Township	0.64 (0.29-1.45)	0.27	0.288
Town	0.93 (0.27-3.24)	0.59	0.913
Village/farm	2.14 (0.99, 4.63)	0.84	0.053
Self- reported COVID-19 infection (of participant and/or close friends and family)			
No	ref		
Yes	2.10 (0.83-5.36)	1.00	0.119
Working from home challenging			
No			
Yes	0.64 (0.35-1.17)	0.20	0.147
Food insecurity			
Food secure	ref		
Mildly food insecure	0.98 (0.36- 2.68)	0.50	0.975
Moderately food insecure	2.50 (1.12- 5.55)	1.02	0.025*
Severely food insecure	1.09 (0.46- 2.58)	0.48	0.838
Mental distress			
Minimal	ref		
Mild	1.14 (0.41- 3.22)	0.60	0.802
Moderate	1.39 (0.48- 4.01)	0.75	0.546
Severe	7.08 (2.67-18.81)	3.53	<0.001*

*Significance at $p<0.05$.

4.1 Strengths and limitations

The current study has several strengths. First, a study of this nature, that aimed to investigate the relationship between student dropout, food insecurity and mental distress during the COVID-19 pandemic, has not previously been conducted in South Africa- in part, due to the difficulty of following up a cohort of students to assess student dropout rates. Second, a weighting was applied to our survey sample to ensure representation of the student population by sex and population group. Third, the survey sample was diverse in terms of race, representative of the South African higher education sector. However, the study has also some limitations. Given the complexity of the COVID-19 pandemic and its both direct and indirect, realised and unknown consequences on individuals, the observed prevalence and interactions between student dropout, food insecurity and mental distress cannot be solely attributed to the COVID-19 pandemic. Furthermore, student dropout does not account for students who persist in other higher education institutions. In addition to this, findings are from one university in South Africa, and therefore cannot be generalized to the Republic as a whole. Finally, self-selected sampling or self-reporting may have created bias. To address the potential selection bias, the authors have weighted the findings to the underlying student population.

4.2 Practical implications

The global higher education landscape experienced significant upheaval due to the COVID-19 pandemic. There is a growing perspective suggesting the likelihood of more severe pandemics in the future. Regardless, disruptions can manifest in various other ways, such as violent student protests, a frequent occurrence in South Africa, economic downturns, and political instability, all of which have the potential to adversely affect groups of university students. These disruptions are likely to have repercussions on economic aspects, including food insecurity, and the mental well-being of university students. Furthermore, in part due to the COVID-19 pandemic, new ways of delivering higher education, including hybrid models of delivery are being explored. In light of the present study, it will be important to consider psychosocial and mental health factors when designing these models. Identifying ways of allowing students to potentially learn remotely yet maintain a sense of inclusivity and connectedness as well as ensuring food security will likely contribute to reduced dropout rates.

The present study recognizes these factors, along with other critical elements, as crucial contributors to students' decisions to dropout. Collectively, this awareness presents an opportunity for higher education institutions to take a proactive approach in implementing strategies to retain students during periods of disruption and implementation of innovative, hybrid teaching methods, by targeting the food security and mental well-being of its student population.

5 Conclusion

University dropout rates remain a concern in higher education, with levels from one South African university found to slightly increase during the recent COVID-19 pandemic. Food insecurity and severe mental distress, two factors heavily impacted by the COVID-19 pandemic, were found to be strong predictors of student dropout with future studies needed to explore whether the changing trends identified in the current work persist after the COVID-19 pandemic. Regardless, given the known impact of food insecurity and mental distress on student success, institutions of higher education should provide targeted support to students found to

be food insecure and those who are experiencing mental distress, thereby improving student success and reducing dropout.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by University Human Research Ethics Committee (Non-medical) (H20/06/22) University of the Witwatersrand Human Research Ethics Committee (HREC) (Medical) (M210712). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

FW: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Funding acquisition, Writing – review & editing. RW: Conceptualization, Writing – review & editing, Methodology. LM: Investigation, Writing – review & editing, Project administration. MM: Conceptualization, Investigation, Writing – review & editing, Funding acquisition, Methodology, Project administration. UK: Supervision, Writing – review & editing. FG: Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Challenges of Teaching and Learning under Lockdown at Wits University: Implications for the Future of Blended Learning

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Abstract

In response to social distancing regulations of 2020 aimed at curbing the spread of the COVID-19 virus, universities had to rapidly transition from face-to-face learning to Emergency Remote Teaching and Learning (ERTL). University students and staff faced many barriers to reliably accessing online platforms, together with widespread psychosocial challenges associated with the pandemic. This article reports on these challenges, juxtaposing the experiences of university staff members and students at the University of the Witwatersrand, Johannesburg (Wits). This study used a mixed methods design and drew on two university-wide surveys for staff and one for students, followed by in-depth interviews (IDIs) and focus group discussions (FGDs). Of those invited, 9% of the student body and 7% of staff responded, with 43 students and 22 staff members participating in the interviews and discussions. Three overarching challenges emerged for both staff and students: 1) *physical limitations,*

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including poor access to reliable internet, compounded by persistent power outages; 2) *pedagogical challenges* as staff and students adjusted to a new learning modality; and 3) *balancing* aspects of personal life and wellbeing with work and studies, including remaining productive while contending with family responsibilities and emotional challenges brought about by the pandemic. The study highlights several issues, including structural considerations and the importance of promoting a sense of community and belonging, that should be considered as the University transitions to blended learning.

Keywords: COVID-19; teaching and learning; wellbeing; higher education; blended learning; South Africa

Introduction

In March 2020, following the government's declaration of a national state of disaster (Republic of South Africa 2020), the University of the Witwatersrand, Johannesburg (Wits), like other South African universities, suspended all contact activities, including teaching and learning. This marked the beginning of an extended period of confusion and apprehension on what was to come (Nyar 2021) and heralded the introduction of a new mode of teaching and learning, Emergency Remote Teaching and Learning (ERTL) (Charles Hodges et al. 2020). This new mode of learning, which took place fully online, provided a practical means of saving the academic year whilst adhering to strict lockdown restrictions (Wits 2020; Landa, Zhou, and Marongwe 2021; Motala and Menon 2020).

Challenges faced by South African students with ERTL have been well documented (Motala and Menon 2020), with difficulties ranging from infrastructural challenges and non-conducive learning spaces to precarious financial positions due to job loss, all coupled with the electricity crisis resulting in frequent power outages (van-Schalkwyk 2020; Gittings et al. 2021; Laher et al. 2021). These challenges to productive learning raised important questions, especially the physical barriers to including students from disadvantaged backgrounds (Themane and Mabasa 2022). The impact of the pandemic on mental health was less disproportionate, with students from all demographics reporting a multitude of negative feelings, including isolation, anxiety, and grief (Landa, Zhou, and Marongwe 2021; Laher et al. 2021).

Although the literature on the impact of COVID-19 among South African higher education institutions (HEIs) has given us important insights, it has often been through the lens of the student experience (Laher et al. 2021; Themane and Mabasa 2022; Fouche and Andrews 2022). This paper introduces the perspectives of university staff members and demonstrates that there is an intersection between the challenges that staff and students faced during ERTL. Understanding these challenges will allow for the proactive mitigation of potential challenges to learning as institutions move to blended learning (Wits 2019).

Problem Statement

The March 2020 declaration of a national state of disaster compelled universities to suspend all contact activities, leading to the swift implementation of Emergency Remote Teaching and Learning (ERTL). While instrumental in salvaging the academic year during strict lockdown restrictions, this online mode of learning presented a myriad of challenges for South African universities. There remains a notable gap in understanding the challenges faced by university staff members during this time: how staff experiences compare with student experiences, how lessons learnt can improve future adoptions of ERTL and understanding the implications of these lessons as institutions transition to blended learning.

Research Objectives

This research aimed to address this gap by introducing staff members' perspectives, identifying the overlapping challenges faced by students and staff during ERTL and recognising critical factors gleaned from ERTL during lockdown that could facilitate the successful shift towards blended learning.

Literature Review

This literature review briefly covers the key implications of the rapid transition from face-to-face instruction to ERTL that impacted both students and staff. It is divided into three sub-themes: i) access and connectivity, ii) pedagogical redesign and technological adaptation, and iii) psychosocial impact.

Access and Connectivity

The immediate challenge in implementing ERTL was the issue of access and connectivity (Themane and Mabasa 2022; Motala and Menon 2020; van-Schalkwyk 2020). Institutions put in place several measures to ensure that the shift to ERTL was equitable. This included providing students and staff with devices, zero-rating critical educational websites, and data allocation (Landa, Zhou, and Marongwe 2021; Nyar 2021; Motala and Menon 2020; Wits 2020). Given these provisions, the main connectivity challenges faced by students proved to be infrastructural. Poor cell phone signal, particularly for students residing in remote areas, coupled with insufficient data and compounded by an erratic power supply (loadshedding) brought about the physical lack of access of many students, particularly those from disadvantaged backgrounds (Themane and Mabasa 2022; Landa, Zhou, and Marongwe 2021; Laher et al. 2021; Fouche and Andrews 2022).

Pedagogical Redesign and Technological Adaptation

Apart from infrastructural needs, a successful pivot to ERTL necessitated that teaching staff quickly adapt to using multiple online tools and technologies for teaching and learning (Nyar 2021). There were limited opportunities for capacity building, and

efficient collaborations between various institutional departments and across academic and professional staff boundaries were essential (Phakeng, Habib, and Kupe 2020; Krull and MacAlister 2022). Perhaps the most challenging was a pedagogical redesign that enabled remote learning without compromising epistemological access (Motala and Menon 2020). This redesign was continuous and iterative. It included getting a tally of existing institutional online teaching and learning tools, understanding their capabilities, where relevant- unlocking further functionality, acquiring other appropriate technologies, and addressing integration challenges.

Further, staff required guidance on the pedagogical knowledge needed for online instruction and assessment (Bekker and Carrim 2021). Ongoing support in navigating digital environments was fundamental for both staff and students. In short, efforts towards the pedagogical redesign and technological adaptation were critical and only achieved through collaborative efforts from various stakeholders inside and outside HEIs (Krull and MacAlister 2022).

Psychosocial Impact

In addition to access issues and new pedagogical approaches, the COVID-19 lockdown presented psychosocial challenges. Mental distress arising from uncertainty on how the pandemic would progress, unfavourable living conditions, loss of income, food insecurity, fear of infection and bereavement, especially among students, have all been widely reported (Nyar 2021; Laher et al. 2021; Motala and Menon 2020; Themane and Mabasa 2022; Olawale et al. 2021). Although there are limited accounts of staff member experiences, there is evidence that staff faced similar challenges (Badaru et al. 2022) while also dealing with the risk of burnout due to workload and work-related stress (Olawale et al. 2021).

Conceptual Framework

Maslow's hierarchy of needs model (Maslow 1943), which argues that there are five needs for self-actualisation, guides this work. COVID-19 and its impact on teaching and learning can be reflected through each of the need domains:

1. *Physical*—These were important in COVID-19 as students needed to abruptly vacate university residences (Nyar 2021), leaving some with no stable accommodation. There was increased food insecurity risk largely due to income loss (Laher et al. 2021; Nyar 2021), all of which are critical needs necessary for well-being.

2. *Safety and security—A*lso important in this context as the lockdown and the subsequent university residence closure and other social distancing protocols were safety measures. However, this did not diminish the fear of exposure or 'coronaphobia', which significantly affected both staff and students (Olawale et al. 2021).

3. *Love and belongingness—T*he pandemic, through physical distancing, disrupted staff and students' social experience at the university, in many instances leading to feelings of isolation (Olawale et al. 2021). This meant that staff and students needed to be creative in finding other channels (such as WhatsApp) for social interactions (Themane and Mabasa, 2022).

4. *Self-esteem*—Understood as feelings of accomplishment and achievement—was a challenge for the ERTL, as some staff and students had trouble gaining sustained access to online learning platforms (Motala and Menon 2020) and engaging with new assessment methods that brought about uncertainty for both staff and students (Fouche and Andrews 2022).

5. *Self-actualisation*—The challenges of the pandemic and the move to ERTL impacted the personal growth of both staff and students, as research productivity plummeted and opportunities for experiential learning were limited (van-Schalkwyk 2020).

Maslow's hierarchy of needs model provides a framework for HEIs to consider when reflecting on the impact of COVID-19 and the move to ERTL on both staff and students. It also provides a basic outline of domains that interventions can prioritise in meeting the holistic needs of staff and students in the university setting.

Methods and Procedures

Context

This research was conducted at the University of the Witwatersrand, Johannesburg (Wits), an urban South African university. In 2020, Wits had an enrollment of approximately 41,000 students, with 62% and 38% of students pursuing undergraduate and postgraduate studies, respectively (Wits 2020).

Research Design

This study used a cross-sectional, mixed-methods research design. The research design integrated qualitative and quantitative approaches and allowed for improved reach that captured the complexity of the topic. This approach also allowed data to be corroborated, enhancing the validity of the findings. Self-administered, web-based questionnaires, one for students and one for staff were used to capture quantitative data. Focus group discussions (FGDs) and in-depth interviews (IDIs) were used to collect qualitative data.

Study Participants

A sample of students and staff aged 18 years and older was drawn, and those selected were invited to participate. Groups of staff and students with limited access to online platforms or devices and who were unlikely to complete the online questionnaire were

prioritised for the qualitative work. In addition, representation across faculties, genders, ages, staff categories, levels of study (for students) and programme type (for students) was considered for the qualitative work.

Procedure

Data collection took place between September and November 2020. Prospective study participants for the surveys were recruited via email. Following an online consent process, participants completed the self-administered online surveys using the zero-rated REDCap online survey platform (Harris et al. 2019).

For the qualitative work, participants could choose to participate in one activity (either the IDI or FGD), which was contingent upon providing consent. To maintain participant anonymity during IDIs and FGDs, pseudonyms were assigned. All FGDs and most IDIs were in English, with a few IDIs conducted in isiZulu and Sesotho. IDIs and FGDs were recorded and saved on Zoom and MS Teams. Following interviews, data were labelled by date, meeting time, participant pseudonym and the data collector. No information was included in the audio recordings that could identify the participants. The audio recordings were translated (where necessary) into English and transcribed.

Variables and Measures

The project team, which included representatives from all university faculties and key central departments, including Academic Affairs, Student Affairs, and ICT, collectively designed the study instruments. Validated tools were used to screen for anxiety and depressive symptoms.

Socio-Demographic Variables

Demographic variables of interest included race, faculties and departments students were enrolled in/staff belonged to, students' level of study, the type of programmes students were enrolled for, student programme type and staff category.

COVID-19 and Lockdown Related Variables

The research also aimed to capture factors related to COVID-19 and the lockdown. The variable 'Exposure to COVID-19' indicated staff and student participants who were infected with COVID-19, those whose close friends and/or family had become ill because of COVID-19, and those who expressed concern about getting infected. The variable 'Home working environment' indicated those with access to a working computer/ laptop and reliable internet. Finally, the variable 'Biggest challenges of lockdown' identified participants who had various challenges, including cyberbullying, gender-based violence (GBV), food insecurity and high workload.

Mental Distress

The 7-item Generalised Anxiety Disorder questionnaire (GAD-7) was used to screen for anxiety symptoms, and the 2-item Patient Health Questionnaire (PHQ-2) to screen for depressive symptoms. The GAD-7 self-report questionnaire uses a two-week recall (Spitzer et al. 2006). The PHQ-2 also uses a two-week recall to screen for depressive symptoms (Arroll et al. 2010). Both the GAD-7 and PHQ-2 utilise four response categories: i) not at all, ii) several days, iii) more than half the days and iv) nearly every day. The GAD-7 has a scale from 0-21, and the score categories are 0–4 minimal anxiety symptoms, 5-9 mild anxiety symptoms, 10-14 moderate anxiety symptoms, and 15-21 severe anxiety symptoms. The PHQ-2 has a scale from 0-6. The score categories are 0–2, unlikely major depressive disorder, and 3-6, likely major depressive disorder. Similar studies have used these tools (Wagner et al. 2022; Visser and Law-van Wyk 2021).

Data Analyses

The quantitative data underwent cleaning and analysis using Microsoft Excel (Version 15, Seattle, USA) and STATA software (version 14; College Station, Texas, USA). Descriptive statistical analyses were conducted on all quantitative variables.

Two senior researchers analysed the qualitative data using a thematic analysis approach. They reviewed the IDI and FGD transcripts independently and extracted common themes from the data. From these themes, each researcher developed a provisional coding framework. Following discussion and comparison, the two frameworks were synthesised into a single framework for the analysis. One of the researchers then coded all transcripts with the final coding framework using NVIVO 12 Pro software. This process was followed separately for student and staff transcripts.

Results

A total of 3 510 students, 9% of the enrolled student population, completed the quantitative survey. Students who participated were mainly female (64%), African (63%) and registered full-time (85%) for undergraduate studies (68%). Most students were pursuing general Bachelor's degrees (36%), and most were from the Faculty of Humanities (30%).

A total of 505 staff (7% response rate) completed the survey. Staff respondents were mostly female (68%), white (48%) and academic (51%).

Table 1: Demographic Characteristics of Study Participants

	Students	**Staff**
Sex	**N (%)**	**N (%)**
Female	2 243 (64)	344 (68)
Male	1 262 (36)	159 (31)
Not specified	-	2 (0)
Race		
African	2 217 (63)	151 (30)
Chinese	20 (1)	-
Coloured	162 (5)	34 (7)
Indian	429 (12)	54 (11)
White	682 (19)	243 (48)
Faculties and Departments		
Humanities	1 056 (30)	89 (18)
Commerce, Law & Management	749 (21)	68 (13)
Engineering	566 (16)	49 (10)
Health Sciences	560 (16)	85 (17)
Science	576 (16)	53 (10)
Other departments/ units	3 (0)	161 (32)
Level of study		
Postgraduate	1 126 (32)	
Undergraduate	2 384 (68)	
Programme type		
General Bachelors Degree	1 250 (36)	
Professional 1st Bachelors Degree	1 097 (31)	
Undergraduate Occasional Students	37 (1)	
Honours Degree	290 (8)	
Occasional Student Postgrad	12 (0)	
Postgraduate Diploma	199 (6)	
Masters Degree (Research and Coursework)	350 (10)	
Masters Degree (Research)	136 (4)	
Doctoral Degree	136 (4)	
Programme type		
Full time	2 979 (85)	
Online	18 (1)	
Part Time	510 (15)	
Staff category type		

Professional and Administrative Staff		228 (45)
Academic Staff (including joint)		264 (52)
Other		13 (3)

More staff members (8%) reported being infected with COVID-19 than students (3%). Furthermore, 68% of staff knew someone close to them who had been infected, and 70% of staff members expressed concern about getting infected; these figures were 58% and 68%, respectively, for students.

Regarding the physical environment, most students and staff had access to functioning laptops (85% and 91%, respectively) and reliable internet (66% and 57%, respectively). For students, the top three challenges of lockdown were high workload (65%), family responsibilities (60%) and working from home (59%). For staff, the top three challenges were restriction in movement (60%), high workload (50%) and family responsibilities (49%) (Table 2).

In terms of mental distress, 20% of students reported severe anxiety symptoms, while 43% reported severe depressive symptoms. Of staff, 20% reported severe depressive symptoms, and 10% reported severe anxiety symptoms.

Table 2: Challenges Related to COVID-19

	Students	**Staff**
Exposure to COVID-19	**N (%)**	**N (%)**
COVID-19 infection	105 (3)	41 (8)
COVID-19 infection of close friends and family	1 755 (58)	345 (68)
Concern of getting infected	2 386 (68)	354 (70)
Home working environment		
Access to functioning computer/ laptop	2 934 (85)	460 (91)
Access to reliable internet	2 317 (66)	288 (57)
Challenges of lockdown		
Working from home	2 070 (59)	157 (31)
Boredom	1 544 (44)	88 (17)
Confidence navigating online platforms	1 158 (33)	125 (25)
Cyber-bullying	281 (8)	39 (8)
Family responsibilities	2 106 (60)	246 (49)
Food insecurity	702 (20)	70 (14)
Gender based violence (GBV)	491 (14)	59 (12)
Domestic violence	421 (12)	61 (12)
High workload	2 282 (65)	255 (50)
Limited space to study/work	1 720 (49)	155 (31)
Restriction in movement	1 895 (54)	301 (60)
Other	211 (6)	65 (13)
No challenges	35 (1)	34 (7)

Mental distress		
Severe anxiety symptoms	702 (20)	51 (10)
Severe depression symptoms	1 514 (43)	101 (20)

Qualitative Findings

The sample included: for IDIs; 20 students and 10 staff, and for FGDs; 23 students and 12 staff members. There were three student FGDs, each comprised of 7 to 9 students, and two staff FGDs, one consisting of 7 support staff and the other of 5 academic staff.

Various themes emerged from the qualitative data. These themes were categorised into three broad categories. The first theme was *Challenges with technology*, which encapsulated themes on data accessibility and connectivity. The theme *Pedagogical drawbacks and advantages* captured matters about learning and teaching strategies, managing workloads and the consequences of lockdown on teaching and learning. The final category was *Multidimensional impact on wellbeing*, which included household/domestic challenges and mental wellness themes.

Challenges with Technology

The FDGs and IDIs with students revealed that most students had access to data through the monthly data provision from the university or through their means. Students who relied primarily on the monthly data allocation from the university faced multiple challenges. The first challenge was that early in ERTL, students who used mobile phone providers other than the university's initial chosen provider had to buy new SIM cards to access data. Secondly, several students reported insufficient data allocation and often had to buy additional data to meet their needs. Finally, students frequently struggled with poor cell phone reception and intermittent internet connectivity. The poor reception and internet connection were often attributed to frequent power cuts, which disrupted studying and working:

> "the connection one was a problem, it was a problem that cost because now when we started classes on Teams […] you were always late on class, if you have data you have connection issues." Student- IDI 5

> "So we wouldn't have electricity for a week and then when you log in you've got so much work and you can't manage it. I've missed uhm submission dates, I've missed quizzes, I've missed important announcements […] I never knew when they were happening because, wow, they were probably happening when we didn't have electricity..." Student- IDI 10

Pedagogical Drawbacks and Advantages

While there were a few exceptions, most students struggled with learning under lockdown. Students found online learning impersonal; they found asking questions during online lectures daunting and awkward. They also found that getting opportunities

for one-on-one consultations with lecturers required more effort and took longer as email responses were often delayed. The class subject matter would have changed by the time students secured appointments with lecturers.

> "When you're on campus, there's an in-depth and nuanced dialogue with the students in class and the lecturer which can [be] carried into the lecturer's office, you know for further, um, immediate clarification." Student- FGD 3

Not only were engagements with lecturers affected, but students also commented that organic class discussions and debates, common in face-to-face learning, could not be replicated on online platforms. This was particularly challenging for new students, who felt they had missed out on being immersed in the Wits' academic culture.

> "The atmosphere [in remote learning] no longer allows you or enables you to engage and critically think. We used to challenge each other in class, challenge each other's ideas and engage and that will also enable others to think and engage." Student- IDI 5

Students also commented on adjusting to the new assessment methods. Some students were unsure whether approaches such as open-book exams adequately tested their knowledge. Students commented on the increased opportunity to cheat during tests, as it was possible to communicate on platforms such as WhatsApp during tests to discuss answers.

However, not all aspects of learning were negatively affected. Academic staff members also noted some surprises in the new learning modality. For example, some cohorts of students seemed to understand complex topics better and performed better when assessed. This was attributed to students being able to replay recordings. Students listed this as one of the key benefits of learning online. They mentioned that having lecture recordings that they could refer to was invaluable.

> "…We found in any case that they've actually performed better, their understanding seems to be better, on average, then in previous years, which is very interesting and unexpected. And we think it has to do with the fact that they don't have to take lectures, all the information was given to them and they can go over it again and again…" Academic Staff- FGD 1

Both staff and students commented on the increased workloads during lockdown and working late into the night. Students attributed the heavy workload to making up for lost time, academic staff compensating for the lack of practical activities, and lecturers thinking they had more time due to the lockdown.

> "It was actually a lot. It required well at least a week but then now you were given I think about two days to complete the whole thing, of which at some point came as a mission impossible. But then again, we did it, eish [gosh], we had to." Student- IDI 17

Staff also noted that with the increasing workload, they were working far beyond the standard working day. A staff member from the ICT department commented on how students would contact her late in the evenings for support with overnight data. Teaching staff also reported working weekends and evenings to connect with students, as this was when most students were online.

> "As soon as they get your number they will call you at 10 pm to tell you that they can't access their data and they need to submit stuff." Staff- IDI 10

Multidimensional Impact on Wellbeing

Several factors related to living conditions and general well-being made studying and working during lockdown challenging. This included limited access to quiet physical space where students and staff could work for extended periods. Furthermore, household and domestic demands competed with work and studying, such as childcare and chores. An important theme to emerge was the greater expectations placed on female staff and students regarding caregiving and taking on the greater share of household responsibilities.

> "The support wasn't enough at home since they expect you to do some house chores, you need to clean the house, wash the dishes, while like, when I'm staying at res [student residence hall], I know I'm eating at dining hall and I don't have like that time to wash dishes…" Student- FGD 1

Participants had a fear of contracting COVID-19 and were also concerned for their friends and family. A student who tested positive for COVID-19 recalled feelings of being overwhelmed with information and being unsure of whether he would survive. A few staff and students reported losing several people close to them and commented on the lack of closure after their passing.

> "The challenge is that we are left with broken hearts because we were not able to help the family out or to attend the funeral." Staff- IDI 12

Staff and students were also candid about their mental wellbeing during the lockdown. Several stressors, such as household tensions, fears of physical violence, and a lack of in-person contact with peers, led to feelings of confinement and loneliness. Students also felt that poor communication from lecturers induced feelings of anxiety among students.

> "…but the longer they take to communicate a way forward the more anxiety comes to the students" Student- IDI 8

Staff members also commented on the financial stress and burden brought about by the pandemic. Cleaning and security staff commented on how the pandemic led to their family members and friends being laid off, speaking on how this impacted their financial well-being and the expectation that they would provide support.

> "... [COVID-19] affected me greatly because I'm the one that used to help them a lot, they used to think that my job is better than theirs. They have thrown everything into my hands, expecting me to buy this and that". Staff- IDI 12

Discussion

The COVID-19 pandemic significantly impacted higher education worldwide. In South Africa, universities worked hard to salvage the 2020 academic year, with most moving to ERTL (van-Schalkwyk 2020). The migration to ERTL at Wits and other universities amid a raging pandemic was incredibly challenging for both students and staff and had an impact on several aspects of their lives, including epistemic access, pedagogical approaches and well-being (Themane and Mabasa 2022 Laher et al. 2021; Nyar 2021).

Factors aligned to the physical safety and security pillars of Maslow's hierarchy emerged from the survey, including challenges with food insecurity and issues around COVID-19 infection. The findings of the current study are congruent with previous literature. The current study found that 68% of students expressed concern about getting infected with COVID-19, which is in line with findings from another South African institution that found 73% of their students were moderately or extremely fearful of contracting COVID-19 (Visser and Law-van Wyk 2021).

Connectivity issues also emerged as an important challenge, although most students had access to functioning laptops and computers. Concerns regarding device access did not recur in the qualitative interviews, which can be attributed in part to the university device loan programme (Wits 2020). The qualitative data strongly focused on physical barriers to learning under lockdown. These challenges are critical and directly impact students' productivity, potentially impeding their ability to feel accomplished and reach their full potential (or self-actualisation). Issues surrounding unpredictable power outages, poor cellular reception, and inadequate data allowance are aligned with findings from other empirical studies (Laher et al. 2021; Themane and Mabasa 2022; Fouche and Andrews 2022).

The current study revealed that staff members faced challenges similar to those faced by students. Both students and staff reported family responsibility and high workload as some of their biggest challenges. These findings were elaborated on in the interviews and discussions, with students reporting tight deadlines and staff members noting extended working hours. These findings corroborate those of Olawale et al. (2021) and Badaru et al. (2022), who reported on the challenges staff faced with poor connectivity, power outages, and expanding scopes of work during ERTL. These results, from both staff and students, on structural barriers provide important considerations for undertaking online components of blended learning (Wits 2019), a mode of learning that is gaining traction after the pandemic (Wits 2019). ERTL uncovered critical infrastructural inadequacies that led to unequal access to learning platforms and loss of

productivity (Themane and Mabasa 2022). Future hybrid learning models must address these structural challenges to ensure equitable learning.

Staff and students also commented on the challenges of teaching and learning online, including the lack of interpersonal engagements with peers and lecturers. Staff members noted that, in certain instances, students performed better under ERTL. This was aligned with other findings where teaching staff observed increased engagement with readings and improved understanding of concepts, leading to improved scores in formal assessments (Bekker and Carrim 2021). This evidence is important for future blended learning as it suggests that a well-designed blended approach can present opportunities to enhance the teaching and learning experience (Bates 2022). However, ERTL did uncover shortcomings, particularly around online assessment practices (Landa, Zhou, and M orange 2021; Themane and Mabasa 2022), with crucial implications for future blended learning. The skills and strategies acquired from ERTL and the flexibility of blended learning can allow staff to optimise their academic offerings, leveraging the benefits of online platforms and in-person interactions.

Finally, both staff and students reported high levels of mental distress, including high levels of depression symptoms among students. These results are aligned with findings from another South African HEI, which revealed that depression affected 35% (compared to 43% in the current study) of students during the 2020 lockdown (Visser and Law-van Wyk 2021). Mental distress was likely brought on by several matters, as highlighted in the qualitative data, including struggles with isolation and confinement, poor experience at home that made it difficult to work or study, the need to constantly balance university duties with home responsibilities, financial stress due to job loss, and grief due to the passing of family and friends. These findings, which compound physical needs such as income with needs for belonging, are consistent with findings from similar studies involving staff and students (Laher et al. 2021; Themane and Mabasa 2022; Fouche and Andrews 2022; Badaru et al. 2022). Similar work found that female students were at higher risk for anxiety and depression during the pandemic (Visser and Law-van Wyk 2021). This can, in part, be attributed to additional domestic responsibilities, such as caregiving, which are required of female staff and students.

Concluding Remarks

Using a mixed methods approach framed by Maslow's hierarchy of needs model, this work highlights several key challenges shared by students and staff, including challenges with connectivity, balancing home and university responsibilities, and coping with the pandemic's mental toll. By proactively addressing these challenges, institutions can prepare for future teaching and learning disruptions. Establishing sustainable solutions for addressing connectivity issues is crucial, given that these pose a significant obstacle to ERTL. Additionally, improving communication strategies, encompassing direct interactions between staff and students and utilising virtual platforms to foster community formation, is imperative for mitigating uncertainty and

combating the prevailing sense of loneliness many staff and students experienced during lockdown. Lastly, the experience of ERTL and the lockdown highlighted the urgent need for upskilling staff and students with positive coping mechanisms to assist in combating mental distress. Given the emotional toll associated with emergency measures like ERTL, these coping skills are indispensable for both groups.

These lessons from ERTL may be useful as universities embrace blended learning. In this new mode of teaching and learning, important considerations are required to circumvent the challenges experienced during the COVID-19 pandemic and the introduction of ERTL. In doing so, universities can reap the potential benefits of integrated learning approaches and ensure staff and students have a sense of community, even remotely.

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Ethics

This study received ethical approval (H20/06/22) from the University of the Witwatersrand Human Research Ethics Committee (non-medical) and (M210712) from the University of the Witwatersrand Human Research Ethics Committee (medical). Permission was also received from the University Registrar to collect data.

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Food Security

Impact of returning home on university student hunger during South African Covid-19 lockdown

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Abstract

The COVID-19 pandemic exacerbated hunger levels in South Africa, with an increase from 10% pre-pandemic to 23% during the pandemic. Pre-pandemic national and global research identified university students to be more vulnerable to hunger compared to the general population. This elevated risk is commonly associated with prevalent financial mismanagement. However, research investigating the prevalence of hunger during the pandemic among this at-risk group is limited.

This study aimed to understand the prevalence of - and factors associated with - hunger during the COVID-19 pandemic among students at an urban university in Johannesburg, South Africa. An online, self-administered survey produced a sample of 596 students. The Household Hunger Scale (HHS) was used to assess hunger. Most students (84%) who resided in on- or off-campus residences before the lockdown returned home during the lockdown. The weighted prevalence of hunger during lockdown was 16.4% (95%CI 13.6, 19.6). Bivariate analyses found living alone to be significantly associated with hunger, while multivariate analyses found that first-generation students (odds ratio (OR) = 1.78; 95%CI: 1.04, 3.07, p =0.015), financial aid recipients (OR = 2.69; 95%CI: 1.47, 4.91, p =0.001), and those experiencing financial stress/worry (OR = 3.38; 95%CI: 1.85, 6.18, p <0.001) were significantly more likely to experience hunger.

The high prevalence of hunger during lockdown is concerning, the mandated return of students to their homes during the pandemic may have been a mitigating factor. Profiling students at risk for hunger may allow support services to implement targeted interventions when confronted with similar circumstances in future.

1 Introduction

Hunger is an enormous global challenge. The United Nations' (UN) sustainable development goals (SDGs) have included the eradication of hunger by the year 2030 as Goal 2 (United Nations Sustainable Development 2015). Eliminating hunger and efforts towards attaining food security are crucial, as both are linked to lost productivity due to difficulties with concentration and links to malnutrition, which impede healthy development as well as increased susceptibility to illnesses (FAO 2022). South Africa, like other low- and middle-income countries (LMIC), faces a hunger challenge, driven by a myriad of issues including high levels of unemployment, rising costs of living and an energy crisis (Stats SA 2023).

Hunger is often confused with food insecurity, however, whilst related, the two are different (FAO 2022). The Food and Agriculture Organization (FAO) defines hunger as "an uncomfortable or painful sensation caused by insufficient food energy consumption" (FAO 2008). Contrarily, food insecurity is a term used to indicate regular lack of access to safe and nourishing food that meets dietary needs for normal growth, development, and an active and healthy life (FAO 2022). Hunger is linked to food insecurity (FAO 2022); in fact the United States Department of Agriculture (USDA 2023) stated that reduced quality, variety, or desirability of a diet is food insecurity without hunger, while the same characteristics with disrupted eating patterns or reduction in food intake is food insecurity with hunger. Much previous work has examined university student food insecurity (Kassier and Veldman 2013; Munro et al. 2013; Sabi et al. 2018; Wagner et al. 2021), while literature on university student hunger, is limited, especially in Africa.

The COVID-19 pandemic had serious implications for both hunger and food insecurity in South Africa (Stats SA 2020). The pandemic and strict lockdown led to job loss and reduced access to social grants which resulted in many households not having money to buy food (Ginsburg et al. 2022; Gittings et al. 2021; van der Berg et al. 2022). Statistics suggest that the prevalence of hunger fluctuated between 16-23% in 2020 (van der Berg et al. 2022), compared to around 10% in 2017 (Stats SA 2019).

In 2020, the government implemented various targeted social protection measures to mitigate the impact of the pandemic and the associated economic disruptions on its citizens (Gronbach 2021). These measures were generally regarded as successful in reaching intended populations (Megannon 2022). Temporary social protection included: increases in social protection measures such as child support grants and old age grants, a Temporary Employee/Employer Relief Scheme (TERS) which provided financial relief to employers and employees unable to work due to the operational downturn caused by the lockdown and other public health

requirements (Gronbach 2021; Megannon 2022). Further to this, the government issued a special COVID-19 Social Relief of Distress (SRD) grant, whose stringent eligibility criteria included: not receiving any other social grant from the government, for students - not receiving financial aid, and not receiving any benefits from the unemployment insurance fund (Gronbach 2021; Republic of South Africa 2020a). A means test verifying applicants' income through commercial banks formed part of the verification check (Megannon 2022). Although the above may not have benefitted students directly, it may have contributed to improved household food security when pooled.

However, there is a dearth of literature on how the COVID-19 pandemic and lockdown impacted the hunger status of university students in South Africa. Understanding the impact of the pandemic and lockdown on university student hunger is important, as food insecurity and hunger have been linked with poor academic performance (van Woerden et al. 2019; Wagner et al. 2021), poor health outcomes (Pourmotabbed et al. 2020)as well as an increased likelihood of risky sexual behaviour (Govender et al. 2022). It has been described that prior to the COVID-19 pandemic, the prevalence of food insecurity and hunger amongst South African university students were extremely high, with levels of food insecurity between 66-84% (Kassier and Veldman 2013; van den Berg and Raubenheimer 2015; Wagner et al. 2021), and 5-60% for hunger (Rudolph et al. 2018; van den Berg and Raubenheimer 2015; Wagner et al. 2021). Apart from students using financial aid to send remittances home, a practice prevalent in the African context (van den Berg and Raubenheimer 2015), financial mismanagement has also been identified as an important cause of food insecurity among university students (Papadaki et al. 2007; Sabi et al. 2018). Previously, students have reported prioritizing other commitments, including clothing and entertainment over food (Mendes-Da-Silva et al. 2012; Soldavini et al. 2021). It is for this reason that South African literature highlights, with concern, the possible impact of the prevalent practice of universities discontinuing catering services in university residences, opting instead to transform them into non-catered residences to improve their affordability (Munro and Msimango 2023).

The challenges faced by university students during the lockdown, whilst learning remotely, have been well documented (Davitt et al. 2021; Gittings et al. 2021; Landa et al. 2021; Motala and Menon 2020; Wagner, et al. 2024). Challenges included poor access to computer devices and connectivity (data, bandwidth, and network reception) with students living in more remote settings being disproportionately impacted (Landa et al. 2021; Motala and Menon 2020). Some students reported that their new environments were not conducive to studying (Motala and Menon 2020; Wagner, et al. 2024), with some not having dedicated space to study (Landa et al. 2021; Wagner, et al. 2024), facing emotional distress (Landa et al. 2021; Wagner, et al. 2024), and others reporting financial stress as financial situations worsened during lockdown (Gittings et al. 2021; Motala and Menon 2020; Wagner, et al. 2024).

In terms of wellbeing, student hunger has been highlighted as an important psychosocial factor impacted by the pandemic (Gittings et al. 2021; Motala and Menon 2020; Wagner, et al. 2024). Research on this topic has been

mainly from the United States of America and has focused on food insecurity. Research findings have been varied, showing instances of both increased and decreased levels of food insecurity (Davitt et al. 2021; Owens et al. 2020; Soldavini et al. 2021). The most notable and consistent finding across these studies has been that returning home has had a positive impact on food security status (Davitt et al. 2021; Owens et al. 2020; Soldavini et al. 2021).

Empirical research investigating the impact of the pandemic on student hunger has predominantly taken place in Western countries, with limited insights from low- and middle-income countries, such as South Africa. The current research therefore aims to understand the prevalence of hunger among university students at a South African university, as well as the factors associated with hunger, during the COVID-19 pandemic.

1.2 South Africa's Lockdown Context

In response to the COVID-19 pandemic, the South African government instituted a national state of disaster on 15 March 2020 (Republic of South Africa 2020b), all students were required to vacate university residences and encouraged to return home (SA Dept. of Higher Education and Training 2020). The government then introduced a lockdown, guided by 5 alert levels (Republic of South Africa 2020c). Lockdown restrictions were applied at a national level. Alert level 5 (Republic of South Africa 2020d) was the most stringent level, confining people to places of residence, with alert level 1 having more relaxed restrictions including a curfew between 00h00 and 04h00 daily (Republic of South Africa 2020e). Universities adopted a new learning mode, allowing the academic programme to continue remotely (Motala and Menon 2020; Nzimande 2020; van-Schalkwyk 2020). Groups of students were reintroduced into campus as the lockdown levels eased (Nzimande 2020; SA Dept. of Higher Education and Training 2020; van-Schalkwyk 2020). During the lockdown, 'essential services'—including the operation of grocery stores and corner/convenience shops—were not restricted (Republic of South Africa 2020d). Similarly, the transportation and logistics of essential goods, such as food, faced no limitations (Republic of South Africa 2020d). Commuter transport services were allowed to operate, albeit with capacity restrictions, to facilitate the movement of individuals involved in rendering or obtaining essential goods or services (Republic of South Africa 2020d). Moreover, the acquisition of essential goods, like food, was explicitly permitted. (Republic of South Africa 2020d). These guidelines were relevant country wide, including in rural and urban settings. Figure 1 provides a summary of the 2020 lockdown stages and timelines in South Africa.

Attached separately due to size.

Figure 1: Timeline of 2020 lockdown stages and restrictions in South Africa

2 Methods

2.1 Sample

The study was carried out at an urban university in Johannesburg, South Africa with ~41,000 students enrolled in 2020. Sixty percent of these students were pursuing undergraduate studies, with 55% of them being female and the majority (61%) being Black Africans. The university has a diverse student body representing all races and all South African official languages.

The current article analyses a sub-sample of a larger study, whose overall aim was to understand the impact of COVID-19 on the university community (Wagner, et al. 2024). The inclusion criteria for this study were: first-time, first-year students registered full-time towards an undergraduate degree and aged 18 years and older. Only students meeting these inclusion criteria were included in the analysis.

Whilst the entire population was invited to participate in the study, the minimum sample required to power the study sufficiently was 434. This was determined using Cochran's equation $n_0=Z^2 \bullet p \bullet (1-p)/e^2$, corrected for finite populations $n=n_0/1+[(n_0-1)/N]$ (Cochran 1988). The assumptions included a population size 5 700, 99% level of confidence, 5% of marginal error, and a hunger prevalence of 23%.

2.2 Data collection

Using a cross-sectional research design, data collection took place between September and October 2020, during South Africa's COVID-19 lockdown levels 2 and 1. Following ethical clearance, a list of student email addresses meeting the inclusion criteria was extracted from the university data warehouse. The recruitment process for the study was initiated by sending emails to all students at the University who fulfilled the inclusion criteria. Following acceptance via an online consent process, participants completed a self-administered online survey, using the Research Electronic Data Capture (REDCap) platform (Harris et al. 2019).

2.3 Measures

Household Hunger

The study employed the 3-item Household Hunger Scale (HHS) to assess household hunger (USAID FANTA Project 2011). The HHS is a tool (see supplementary file) commonly used in South Africa to assess household hunger and has been validated for cross-cultural use (Deitchler et al. 2010). The scale uses a 4-week recall measuring hunger and is adaptable to various settings allowing for applicability to different contexts. Participants respond to a four-point Likert scale for each item - ranging from 0 (never) to 3 (often – more than 10 times in the last 4 weeks). Following the recoding of data in accordance with the HHS guideline (USAID FANTA Project 2011), the summed responses are then used to determine the level of hunger (a score of 0-1

159 indicating little to no hunger; 2-3 indicating moderate hunger; and 4-6 indicating severe hunger). These
160 parameters have been used previously in similar studies (Jesson et al. 2021; Wagner et al. 2021). The current
161 study defined 'hunger', the outcome of interest in the analyses, as those scoring 2-6, and defined 'no hunger' as
162 those with a score of 0-1.

163 **Socio-demographic characteristics**

164 Socio-demographic characteristics examined in the study included sex ('male' or 'female'), race ('Black
165 African', 'White, 'Coloured/mixed race', 'Indian and Chinese'), first-generation status ('yes' or 'no') denoting
166 students who were first in their family to attend university, discipline of study ('Commerce, 'Law and
167 Management', 'Engineering', 'Health Sciences, 'Humanities' and 'Sciences'), financial aid status (coded as
168 'yes', for those who received funding, or 'no' for those who did not receive funding), as well as high school
169 quintile classification (1-5 and 'other' denoting those who attended private or international high schools or those
170 whose high schools were unknown). The high school quintile classifications were grouped into three in the
171 multivariate analysis: 'Quintile 1-3' and 'Quintile 4 & 5' and 'other'. The school quintile is used in South Africa
172 to classify public schools based on the socio-economic conditions of the communities they serve. Quintile 1
173 schools are found in low resource areas, while quintile 5 schools are found in the most affluent communities
174 (Burger and Naudé 2019).

175 **COVID-19 lockdown factors**

176 Factors arising from the pandemic were considered. The variable 'Place of residence during lockdown' reflected
177 where the students stayed during lockdown and was coded as ' on- or off-campus residence', ' with relatives",
178 ' at home' and ' no stable accommodation'. Self-reported COVID-19 infection of the participant or those around
179 them was captured under the variable "Self-reported COVID-19 infection (of participant and/or close friends
180 and family)" and coded as 'yes' for those reporting infection and 'no' for those not reporting infection by the
181 time of the survey. The number of people currently living in the household was also captured and coded as
182 'living alone', '2', '3-4' and '5 or more'. Other covariates included where the household location during
183 lockdown was situated (coded as 'City/ Suburb', 'Township', 'Town' and 'Village/farm'); whether there was
184 financial stress/ worry during lockdown (coded as 'yes' or 'no'); and finally the variable 'limited workspace at
185 home' to give a sense of whether there was space for students to work (coded as 'yes' or 'no').

186 **2.4 Analytic Approach**

187 Data were cleaned and analyzed using STATA (version 17; College Station, Texas, USA). Descriptive analyses
188 were performed for all variables, with proportions and 95% confidence intervals (95% CI) reported when
189 appropriate. The Pearson's chi-square test was used to compare categorical variables with hunger, and the Mann-
190 Whitney U test was used to compare the continuous variable (age).

Data were weighted by sex and race to adjust for the differences between the students who participated in the study and the underlying student population. Variables included in the logistic regression model were selected using a forward stepwise regression, with a cut-off inclusion of p-values ≤ 0.20 for the model and Odds Ratios (OR) reported. Significance was defined at p-values <0.05.

3 Results

Of the 5,684 students who met the inclusion criteria and were invited to participate in this study, 726 (12.8%) agreed to participate; 130 were excluded from the analyses due to missing data yielding a final analytical sample of 596 (10.5%) participants. The weighted prevalence of hunger among participants was 16.4% (95% CI 13.6, 19.6). Table 1 shows the socio-demographic characteristics of the sample by hunger status. There were significant differences in hunger levels by race ($p < 0.001$), age ($p=0.003$), high school quintile ($p < 0.001$), first generation status ($p < 0.001$) and financial aid status ($p < 0.001$).

Table 1: Weighted socio-demographic characteristics of students by hunger status

	Total sample n=596	**No hunger**	**Hunger**	**p-value**
Total hunger prevalence	-	83.6%	16.4%	-
Sex				0.124
Female	57.0%	85.5%	14.5%	
Male	43.0%	81.1%	18.9%	
Race[1]				<0.001*
Black African	69.0%	77.1%	22.8%	
Coloured/mixed race	4.6%	97.5%	2.6%	
Indian	12.8%	95.9%	4.1%	
White	13.6%	100%	0 .0%	
Age [M (SD)]	20 (± 2.3)	19.8 (± 2.0)	20.1 (± 3.3)	0.003*
High school quintile				<0.001*
1	6.6%	55.0%	45.0%	
2	10.8%	62.1%	37.9%	
3	14.1%	77.7%	22.3%	
4	11.6%	82.4%	17.6%	
5	33.7%	88.7%	11.3%	
Private/ Int./ Other	23.2%	98.6%	1.4%	
Discipline of study				0.466

[1] Race in South Africa is closely linked to socio-economic disparities, different racial groups often have varying access to resources like education, healthcare, and employment (Seekings and Nattrass 2008).

Commerce, Law & Management	14.3%	84.3%	15.7%	
Engineering	23.3%	81.5%	18.5%	
Health Sciences	13.4%	90.0%	10.0%	
Humanities	30.8%	81.3%	18.7%	
Sciences	18.3%	85.0%	15.0%	
First generation status				<0.001*
First-generation	43.0%	72.6%	27.4%	
Non-first generation	57.0%	91.9%	8.1%	
Financial-aid recipient				<0.001*
Yes	50.1%	73.7%	26.3%	
No	49.5%	93.3%	6.7%	
Self- reported disability status				0.277
Yes	3.0%	92.6%	7.4%	
No	97%	83.3%	16.7%	

* Significant at $p<0.05$ (p-values represent frequency differences between no hunger and hunger); Data weighted by sex and race.

In terms of factors associated with COVID-19 and the ensuing lockdown (Table 2), most study participants (84%) who were residing in 'on- or off-campus residence' prior to the lockdown returned home. In total, 87.8% reported residing at home during the lockdown. The bivariate analysis indicated a correlation between hunger status and place of residence ($p < 0.014$), with those having 'no stable accommodation' experiencing the highest levels of hunger. Living alone, increased financial stress/worry, having limited workspace at home, and a more rural household location, were also found to be significantly associated with hunger ($p < 0.001$).

Table 2: Weighted COVID-19 lockdown factors associated with hunger.

	Total sample n=596	**No hunger**	**Hunger**	**p-value**
Place of residence during lockdown				0.014*
On or off-campus residence	5.1%	83.4%	16.7%	
With Relatives	6.8%	81.5%	18.5%	
At home	87.8%	84.2%	15.9%	
No stable accommodation	0.4%	0.0%	100.0%	
Self- reported COVID-19 infection (of participant and/or close friends and family)				
Yes	7.2%	84.5%	15.5%	0.781
No	92.8%	83.5%	16.5%	

Household size				
Living alone	7.4%	69.0%	31.0%	<0.001*
2	18.5%	72.2%	27.8%	
3-4	38.1%	93.6%	6.4%	
5 or more	36.0%	81.9%	18.1%	
Household location during lockdown situated in:				<0.001*
City/ Suburb	55.7%	89.2%	10.8%	
Town	7.0%	86.3%	13.7%	
Township	23.1%	76.3%	23.7%	
Village/farm	14.2%	71.9%	28.1%	
Financial stress/ worry				<0.001*
Yes	55.1%	75.5%	24.5%	
No	44.9%	93.6%	6.4%	
Limited workspace at home				<0.001*
Yes	54.4%	77.4%	22.6%	
No	45.6%	91.0%	9.0%	

* Significant at p<0.05 (p-values represent frequency differences between no hunger and hunger); Data presented as weighted values weighted for sex and race.

The multivariate logistic regression (Table 3) shows that being a first-generation student almost doubled the likelihood of hunger (OR = 1.78; 95% CI: 1.04, 3.07, p =0.037) and receiving financial aid nearly tripled the odds of experiencing hunger (OR = 2.69; 95% CI: 1.47 4.91, p =0.001). Furthermore, financial stress/worry increased the odds of hunger more than three-fold (OR = 3.38; 95% CI: 1.85, 6.18, p <0.001). Finally, the multivariate logistic regression showed that participants who attended more affluent high schools (quintiles 4 and 5; OR = 0.47; 95% CI:0.27, 0.80, p = 0.005) as well as those falling in the 'other' high school category (OR = 0.08; 95% CI:0.02, 0.38, p = 0.001) were significantly less likely to experience hunger.

Table 3: Multivariate logistic regression predicting socio-demographic and lockdown related correlates to hunger.

	OR (95 CI)	**p-value**
Gender (reference: female)		
Male	0.79 (0.47, 1.34)	0.385
Age group in years (reference:18)		
19	0.35 (0.10, 1.24)	0.103
20	0.54 (0.14, 2.00)	0.353
>20	1.03 (0.28, 3.82)	0.967
High school quintile category (reference quintiles 1-3)		

Quintiles 4&5	0.47 (0.27, 0.80)	0.005*
Other	0.08 (0.02, 0.38)	0.001*
First generation status (reference: No)		
Yes	1.78 (1.04, 3.07)	0.037*
Financial-aid recipient	2.69 (1.47, 4.91)	0.001*
Yes		
Self- reported COVID-19 infection (of participant and/or close friends and family) (reference: No)		
Yes	2.00 (0.72, 5.54)	0.208
Financial stress/ worry (reference: No)		
Yes	3.38 (1.85, 6.18)	<0.001*
Limited workspace at home (reference: No)		
Yes	1.57 (0.90, 2.73)	0.113

* Significant at $p<0.05$

4 Discussion

In qualitative studies, hunger has been cited by South African adolescents, including university students, as one of the biggest challenges brought on by the COVID-19 pandemic (Gittings et al. 2021). Yet quantitative evidence of this, especially in LMICs, including South Africa, is limited. This research found the weighted prevalence of hunger among university students to be 16.4% (95% CI 13.6, 19.6) using a tool with 4-week recall period. The study also highlighted several factors that elevated the risk of hunger including being a first-generation student, a recipient of financial aid, and experiencing stress or worry due to finances. Those attending well-resourced, private, or international high schools were significantly less likely to experience hunger.

At 16.4%, the prevalence of hunger reported in the current study, although high, is ~7% lower than the rate of hunger reported at the same university in 2019 (Wagner et al. 2021). The current study found that most students (84%) who lived in on- or off-campus residences prior to the pandemic, returned home. In total, 87.8% of students lived at home at the time of the survey. It is plausible that students' food practices, as well as their eating habits change when they are at home. Furthermore, the presence of women in the household, who are often responsible for obtaining and preparing food, may have played a role in reducing the prevalence (Gittinger et al. 1990). Studies conducted in South Africa prior to the pandemic suggest that students who lived with their parents had the lowest risk of hunger (van den Berg and Raubenheimer 2015). Comparable studies internationally attributed decreases in food insecurity and hunger during the COVID-19 pandemic to students returning home and benefiting from pooled resources and a reduction in the consumption of unhealthy foods as well as alcohol (Davitt et al. 2021; Owens et al. 2020; Soldavini et al. 2021). The findings of lower levels of reported hunger in this study align. It is crucial to recognize the potential impact of the various social protection

measures implemented by the government during this period on improved food security (Gronbach 2021; Republic of South Africa 2020a). However, it is also important to note that when using high school quintile as a proxy of socio-economic status, and considering that social grants rely on means testing, only a limited number of the students under study would likely have qualified.

It was interesting to note that factors related to moving back home due to the lockdown such as changes in household size and location were significant in the bivariate analysis (both at $p<0.001$) but did not meet the threshold to be included in the multivariate analysis. These factors are important and are considered to influence hunger status. Increased household size, for instance, is generally thought to increase the risk of hunger (Stats SA 2023; van der Berg et al. 2022). However, in the case of university students, who often live alone, research has consistently indicated significantly higher levels of hunger than the general population (Kassier and Veldman 2013; Rudolph et al. 2018; Wagner et al. 2021). Findings from the current study, indicating that students who live alone had the highest levels of hunger (31.7%; $p<0.001$), are, therefore, not surprising. Associations between household location and hunger were also expected. Literature has shown that households located in rural settings were more likely to run short of money (Ginsburg et al. 2022) as well as experience household hunger during the pandemic (van der Berg et al. 2022). This aligns with findings suggesting that university students who resided in villages or farms during the pandemic had the highest prevalence of hunger (27.4%; $p<0.001$) .

The current research reaffirms the importance of socio-economic factors as predictors of hunger, even during a pandemic. Our findings that being a first-generation South African university student, receiving financial aid and experiencing financial stress/worry increased the likelihood of hunger, with students matriculating from high schools located in affluent communities having a lower likelihood of experiencing hunger are consistent with both local and international literature. Evidence supports our finding of first-generation students being at higher risk for food insecurity and hunger (El Zein et al. 2019; van den Berg and Raubenheimer 2015), mainly related to poor financial prospects associated with lower education attainment (Stats SA 2022) of parents. The increased risk of hunger by students receiving financial aid, although counterintuitive aligns with previous findings suggesting that even after receiving financial aid, low-income students often have higher levels of food insecurity compared to students not receiving financial aid (Davitt et al. 2021; El Zein et al. 2019; Rudolph et al. 2018; van den Berg and Raubenheimer 2015). Previous studies have highlighted the financial stress experienced by students resulting from money for food being depleted due to delays in financial aid payments because of COVID-19 (Gittings et al. 2021). Findings of financial stress/worry as a predictor of hunger therefore reinforce findings from similar literature. Finally, in terms of high school quintile, it makes sense that students matriculating from high schools located in affluent communities were less likely to experience hunger compared to students attending high schools located in lower socio-economic communities (Republic of South Africa 2006), as they were likely to have the economic means to purchase food as required.

Strength and limitations

To our knowledge, this is the first study from South Africa and Africa to assess the prevalence and predictors of student hunger during the COVID-19 pandemic. This study had a higher response rate (10.5%) when compared to similar studies (response rates between 4.4 and 6.9%) (Davitt et al. 2021; Owens et al. 2020; Soldavini et al. 2021). However, the following limitations should be considered when interpreting the results: i) the study is cross-sectional in nature, and thus determining causality between hunger and the COVID-19 pandemic is not possible; ii) although the finding indicating a link between a lack of stable accommodation and hunger provides valuable insight, the small number of students without stable accommodation may limit the interpretation iii) the generalizability of the current findings is limited as the work was carried out at a single South African university; however, the student body of the university is diverse and representative of the multicultural nature of the South African higher education sector; iv) the study could have been strengthened by including questions on household head characteristics in the survey for inclusion in the multivariate analyses, and v) bias could have been introduced due to self-selected sampling or self-reporting. We mitigated this selection bias by weighting the findings to the underlying student population and undertaking a self-reported survey in an attempt to mitigate social selection bias.

5 Conclusion

This is the first study from South Africa to assess the prevalence and predictors of hunger during the COVID-19 pandemic, showing that nearly one-fifth (16.4%) of undergraduate university students suffered from hunger during the pandemic. The COVID-19 pandemic has caused global devastation, particularly on university students who were already consistently reporting higher levels of hunger when compared to the general population prior to the pandemic. International studies suggest that the return of students to their homes during lockdown reduced the prevalence of hunger. There is, however, a scarcity of studies exploring these trends in South Africa. This study shows that at one South African university, like in other parts of the world, students moving back home during lockdown present with a high, but reduced prevalence of hunger (compared to earlier, pre-pandemic work). Moreover, this study highlights the continuing impact of financial factors on hunger, even during the COVID-19 pandemic. The study has highlighted that students who are first generation, receiving financial aid and experiencing financial stress may be at higher risk of hunger and might benefit from early intervention as a result.

Author Contributions

FW, RGW, MM conceptualized the research and UK, FXG-O and FW determined the scope of the manuscript. FW, LM and MM collected the data, and FW analysed the data. FW drafted the first version of the manuscript, which was critically reviewed by all other authors, who then approved the final version for submission.

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Data Availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics

Ethical approval was received from the University Human Research Ethics Committee (Non-medical) (H20/06/22) as well the University of the Witwatersrand Human Research Ethics Committee (HREC) (Non-Medical) (M1900627). Written permission was received from the Office of the Registrar to conduct the study.

Conflict of Interest

The authors declare that they have no conflict of interest.

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