



The Impact of Exercise on Depression and Anxiety in First-Year Students at a Rural University in South Africa

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ABSTRACT Students who move into tertiary institutions can experience stressors, which may lead to low self-esteem, anxiety and depression. This may be alleviated by exercise. The aim of the study was to investigate the impact of exercise on depression and anxiety on first-year students registered at the University of Venda (UNIVEN). A cross-sectional survey design was used. The study sample consisted of 320 randomly selected first-year students, 160 students who exercised regularly and 160 students who did not exercise. Data was collected using the Beck Anxiety Inventory (BAI), and the Beck Depression Inventory-11 (BDI-11). Data was analysed using descriptive statistics, analysis of variance (ANOVA) and regression analysis. There were no statistically significant differences when comparing the different ages and gender with exercise, depression and anxiety. The study highlights the role that exercise plays as an intervention in mental health issues among first-year university students managing with a new environment adjustment and the academic demands.

INTRODUCTION

Moving to university from high school marks a significant milestone in the journey of young adults, with new experiences, academic challenges, and the opportunities for independence. However, the first year at university can be overwhelming, as many first-year students struggle with their study demands and the adjustment to a different environment (Nel and Tshikovhele 2018). Nel and

Tshikovhele (2018) found that during this crucial phase, students have a low sense of belonging. It was also reported that this vulnerability to psychological distress can have disastrous effects on their mental health (Nel and Tshikovhele 2018). Recognising the need to address these challenges, recent studies have explored potential solutions to enhance the mental well-being of first-year students. It has emerged from this research that physical exercise appears to hold the key to mitigating these issues and improving mental wellbeing among this vulnerable population. By adopting a regular exercise regimen, students can experience a remarkable boost in their psychological well-being, leading to higher levels of self-esteem, physical health and a healthier outlook on life (Dwichehyaningtyas et al. 2021; Nel and Tshikovhele 2018).

Murphy et al. in 2019 confirmed that for first year university students the evidence was overwhelming that exercise has a positive impact on their health without the adverse events that medication may pose.

Studies have shown that individuals who engage in regular exercise are likely to have positive health benefits over their entire lifespan including

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mental well-being. This is because positive endorphins are released during exercise, which augment an individual's feelings of happiness (Hamidah et al. 2015; Zeng et al. 2019). In this study, regular exercise refers to any physical exercise undertaken three times a week for thirty minutes or more, over a period of two or more months. Non-regular exercise refers to students who did not engage in physical exercise. Many first-year university students struggle to cope with the academic demands and adjusting to a new environment. This makes them vulnerable to psychological illnesses. However, this can be alleviated by exercise (Nel and Tshikovehele 2018). Studies have found a strong relationship between exercise and high levels of cognition and happiness (Okely et al. 2021; Bull et al. 2020). Females who participated in exercise showed a more optimistic mental well-being as compared to males ($p=0.001$). However, it is important to note that there may be potential drawbacks to using exercise as a tool for boosting mental health among university students who have contraindications to doing strenuous physical exercises (Hamidreza 2015).

According to Linde (2014) and Cahuas et al. (2020), depression is a negative factor in everyday life and impacts all areas of the physical and cognitive make-up of an individual. Moreover, depression is likely to affect every person at least once in their lives. This is due to a combination of environmental, genetic, biological and psychological factors, which can give rise to depression. Most doctors or psychiatrists prescribe antidepressive therapy in the form of drugs, psychotherapy, support groups, or lifestyle/behavioural modification (which can include exercise) in order to help patients diagnosed with depressive symptomatology (Morgan et al. 2013; Halliday et al. 2019; The Mental Health Foundation 2016).

Depression is likely to become the most life-threatening cause of incapacity worldwide in the next decade (Serretti and Porcelli 2018; Okely et al. 2021). According to Krogh et al. (2011), studies using rigorous research designs and random samples have found that exercise improves all types of depression, both severe and mild. Perry et al. (2020) also noted that using 'green' prescriptions like exercise is cheaper and less invasive than pharmacological interventions, with fewer or no serious side effects. Other research findings also confirm that non-professional exercise routines are as effective as work-out programmes designed by professional

trainers in lessening depression (Callaghan et al. 2011; Pickett et al. 2017).

Research trials have shown that medication or medication and exercise or exercise alone decreased depression significantly and there were no significant statistical differences between any of the three treatment options. However, the group that used medication had a quicker positive reaction to treatment in the initial month of medication (Carek et al. 2011). Brammer in 2018 showed that exercise reduced depressive symptoms, with reduction rates of 45 percent in an exercising group that was supervised, 40 percent in an exercise group that was home-based and 47 percent in a group that was taking medication. Depressive symptomatology showed improvement when exercise was added to a medication regime.

Thus, for first-year university students the evidence is convincing that exercise has a positive impact on their health without the adverse events that medication may pose (Murphy et al. 2019).

In South Africa, the relationship between anxiety, depression and exercise in university students has not been extensively studied. Therefore, the objective of this study was to investigate the impact of exercise on anxiety and depression among first-year students registered at UNIVEN.

METHODOLOGY

Study Design

This was a cross-sectional survey, using the standardised tools, Beck Anxiety Scale (BAI) and Beck Depression Inventory (BDI), which were piloted prior to the study. The research design was appropriate for this study because the research accumulated data about specific issues (depression levels and anxiety), in a defined population (exercisers and non-exercisers) at a specific moment in time.

Study Setting

The study was conducted at the University of Venda in Thohoyandou, Limpopo Province, South Africa, a rural-based university. The majority of the students at this historically underprivileged university are Black Africans.

Study Population, Sampling Technique and Sample Size

All first-year undergraduate students who were registered at the UNIVEN for the 2019 academic year comprised the study population. According to the Office of the Registrar of UNIVEN, there were 1,900 first-year students enrolled there. At the beginning of the 2019 academic year, the researchers took part in the orientation for first-year students. During the event, the researchers asked, with permission from the leaders of the orientation, students who were interested in participating in the study to send their email addresses to the researchers via their cell phones. The researchers introduced the survey, its goal, and its objectives to that new cohort of students. The primary researcher's laptop contains a database with all of the students' email addresses that was made available for this survey. A list of survey respondents was created. A total of 1300 email addresses (68.4% participation rate) were on the established list from the 1900 first-year students who had registered. The students' email addresses were used to send the questionnaire. Following that, the returned questionnaires were divided into two groups comprising those who regularly exercised and those who did not. Exercisers and non-exercisers were classified as non-regular exercisers were those who did not engage in any physical activities, while exercisers were those who engaged in physical activity three times per week for about thirty minutes over a period of two months or more.

Using Krejcie and Morgan's (1970) table, a sample of 320 was representative of this population. To ensure that random sampling for the study could be properly constituted and to account for attrition 300 exercisers and 300 non-exercisers were randomly identified from the email lists and questionnaires emailed to them. Simple random sampling was then used to find the designated sample of 320. In this regard the lists of 300 exercisers and 300 non-exercisers were used. The final sample was 160 exercisers and 160 non-exercisers. Students with a history of depression or anxiety disorders, less than 18 years of age as well as those who were unable to exercise owing to physical, mental or medical conditions were excluded from the study.

Data Collection

Data collection was conducted for over one month and was completed five weeks before the

first COVID-19 lockdown in South Africa. The questionnaires employed were psychological tests that have been standardised across time and across a variety of populations (Babbie 2020). The tools used to measure anxiety and depression respectively were the Beck Anxiety Scale (BAI) and the Beck Depression Inventory-11 (BDI-11).

The Beck Anxiety Scale (BAI)

The Beck Anxiety Scale (BAI) was developed by Aaron T. Beck and Robert A. Steer in 1993. The administration of the test takes 5 to 10 minutes to complete. The BAI is a standardised, self-report measure for anxiety in adults and adolescents 17 years and older. It is a 21-item multiple-choice survey. Because the items in the BAI describe the emotional, physiological, and cognitive symptoms of anxiety but not depression, it can discriminate anxiety from depression. The items on the BAI are all related to feelings of anxiety thus were appropriate for this research. It is easy to administer and has proven validity across cultural groups (Beck et al. 1988; Nel and Tshikovhele 2018). Questions are easy to understand across cultural groups. A Likert type scale is used and the respondent circles appropriate blocks or headings for the scale. Responses include 'feeling hot, numbness or tingling, unable to relax'. Internal consistency (Cronbach's Alpha) for the questionnaire ranges from .92 to .94, which is good, and the test-retest reliability is acceptable (Fydrich et al. 1992). The Cronbach *Q* (internal consistency) for the BAI for the present sample was calculated at 0.90.

The Beck Depression Inventory-11 (BDI-11)

The BDI-11 is used to screen for depressive symptomatology and was originally introduced by Beck et al. in 1961 and was later revised. The BDI-11 is a 21-item self-report rating inventory measuring different types of symptomologies related to depression. It is a self-administered questionnaire, which takes about ten minutes to complete. Questions in the scale are easy to understand across cultural groups for instance, "I do not feel sad" and "I feel sad much of the time." Globally, across multiple sites and studies the Cronbach Alpha for the BDI has been estimated at 0.85 to 0.96 (Zeng et al. 2019). It has been noted as reliable and valid in South African contexts (Pillay et al. 2002). The Cron-

bach Q (internal consistency) for the BDI-11 for the present sample was calculated at 0.94.

Pilot Study

To test the accuracy of the questionnaire, a pilot study of 30 respondents comprising 15 exercisers and 15 non-exercisers, among the second-year students of the same university (UNIVEN) was carried out. The overall protocol's Cronbach alpha was 0.90. There were no issues with the questions, and the final sample did not include the questionnaires from the pilot study.

Data Analysis

The study used descriptive (mean, percentages and graphs) and inferential statistics that is Analysis of Variance (ANOVA) and regression analysis to give a well-defined picture of the data. Inferential statistics are used to draw conclusions and/or to make predictions inherent to a population based on collected data (Babbie 2020; Bryman and Cramer 2009). They are also used to investigate differences between and amongst groups. ANOVA was used as an analysis of gender and age therefore both between and within group differences were established. Logistic regression analysis was used to establish whether age and gender influenced any outcomes. The results are presented in graphical and tabular format interpreted from responses to the questionnaires.

Ethical Issues

The University of Limpopo through Turfloop Research and Ethics Committee (TREC) and UNIV-

EN committees approved the research study, and the ethical clearance number is TREC/349/2019: PG. The respondents were informed in detail about the study and if they agreed to participate, they were asked to fill in the informed consent forms. Anonymity and confidentiality were ensured during the entire study process. The respondents were informed that there was no material benefit for participating in the study, and they could leave the research process at any time.

RESULTS

Demographic Data

The majority of these first-year students were African (95%), followed by Coloured and Indian (2% each), and White (1%).

Table 1 indicates the age distribution of the participants. Two hundred and eighty-eight participants (71%) were between the ages of 18-21 years, while 92 participants (29%) were between the ages of 22 and 29.

Gender Distribution

Table 1 indicates that there were 160 (50%) participants who were male and 160 (50%) participants who were female.

Exercise Frequency

Table 1 indicates that 160 participants (50%) did not exercise at all, 120 participants (37%) exer-

Table 1: Descriptive statistic results for the BAI

<i>Exercise frequency</i>	<i>Gender</i>	<i>Age group</i>	<i>n</i>	<i>BAI Mean</i>	<i>BAI SD</i>
<i>Not At All</i>	Male	18-21	56	27.66	14.11
		22-29	24	20.88	12.75
	Female	18-21	65	25.06	9.39
		22-29	15	26.07	12.61
<i>Regularly</i>	Male	18-21	34	16.18	8.88
		22-29	20	12.15	7.51
	Female	18-21	44	14.66	10.45
		22-29	19	15.47	12.47
<i>Every Weekday</i>	Male	18-21	19	1.79	8.44
		22-29	7	10.00	9.02
	Female	18-21	10	9.80	9.72
		22-29	7	9.43	5.83

cised regularly, and 40 participants (13%) exercised every weekday.

The Beck Anxiety Inventory (BAI)

The descriptive statistics results for the BAI are presented in Table 1.

Table 1 indicates that 56 males in the age group 18-21 years did not exercise at all (M=27.66: SD =14.11). In the 22-29-year age group, 24 males did not exercise at all (M=20.88: SD= 12.75). Sixty-five (65) females in the age group 18-21 years did not exercise at all (M=25.06: SD= 9.39). In the 22-29-year age group, 15 females did not exercise at all (M=26.7: SD= 12.61).

Thirty-four (34) males in the age group 18-21 years exercised regularly (M=16.18: SD=8.88). In the 22-29-year age group, 20 males exercised regularly (M=12.15: SD=7.51). Forty-four (44) females in the age group 18-21 years exercised regularly (M=14.66: SD= 10.45). In the 22-29-year age group, 19 females exercised regularly (M=15.47: SD=12.47).

Nineteen (19) males in the age group 18-21 years exercised every weekday (M=11.79: SD=8.44). In the 22-29-year age group, 7 males exercised every weekday (M=10.00: SD=9.02). Ten (10) females in the age group 18-21 years exercised every weekday (M=9.80: SD 9.72). In the 22-29-year age group, 7 females exercised every weekday (M=9.43: SD=5.83).

Analysis of Variance (ANOVA) Results for the Beck Anxiety Inventory (BAI)

The ANOVA results are presented in Table 2 format followed by an explanation.

Table 2: Analysis of Variance (ANOVA) results for the BAI

	DF	F	P	η_p^2
Exercise	2,308	36.63	<0.001*	0.19
Gender	1,308	0.04	0.84	0.00
Age	1,308	1.43	0.23	0.00
Exercise x Gender	2,308	0.20	0.82	0.00
Exercise x Age	2,308	0.14	0.87	0.00
Gender x Age	1,308	2.26	0.13	0.01
Exercise x Gender x Age	2,308	0.33	0.72	0.00

*p < 0.001

Analysis of Variance showed that there was a main effect of Exercise Frequency: $F(2, 308) = 36.63, p < 0.001, \eta_p^2 = 0.19$. An effect size (partial eta

squared, η_p^2) of 0.19 is considered as large. There were no effects of gender and age, therefore only the exercise groups were further analysed.

Post-hoc analysis (Bonferroni) revealed that the participants who did not exercise at all had a significantly higher score on the BAI than those who exercised regularly ($p < 0.001$). There were also significant differences in scores between participants who exercised regularly and those who exercised on weekdays only ($p < 0.001$). A box plot depicting these results is included to show current effect and confidence intervals.

Descriptive Statistic Results for the Beck Depression Inventory-11 (BDI-11)

Table 3 presents the descriptive statistics for the BDI-11. Fifty-six (56) males in the age group 18-21 years did not exercise at all (M=31.82: SD=18.21). In the 22-29-year age group, 24 males did not exercise at all (M=22.33: SD= 15.82). Sixty-five (65) females in the age group 18-21 years did not exercise at all (M=21.97: SD=12.22). In the 22-29-year age group, 15 females did not exercise at all (M=28.93: SD= 14.36).

Thirty-four (34) males in the age group 18-21 years exercised regularly (M=10.21: SD=7.87). In the 22-29-year age group, 20 males exercised regularly (M=10.70: SD=11.11). Forty-four (44) females in the age group 18-21 years exercised regularly (M=12.43: SD=11.92). In the 22-29-year age group, 19 females exercised regularly (M=11.11: SD=9.49).

Nineteen (19) males in the age group 18-21 years exercised every weekday (M=13.11: SD=10.39). In the 22-29-year age group, 7 males exercised every weekday (M=5.43: SD= 5.91). Ten (10) females in the age group 18-21 years exercised every weekday (M=4.50: SD= 6.59). In the 22-29-year age group, 7 females exercised every weekday (M=6.00: SD=8.08)

Analysis of Variance (ANOVA) Results for the Beck Depression Inventory-11 (BDI-11)

Analysis of Variance for BDI-11 showed that there was a main effect of Exercise Frequency: $F(2, 308) = 50.02, p < 0.001, \eta_p^2 = 0.25$. There were interacting effects of Gender and Age: $F(1, 308) = 4.62, p = 0.03, \eta_p^2 = 0.01$, and Exercise, Gender and Age: $F(2, 308) = 3.38, p = 0.04, \eta_p^2 = 0.02$, therefore the gender and age groups were analysed separately.

Table 3: Descriptive statistics for the BDI-11

Exercise frequency	Gender	Age group	N	Bdi-11Mean	Bdi-11Sd
Not At All	Male	18-21	56	31.82	18.21
		22-29	24	22.33	15.82
	Female	18-21	65	21.97	12.22
		22-29	15	28.93	14.36
Regularly	Male	18-21	34	10.21	7.87
		22-29	20	10.70	11.11
	Female	18-21	44	12.43	11.92
		22-29	19	11.11	9.49
Every Weekday	Male	18-21	19	13.11	10.39
		22-29	7	5.43	5.91
	Female	18-21	10	4.50	6.59
		22-29	7	6.00	8.08

An effect size (partial eta squared, η^2) of 0.25 is considered as large, while those of 0.04 and 0.03 are considered as small (Table 4).

Table 4: ANOVA results for the BDI-11

	DF	F	P	η^2
Exercise	2, 308	50.02	< 0.001**	0.25
Gender	1, 308	0.61	0.44	0.00
Age	1, 308	0.74	0.39	0.00
Exercise x Gender	2, 308	0.69	0.50	0.00
Exercise x Age	2, 308	0.15	0.87	0.00
Gender x Age	1, 308	4.62	0.03*	0.01
Exercise x Gender x Age	2, 308	3.38	0.04*	0.02

* $p < 0.05$, ** $p < 0.001$

Post-hoc analysis (Bonferroni) revealed that the groups who did not exercise at all (both gender and age groups) had significantly higher scores on the BDI-11 than the groups who exercised regularly ($p < 0.001$). The groups who exercised regularly also scored significantly higher on the scale than the groups who exercised on weekdays ($p < 0.01$).

The interaction of age and gender on the BDI-11 was an indication that the younger male group, who did not exercise at all scored significantly higher on the scale than the younger females who did not exercise at all ($p = 0.03$). This was not the case for the older group who did not exercise. A box plot depicting results for the inventory is included to show current effect and confidence intervals.

Logistic Regression Results for the Beck Anxiety Inventory (BAI) and the Beck Depression Inventory (BDI-11)

Logistic regression results for anxiety and depression for the two scales/inventories used in this research are presented in Table 5.

Logistic Regression Analysis Results for Anxiety (BAI)

There was a significant effect of exercise participation only. The OR was 0.87 (CI 0.83, 0.91), which means that the odds were that not participating in exercise had a slightly higher (13%)

Table 5: Logistic regression results for the BAI and BDI-11

	Estimated beta	P-value	Odds ratio	95% confidence Intervals	
<i>Anxiety</i>					
Gender	<0.01	0.95	1.00	0.98	1.02
Age	- 0.02	0.09	1.00	0.97	1.00
Ethnicity	- 0.01	0.83	0.99	0.93	1.06
Exercise	- 0.13	<0.001**	0.87	0.83	0.91
<i>Depression</i>					
Gender	0.01	0.09	1.01	1.00	1.03
Age	- 0.01	0.02*	0.98	0.96	1.00
Ethnicity	0.00	0.92	1.00	0.95	1.06
Exercise	- 0.12	< 0.001**	0.89	0.84	0.93

$p < 0.05$, ** $p < 0.01$

chance of having more anxiety symptoms than the exercising group.

No statistically significant results were noted for gender ($p = 0.95$), age ($p = 0.09$) and ethnicity ($p = 0.83$).

Logistic Regression Analysis Results for Depression (BDI-11)

There was a significant effect of age. The OR was 0.98 (CI 0.96, 1.00), which means that the odds were that older participants had a slightly higher (2%) chance of having more symptoms of depression than the younger group.

There was also a significant effect of exercise participation. The OR was 0.89 (CI 0.84, 0.93), which means that the odds were that those not participating in the exercise group had a higher (11%) chance of having more symptoms of depression than the exercising group.

No statistically significant results were noted for gender ($p = 0.09$) and ethnicity ($p = 0.92$).

DISCUSSION

The ANOVA and logistic regression results confirm that students who exercise have fewer anxiety and depression symptoms. The ANOVA analysis indicated that the groups of students who did not exercise at all (both genders and age groups) had significantly higher scores on the BDI-11 (for depression) than the groups of students who exercised regularly ($p < 0.001$). In summary the first-year students who did not exercise had significantly more symptoms of depression.

The interaction of age and gender on the BDI-11 was an indication that the younger male group, who did not exercise at all scored significantly higher on the scale than the younger females who did not exercise at all ($p = 0.03$). This was not the case for the older group who did not exercise.

The BDI showed that older respondents had significantly more symptoms of depression than younger respondents. The logistic regression showed that the OR was 0.98 (CI 0.96, 1.00), which means that older respondents had a slightly higher (2%) chance of having more symptoms of depression than younger respondents.

There was a significant effect of exercise participation. The OR was 0.89 (CI 0.84, 0.93), which

means that not participating in exercise had a higher (11%) chance of having more symptoms of depression than the group of exercisers.

The results show high levels of depression and anxiety symptoms among students and this is supported by research conducted by Adegoju and Abon (2021) who report that mental health issues are amongst the most predominant health challenges amongst first year students at tertiary institutions. Furthermore, in this study it was concluded that students who engage in physical exercise showed more positive mental health in terms of anxiety and depression than non-exercisers. It was also concluded that for both genders engaging in exercise contributed to positive mental health outcomes.

The results of the present study indicate that respondents with higher levels of depression on the BDI-11, were not exercising.

Students who exercise regularly have less anxiety symptoms. According to the ANOVA analysis, the respondents who did not exercise at all had a significantly higher score on the BAI (anxiety) than those who exercised regularly ($p < 0.001$).

The results from the logistic regression analysis indicated that there was a significant effect of exercise participation. The OR was 0.87 (CI 0.83, 0.91), which means that the odds were that the group not participating in exercise had a slightly higher (13%) chance of having more anxiety symptoms than the group of exercisers. The results of the present study are supported by research conducted by Brammer (2018), which reported that physical activity plays a role in stabilising and lessening feelings of anxiety as well as promoting positive overall well-being and mental health, irrespective of gender or age. Zhang in 2023 confirms that exercise improves all depression symptomatology. Exercise is thus a strong measure for use in the treatment of anxiety and depression.

Another study that supports the results of the present study is research conducted by Rippe (2018), which noted that regular exercise has many psychological and emotional benefits that help individuals gain confidence. Meeting exercise goals or challenges, even small ones, can boost an individual's self-confidence. Furthermore, it helps people overcome social anxiety. Additionally, a study by Mandolesi et al. (2018) reported that individuals who exercise have less likelihood of having anxiety and depression as opposed to those

who are completely sedentary. In this study it was concluded that students who engage in physical exercise showed more positive mental health in terms of anxiety and depression than non-exercisers. It was also concluded that for both genders engaging in exercise contributed to the positive mental health outcomes. Lun et al. (2018) also found that students who exercised on a regular basis showed higher levels of self-confidence and reported less depressive and anxiety symptomatology. Heissel et al. (2023) state that exercise is a medicine for depression.

The study's findings are consistent with those of local and worldwide studies that revealed that exercise can help students feel less worried, more confident, and less depressed. In order to improve students' mental health as well as their general well-being, it is believed that the findings will motivate UNIVEN to include exercise and sport in their student offerings. This should consider if the student is physically disabled, pregnant, or suffering from a chronic condition such as asthma.

These findings are supported in research by Burke and Dempsey (2021), which indicated that exercise improves psychological or mental health by reducing anxiety, depression, and negative mood and by improving cognitive functions and social interactions.

Students who exercise regularly have fewer depressive symptoms than students who do not exercise regularly.

CONCLUSION

The findings of this study support literature both local and international, regarding the positive impact of exercise on depression and anxiety.

Overall, the current study contributes to understanding the impact exercise plays as an intervention in mental health challenges that may occur because of adjustment difficulties and academic demands placed on first year students attending tertiary institutions. The knowledge provided by this study will help the university and tertiary institutions generally, in providing exercise interventions for students.

RECOMMENDATIONS

Tertiary institutions need to consider implementing exercise programmes for use by undergraduate students. Students should be made aware

of how exercise mediates against depression and anxiety, and helps improve physical and psychological well-being.

LIMITATIONS

The study was carried out at a single university in a rural area, thus outcomes in an urban setting may differ. The approach used in this research is quantitative. Based on the information gathered, it could have been beneficial to employ a mixed approach to also get a more holistic understanding of the phenomenon.

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