

## Measuring the positive impact of school based activities on adolescent anxiety, depression and cortisol expression.

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## **Executive Summary**

The Skillset Senior College (SSC) School Based Research Project aimed to investigate the impact of school-based activities on depression, anxiety and cortisol levels in a senior school setting (Year 10 - Year 12). Our goal was to develop a school wide research project, that provided evidence that schools can have a significant positive impact on adolescent mental health.

The project aligned with the school's vision of creating 'the best future imaginable' by providing opportunities for students to engage with novel activities in the hope they may improve mental health outcomes. It also increased opportunities for building connections between students, staff and external partners.

#### **Research Design**

The research was designed with three key goals in mind:

- to understand how mental health scores and cortisol levels differed between distinct populations within the school, including between genders and between indigenous and non-indigenous students.
- the effectiveness of medical self-report questionnaires in a school setting, particularly when working with at-risk youth.
- the contribution of the schools fledgling outdoor education program on student mental health.

A repeated measures, quasi experimental approach was implemented to gather quantitative data across three terms in 2021. Participants were aged between 14-19, and enrolled students across each year group at SSC. Participants had to 'opt-in' to the study by providing written consent, and parental/carer consent was obtained where necessary. Students who did not wish to participate were included in the activities however, no personal data was collected.

#### The Intervention

An intervention model was used, with students participating in a range of activities for 4weeks per term, over a 6 month period, from 16 February 2021 until 17 August 2021 in New South Wales, Australia. Data were collected before and after each activity via saliva sampling (cortisol testing) and self-report medical questionnaires (General Anxiety Disorder - 7 questionnaire; Patient Healthcare Questionnaire - 9 and the Warwick Edinburgh Mental Well-being questionnaire ).

#### **Key Research Questions & Findings**

#### Research Question 1

Can we measurably decrease anxiety and depression scores in at-risk adolescents?

#### **Research Finding**

Yes. We found a measurable decrease in adolescent anxiety and depression scores throughout the study. Depression scores decreased by 34% and anxiety decreased by 26%.

#### **Research Question 2**

Are medical self-report questionnaires useful and valid when working with at-risk adolescents?

#### **Research Finding**

Yes. We found the GAD-7, PHQ-9 and Warwick Edinburgh Mental Well-being questionnaires valid, consistent and unidimensional. This gives us confidence that our results are indeed valid and reliable measurements of anxiety, depression and wellbeing.

#### **Research Question 3**

Are there differences in levels of depression and anxiety between distinct groups (gender, ethnic groups) at Skillset Senior College?

#### **Research Finding**

Yes. We found females reported significantly higher levels of anxiety and depression than males and significantly lower levels of wellbeing (P < 0.05). We found no significant difference in anxiety and depression scores between indigenous and non-indigenous Australians in this study (P > 0.05)

#### **Research Question 4**

Can school-based wellbeing activities impact adolescent cortisol levels?

#### **Research Finding**

We found no significant difference in salivary cortisol levels between males and females. We did find a significant negative correlation between cortisol level and depression score across both genders. As cortisol level increased, depression score decreased.

#### **Research Question 5**

#### Does participating on an overnight hike impact levels of anxiety and depression?

#### **Research Finding**

We found a significant difference in depression scores between participants who completed an overnight hike and a control group (P < 0.05). We did not find a significant difference in anxiety scores between participants who completed and overnight hike and a control group. Interestingly, we found significant differences in anxiety and depression scores between participants and the control group (P < 0.05) *prior* to the hike taking place.

#### **Summary of Findings**

The data gathered in this study provides strong evidence that schools *can* have a positive impact on adolescent depression and anxiety and can also influence cortisol production.

With the appropriate psychological safe guards in place for both staff and students, we recommend replication of this study across schools within Australia and beyond. Replication of this study would increase confidence in the reliability of our results and importantly, may improve mental health outcomes for a greater cross-section of adolescents.

#### Impact of the research

This research has important and far-reaching implications. For our school and alternative schools like ours, it provides some legitimacy to our student centred educational approach when working with young people. Beyond secondary education, the research and associated interventions have gained interest across a range of disciplines from occupational therapy, sport science and social science. Given the common barriers to physiological and psychological research within school environments such as access to schools, ethics and funding, many practitioners have recognised the uniqueness and importance of this study.

This study provides a strong foundation for future explorations into teacher-led wellbeing interventions across the education sector, that are supported by experts in their respective fields.

### Introduction/Background

#### About Skillset Senior College (SSC)

At Skillset Senior College our mission is to partner with young people who may be experiencing barriers to their education; including mental health issues, bullying, homelessness, trauma, substance use, disability and family instability, and to support them to complete their secondary schooling. Often adolescents from disadvantaged backgrounds experience high levels of exposure to stress and trauma (Mendelson et al., 2015), which can impact emotional wellbeing, childhood development milestones, and ultimately lead to disengagement in the school environment. Therefore, improvement in wellbeing may increase student retention rates, providing more opportunity for practitioners to work with at-risk adolescents.

Staff at Skillset Senior College establish meaningful connections with students by prioritising relationships and engagement over a content-driven approach. We achieve this by modelling appropriate behaviours in and out of the classroom, by creating a welcoming culture and by fostering a sense of belonging within the school community. Although the impact on students is obvious to internal staff, importantly we lacked any meaningful data to support this.

Therefore, in 2019, as a school we decided to conduct a pilot study to begin gathering baseline data on student mental health. We found students were responding positively to interventions within the school environment and importantly, we could measure this with primary data collected by staff members. Our pilot study formed the basis of a successful grant application to AISNSW, which enabled us to conduct a larger project over the course of 2020-2021.

#### **Rationale/Justification**

From the author's experience, fostering a culture of belonging and connection between staff and students is often a lower priority than academic achievement for many schools across Australia, or indeed globally. Although academic achievement is important, at Skillset Senior College we've found that by focussing on a young person's self-worth first, attainment and academic success often follows. Sadly, the reverse is not always true. By focussing solely on attainment and academic success, often a young person's self-worth can deteriorate. Therefore, by showcasing the evidence-based intervention approach adopted within this study, we can begin to have broader conversations on the wide-ranging benefits of targeted student wellbeing opportunities.

#### **Report Structure**

The structure of this report will initially follow the 'Hourglass Method' of scientific writing i.e. the report will start with the broad global implications of mental health research before becoming narrower in scope as we discuss our methodology and results. The scope of the

paper will broaden again when discussing our results and discussion together, framing our findings in a global context. The report will conclude with study limitations and recommendations for future investigation.

### **Literature Review**

#### **Mental Health Globally**

It is estimated that a total of 792 million people were living with a mental health disorder globally in 2017 (Dattani & Roser 2021). Equating to approximately one in ten people or 10.7% of the world's population. Although diverse and complex, the most common types of mental health disorders typically include forms of anxiety, depression, bipolar, eating disorders and schizophrenia. Factors that contribute to the overall mental health of an individual is multifaceted and may be impacted directly by their genetics (Hyman, 2014; McCammon & Sive, 2015), gender (Afifi, 2007; Rosenfield & Mouzon, 2013), ethnicity (Samaan, 2000; U.S. Department of Health and Human Services, 2001; Villatoro et al., 2018) and/or by environmental factors such as diet (O'Neil et al., 2014; Parletta et al., 2019), substance use (Wu et al., 2003; Baingana et al., 2015) and socio-economic status (Eibner et al., 2004). Thus, deriving the core causes of declines in mental health is challenging and typically the result of many personal and social elements influencing an individual's life. The two most common mental health disorders globally are forms of anxiety and depression, of which females are overrepresented in both groups, compared with males. The literature supporting strong gender differences between females and males in levels of anxiety and depression is well established (Weissman & Klerman, 1977; Bebbington, 1996). Such differences are even more pronounced during adolescence (Lewinsohn et al., 1998; Salk et al., 2017). Studies suggest adolescent females are more likely to develop decreased feelings of self-worth and self-competence than males of the same age (Hill & Pallin, 1997; Ohannessian et al., 1999; Craft et al., 2003).

#### Factors influencing mental health challenges

Proposed factors which contribute to the observed sex differences in levels of anxiety and depression include childhood experience, social/cultural behaviour and biological differences. Females are more likely to experience childhood trauma and have increased reactivity to some types of trauma than males (Freedman et al., 2002; Dube et al., 2005). Females are more likely to discuss troubling behaviour and seek support from others, compared with males who are more likely to take personal action or develop avoidant coping mechanisms (Taylor et al., 2000; Carter, 2011; Gluck et al., 2014).

#### Assessing anxiety and depression

Given the immediate and potential future impact of mental health disorders on society, assessment and treatment of the two most common types, anxiety and depression, has received high levels of attention. One of the most common tools for assessing levels of anxiety and depression both medically and academically has been through the use of psychometric testing. Two of the most popular tests include the General Anxiety Disorder-7 (GAD-7) questionnaire and the Patient Healthcare Questionnaire-9 (PHQ-9) (Löwe et al., 2004; Spitzer et al., 2006). The use of such screening tools will likely become more commonplace to quickly assess clinical levels of anxiety and depression post COVID-19

(Sartorão et al., 2020; Stocker et al., 2021; Shevlin et al., 2022). Indeed, some recent publications suggest the unpredictability, stress, misinformation and social isolation in response to COVID-19 has led to a further increase in mental morbidity (Zandifar & Badrfam, 2020). Some authors have suggested the advent of a true mental health crisis given how many people have been affected by COVID-19 both economically and physically (Dong & Bouey, 2020; Proto & Quintana-Domeque, 2021). For adolescents who are considered the most vulnerable and susceptible demographic for developing mental health issues, the negative consequences will likely be more pronounced.

#### Mental health challenges and adolescence

Prevention, diagnoses and treatment of mental health disorders in adolescents (14 - 20 years old) therefore is emerging as a primary focus of concern to limit the prevalence of mental health and substance misuse in adults (Patton et al., 2016; Colizzi et al., 2020). This critical developmental stage offers unique opportunities and challenges for engaging young people in mental health interventions. If a young person does receive appropriate support, information and guidance during this phase of their life, it may significantly impact chances of future employment, level of education and economic status as an adult (Patel et al., 2007). Improving the quality of a young person's mental health not only advances their own life moving forward, but the lives of their own families, their communities and ultimately society (Knapp et al., 2002, 2011; McCrone et al., 2005). Engaging young people in mental health and wellbeing interventions can be challenging. Young people may have a lack of knowledge and awareness of mental health symptoms, existing services or even the appropriate vocabulary to express how they feel. Although the largest cohort suffering from mental health issues globally (Gore et al., 2011), they are the least likely age group to seek professional help (Australian Institute of Health and Welfare, 2011). Given the need for good rapport, trust and time to successfully implement engaging intervention strategies, it is perhaps unsurprising that such research projects are becoming more commonplace in school environments (Fazel et al., 2014; Plumb et al., 2016; O'Reilly et al., 2018).

#### **Engagement through schools**

The results of school based mental health interventions can be striking. A 2004 study by McNeely & Falci found teacher support was protective against substance use such as tobacco, alcohol and marijuana. They also found teacher support had a significant protective effect against suicide attempts. Many studies have found strong feelings of school connectedness in school students had an impact on prosocial behaviour and negative associations with smoking, drug behaviour and antisocial behaviour. Low school connectedness can lead to an increased risk of anxiety and depressive symptoms or elevated incidence of substance use (Bond et al., 2007; Fletcher et al., 2008; Murnaghan et al., 2014). To achieve such positive results, it is imperative schools select appropriate interventions that can be successfully implemented within their own school contexts.

#### **Effective strategies**

#### Sensory engagement

Occupational therapy is a broad field and is used by children and adults of all ages who may be experiencing mental difficulties or living with physical or learning disabilities.

Occupational therapy can play an extremely important role in adolescents, particularly atrisk youth in high school. Occupational therapy can enable at-risk youth to participate more fully in meaningful occupations such as school, improving psychological and physiological health, reducing school dropout rate - improving future employability possibilities and quality of life (Marczuk et al., 2014). A narrow strand of occupational therapy that may improve an individual's quality of life, by improving sensory modulation, is sensory informed intervention or sensory integration therapy (Sinclair et al., 2020). Sensory modulation is the ability to respond appropriately to sensory information. This is particularly useful for those suffering from trauma, mental health issues and addiction. It is also useful for individuals who have developed problematic behaviours who are unaware of their sensory needs or how they are impacted by particular sensory input (Champagne & Stromberg, 2004; Chalmers et al., 2012).

#### Exercise

Studies have shown exercise can moderately improve levels of depression and anxiety (Salmon, 2001; Guszkowska, 2004; Jayakody et al., 2014), however, most studies cite a short term impact rather than long term improvements (Mead et al., 2008). One issue surrounding exercise and mental health is determining what type of exercise is most effective. Numerous studies have shown comparable psychological results from activities that differ significantly in intensity and duration such as running (Szabo, 2003; Hoffman & Hoffman, 2008), swimming (Valentine & Evans, 2001) and cycling (Petruzzello et al., 2009) to yoga (Lavey et al., 2005; Streeter et al., 2010) and walking (Dasilva et al., 2011). A number of factors should be considered and discussed with adolescents prior to the implementation of exercise for mental health purposes. Having a positive or negative experience with exercise during adolescents may impact the life-time adoption and maintenance of exercise. Adolescents are particularly vulnerable to developing selfesteem issues which may be exacerbated or magnified in group sport scenarios surrounded by peers. One example of a school intervention created to tackle physical inactivity in school students is The Daily Mile. The Daily Mile was first established in a primary school in Stirling, Scotland in 2012 and now over 14,000 schools have registered with the program worldwide (The Daily Mile, 2022). The Daily Mile consists of teachers leading their students in walking, jogging or running for 15-minutes within class time. The distance covered in this time is approximately 1 mile (1.6km). Researcher and teacher observations highlighting the myriad of benefits to students may explain the exceptional uptake of schools globally. Teachers have reported improved teacher-pupil relationships and a positive impact on student health and wellbeing (Malden & Doi, 2019).

#### **Therapeutic Writing**

A number of studies have reported psychological and even physiological health benefits of therapeutic writing. A study by Burton and King (2004), found evidence of enhanced mood and decreased health visits for illness in participants who wrote about intensely positive experiences for 20 minutes for three consecutive days, compared with those that did not. Recent studies further support improved outcomes in wellbeing, psychopathology and satisfaction through structured narrative writing (Levis & Levis, 2021). Perhaps the most well studied form of therapeutic writing is expressive writing. Expressive writing encourages participants to write about personal and emotional subjects without worrying about writing conventions such as grammar, spelling or structure. James W. Pennebaker,

Professor of Psychology at the University of Texas, is an authority on this subject and created the Pennebaker Writing Paradigm (Pennebaker & Beall, 1986). The paradigm, like The Daily Mile, is at its core simple, however, the impacts may be profound. The paradigm asks participants to commit to at least 15 minutes of continuous writing for 3-4 consecutive days, participants are encouraged to write without stopping and prompted to write about the following topics;

- Something that you are thinking or worrying about too much
- Something that you are dreaming about
- Something that you feel is affecting your life in an unhealthy way
- Something that you have been avoiding for days, weeks, or years

Numerous studies have demonstrated how expressive writing can reduce symptoms of depression (Gortner et al., 2006; Krpan et al., 2013; Procaccia et al., 2021) and anxiety (Graf et al., 2008; Meshberg et al., 2014).

Despite the apparent benefits, even Pennebaker provides a word of caution that participants may feel slightly sad or depressed after this process however, the feelings should alleviate after a few hours. Indeed, Honos-Webb et al., (2000) suggest potentially negative effects of the Pennebaker Paradigm in 'the absence of a supportive therapy to fully integrate the experiences'. This should be seriously considered by schools prior to implementation of such an intervention with young people.

#### Outdoor Adventure Education

Successful outdoor adventure programs have been described (Hattie, 1997; Ewert & McAvoy 2000; Sibthorpe et al., 2007; Deane & Harré, 2014) as;

- Taking place in unfamiliar natural environments
- Containing challenging activities with real consequences
- Involve cooperation between peers
- Characterised by small group social settings
- Led by trusting individuals who can provide physical and emotional support

To maximise the benefits of adventure education, participants must also be in a state of high attentiveness and receptiveness (Mutz and Müller, 2016). This psychological state of mind has been referred to as the 'groan zone' where individuals are between their 'panic zone' and 'comfort zone'. Despite the promising outcomes of adventure education, barriers exist regarding the validity and reliability of many studies (Hattie et al., 1997). Most studies are limited statically with low sample sizes and further hampered by a lack of randomised controlled trials (Deane & Harré, 2014).

## **Aims and Research Questions**

The primary aim of this project was to devise a school-wide project to assess the impact of school-based interventions on levels of anxiety, depression and cortisol levels in adolescents.

#### Primary Research Question

Research Question 1. Can we measurably decrease anxiety and depression scores in atrisk adolescents?

#### Secondary Research Questions

Research Question 2. Are medical self-report questionnaires useful and valid when working with at-risk adolescents?

Research Question 3. Are there differences in levels of depression and anxiety between distinct groups (gender, ethnic groups) at Skillset Senior College?

Research Question 4. Can school-based wellbeing activities impact adolescent cortisol levels?

Research Question 5. Does participating on an overnight hike impact levels of anxiety and depression?

### **Hypotheses**

#### First Null Hypothesis

 $(\mbox{H1:0})$  - There is no decrease in anxiety and depression scores after a school-based intervention

#### First Alternative Hypothesis

 $(\mbox{H1:1})$  - There is a decrease in anxiety and depression scores after a school-based intervention

#### Second Null Hypothesis

(H2:0) - There is no difference in anxiety and depression scores between male and female participants

#### Second Alternative Hypothesis

(H2:1) - There is a difference in anxiety and depression scores between male and female participants

#### Third Null Hypothesis

(H3:0) - There is no difference in anxiety and depression scores between indigenous and non-indigenous participants

#### Third Alternative Hypothesis

(H3:1) - There is a difference in anxiety and depression scores between indigenous and non-indigenous participants

#### Fourth Null Hypothesis

(H4:0) - There is no difference in cortisol levels after a school-based intervention

#### Fourth Alternative Hypothesis

(H4:1) - There is a difference in cortisol levels after a school-based intervention

#### **Fifth Null Hypothesis**

(H5:0) - There is no difference in depression scores between participants who completed an overnight hike and a control group

#### **Fifth Alternative Hypothesis**

(H5:1) - There is a difference and depression scores between participants who completed an overnight hike and a control group

#### Sixth Null Hypothesis

(H6:O) - There is no difference in anxiety scores between participants who completed an overnight hike and a control group

#### Sixth Alternative Hypothesis

(H6:1) - There is a difference and anxiety scores between participants who completed an overnight hike and a control group

## **Methods and Data Collection Approaches**

#### Methodology

We initially approached this project as a mixed methods study, aiming to collect qualitative data regarding participants thoughts and emotions and quantitative data in the form of cortisol levels. After an extensive review of the literature, we decided the most appropriate approach to gather data on thoughts and emotions, specifically anxiety, depression and wellbeing, was in the form of medical self-report questionnaires. This allowed us to transform qualitative data into quantitative data, enabling more robust statistical interrogation. Thus this is a purely quantitative study.

#### **Research Design**

Our research design evolved over time in response to advice from Charles Sturt University's Human Research Ethics Committee (HREC) and emerging COVID-19 restrictions. Our initial study design proposed to CSU's HREC was a 'true experiment'. Participants would be randomly assigned to groups with a small control group receiving no intervention. The HREC advised it would be more ethical to include all participants with no control group. As a result we adapted our study, and adopted a within-subject design, also known as a repeated measures design where each participant takes part in every condition. In March 2020, our study was postponed due to the developing COVID-19 pandemic. This pause allowed us to analyse some of our data, assess our study and importantly revisit our design given the new challenges raised by COVID-19. When students returned to school, they were no longer permitted to mix between year groups based on health advice from the New

South Wales Government and the Association of Independent Schools New South Wales. We therefore had to reassess our study design in light of these new restrictions. We decided to continue the study in 2021 without randomly assigning participants. Our final study design, implemented in 2021, would therefore be considered as a repeated measures quasi experiment. Despite the substantial alterations to our research design, this approach is still widely used, particularly in pre and post-test studies like this one (Li et al., 2021).

#### **Project Scope**

The scope of this study is limited to cortisol levels and self-reported scores of anxiety, depression and wellbeing in students at Skillset Senior College. We did not assess how our study may have impacted other aspects of our students experience such as academic ability, physical health or attendance, all of which are worthy of further study. As we did not measure these variables, we limit reference to them for the remainder of this report.

#### **Intervention Design**

To implement effective interventions to address our research questions within a school context they had to adhere to the following criteria.

- 1. Evidence of improving health outcomes
- 2. Ease of implementation within a school environment
- 3. Replicable through-out the school week
- 4. Flexible & adaptable
- 5. Does not replace recess provision
- 6. Encourages teacher participation
- 7. Whole school delivery

To satisfy criteria (1) a thorough review of the academic literature supporting the use of the intervention was conducted. With regards to criteria (2) and (3) interventions had to be delivered every day in a 15 minute session in addition to a 1 hour session each week. Factors to satisfy (4-7) included; little to no 'set-up' time, interventions could be implemented even if key staff members were absent and each intervention had to be engaging and impactful to students. After consultation with the appropriate literature, school leaders, external professionals and the teachers carrying out the interventions, we selected sensory engagement, therapeutic writing and daily exercise as our three treatment groups.

The daily exercise group was modelled from The Daily Mile program with an additional recreational walk (The Daily Mile, 2021). Using existing expressive writing programs and paradigms, a bespoke writing program was created by the schools' Head of Wellbeing. This member of staff has appropriate psychological training and qualifications which were imperative to create safe resources in the context of at-risk youth. In addition to this, this member of staff was able to brief and mobilise wellbeing staff members to 'wrap around' students before, during and after each writing session. Although high-quality resources exist for sensory engagement in pre-school and primary school aged students, very little

exists for students in a high school context. Our Lead Teacher, who is Science trained, developed an array of practical lessons designed to engage a range of senses including sight, smell, touch, taste, proprioception and balance (vestibular system). In addition to this the Lead Teacher incorporated breathing exercises that allowed students to focus on their heart beat and turn their attention towards their own physiological processes. In 2021, all Year 10's were invited to conduct an overnight hike in Term 1. Approximately 50% of students completed the hike while the rest remained at school completing normal classes. This presented an opportunity to compare levels of anxiety and depression between students who completed the hike and a control group who did not.

#### **Study Period**

This study was conducted over a 6 month period, across three school terms (Term One, Term Two and Term Three) from 16th of February 2021 until 17th of August 2021 in New South Wales, Australia. The study was curtailed in August 2021 due to New South Wales lockdown restrictions imposed in response to the Covid-19 global pandemic.

#### Participants

A total of 84 participants were invited to participate in this study, 59 agreed to take part. Participants were adolescents and young adults (mean age,  $16.1 \pm 1.16$ ; range age 14-19; male, 42%; female, 58%; Indigenous Australians 32%; Non-indigenous Australians 68%). Ethical approval for the project was granted by the Charles Sturt University Human Ethics Committee (Approval number H19344).

#### Interventions

Participants were assigned to one of three groups for a 4-week period each term, either exercise, therapeutic writing or sensory engagement. Students would rotate into a different group each term, ensuring each participant took part in each condition of the independent variable (repeated measures design). Students would participate in a 15-minute activity each day in their respective group and also participate in a 1-hour group session each week. Overall students would participate in 2 hours of intervention each week, 8 hours total over the 4-week period. In Term 3, students only participated in 4 hours of intervention before New South Wales lockdowns were enforced.

There were four key types of intervention:

#### Exercise

Participants in the exercise group conducted 15-minutes of brisk walking each day in a designated area on campus grounds. During the 1-hour group session participants walked approximately 2.25km around the Macquarie River at Bicentennial Park, Bathurst, New South Wales, Australia.

#### Sensory Engagement

Participants in the sensory engagement group conducted 15-minutes of breathing exercises each day in a dedicated space within school grounds. During the 1-hour group session participants took part in immersive practical demonstrations related to their sensory motor systems.

#### Therapeutic writing

Participants in the therapeutic writing group conducted 15-minutes of writing each day, using prompts designed to encourage deep thought. During the 1-hour group session participants were supported by a member of staff trained in psychology to conduct exercises designed to stimulate profound personal reflection.

#### Overnight Hike

Participants in Year 10 were offered to complete an overnight hike in the Blue Mountains in New South Wales, Australia. A group of Year 10 participants did not take part in this hike and formed a control group for comparison.

#### Sampling Period

Using a pre/post-test design, participants conducted an online self-report questionnaire containing the General Anxiety Disorder - 7 (GAD-7), Patient Healthcare Questionnaire - 9 (PHQ-9) and the Warwick-Edinburgh Mental Well Being Scale, before and after the 4-week intervention period. Saliva samples (n=200) were also collected before and after the 4-week period. Saliva samples were taken throughout the school day between 09:14-14:15, with the majority of samples collected during the AM (71%).

#### Saliva Sampling

#### Sample collection

Salivettes were used to accomplish saliva collection. Participants opened a salivette tube and slid the absorbent cotton roll under their tongue for 2 minutes before replacing the cotton roll back into the centrifuge section of the tube.

#### Sample storage

Samples were stored frozen at -20°C until assay. All samples underwent one freeze thaw cycle.

#### Sample preparation

On the day of assay appropriate number of samples were thawed and analysed using commercially available kits (Salimetrics, USA) according to the manufacturer's instructions. Thawed samples were centrifuged at 1500 x g for 15 min to collect clear saliva and this saliva was used without further processing for all assays. All samples were brought to room temperature before adding to the assay wells and all samples were analysed in duplicate.

#### Sample analysis

Salivary samples were measured using a commercially available ELISA assay (Salimetrics, USA) according to the manufacturer's instructions.

## **Statistical Analysis**

#### **Questionnaire Validation**

Although each survey, PHQ-9, GAD-7 and Warwick-Edinburgh, have been well tested in previous studies. We felt it prudent to test the validity, reliability (consistency) and unidimensionality of each questionnaire in our own school context. We decided to conduct

a validation test using the first pre-test data. We would use this information to determine what questions (if any) should be removed from subsequent analysis.

We assessed the unidimensionality of each questionnaire using a Principal Component Analysis (PCA) and convergent validity using factor loadings for each survey. Reliability/consistency was tested using Cronbach's  $\alpha$ .

#### **Principal Component Analysis**

#### Unidimensionality & Convergent Validity

We conducted an exploratory factor analysis (EFA) on the first pre-test data set (Term 1 March) for each questionnaire. Based off the Guttman-Kaiser Criterion (Guttman, 1954; Kaiser, 1960) only factors with eigenvalues > 1 were retained for further analysis (Nunnally, 1978). Confirmatory factor analysis (CFA) was conducted to confirm factor structure. A chi-square distribution for goodness of fit was carried out to assess if models fitted the data well and factor loadings for each question were interrogated. The rule for convergent validity is that the loadings of all measures should be greater than 0.50 (Hair et al., 2010) with an average of greater than 0.7 for every factor (Pillai, 2020).

#### Cronbachs $\alpha$

#### Reliability & Consistency

Cronbach's  $\alpha$  (Cronbach, 1951) provides a measure of the internal consistency of a test or scale, expressed as a number between 0 and 1. Alpha scores ranging from 0.70-0.95 are considered acceptable values when using Cronbach's  $\alpha$  as an index of test internal consistency (Bland, 1997; DeVellis, 2003).

#### **Correlation tests**

Correlation tests were conducted to measure the strength and direction of association (if any) between GAD-7, PHQ-9 and Warwick Edinburgh survey scores. Correlation tests were also conducted to measure any correlation between cortisol levels and survey scores. This was achieved using a Spearman's correlation test. The Spearman rank-order correlation coefficient is a non-parametric measure of monotonic relationships between paired data. The Spearman coefficient is a number between -1 and 1. A number close to 1 suggests a strong correlation between variables, numbers close to 0 suggest a weak or no correlation between variables. The sign before the number either (+) or (-) indicates the direction of the relationship, either positive or negative respectively. Based on previous literature (Akoglu, 2018) the following designations were used to interpret the strength of association.

Table 1.	Designations	used	to	determine	strength	of	correlations	taken	from	Akoglu
(2018).										

Correlation Coefficient	Interpretation
+1 (-1)	Perfect
+0.9 (-0.9)	Strong
+0.8 (-0.8)	Strong

+0.7 (-0.7)	Strong
+0.6 (-0.6)	Moderate
+0.5 (-0.5)	Moderate
+0.4 (-0.4)	Moderate
+0.3 (-0.3)	Weak
+0.2 (-0.2)	Weak
+0.1 (-0.1)	Weak
0(0)	None

#### **Comparison between independent groups**

To examine differences between independent groups (i.e. gender and indigenous status) a Mann-Whitney U test was conducted on the initial baseline survey. A significance level was set at P < 0.05.

#### Comparison of participants who took part in overnight hike

An additional set of Mann-Whitney U tests were conducted to compare differences between GAD-7, PHQ-9 and Warwick-Edinburgh scores between participants who opted to participate in an two day overnight hike and those that did not in Term 1.

#### **Comparison between paired groups**

To examine differences in survey scores between paired groups and cortisol levels between paired groups (pre-test, post-test) a Wilcoxon Match Pairs Signed Rank Test was conducted. A significance level was set at P < 0.05 (two-tailed). Effect size provides an indication of relationship strength (Bosco et al., 2015). Effect size (r) of significant comparisons were calculated by dividing Z scores by the square root of observations (Fritz et al., 2012; Tomczak & Tomczak, 2014).

$$r = \frac{Z}{\sqrt{N}}$$

We used Cohen's (1962, 1988) benchmarks for classifying correlations of r = 0.1, 0.3, 0.5 as small, medium and large effect sizes respectively.

Only participants who were present for both pre and post-test sampling periods for that term, were retained for analysis. With regard to Term 3, as participants did not complete a full 4-week intervention we deemed a pre/post-test after only 2-weeks inappropriate. Instead we conducted a comparison between Term 1 and Term 3 pre-scores. The authors believe this would provide some indication to changes in 'baseline' levels of anxiety, depression and wellbeing scores amongst participants before and after a total of 16 hours of intervention.

Therefore, three separate comparisons were conducted, Term 1 pre/post scores (n = 35), Term 2 pre/post scores (n = 25) and Term 1 and Term 3 pre-scores (n = 20).

#### Severity of disorders

Using pre-existing score cut-offs, severity of general anxiety disorder and depression were calculated. Individuals who score  $\geq$  10 are considered as having clinical levels of general anxiety disorder and depression. Participants were designated into levels of severity using the following criteria.

PHQ-9 Score	Severity
0 - 4	None - minimal
5 - 9	Mild
10 - 14	Moderate
15 - 19	Moderate Severe
20 - 27	Severe

Table 2. Patient Healthcare Questionnaire (PHQ-9) Scores\*

\* From "Instructions for Patient Health Questionnaire (PHQ) and GAD-7 Measures TOPIC PAGES Background 1 Coding and Scoring 2, 4, 5 Versions 3 Use as Severity and Outcome Measures 6-7." (2010).

Table 3. General Anxiety Disorder (GAD-7) Scores and severity\*

GAD-7 Score	Severity	
0 - 4	None - minimal	
5 - 9	Mild	
10 - 14	Moderate	
15+	Severe	*From Spitzer et

al., (2006)

#### **Cortisol Levels**

To draw comparisons of salivary cortisol of participants in this study to others, we used data collected from a substantial meta-analysis by Miller et al., (2016). In this metaanalysis of 15 independently conducted field studies, Miller et al., (2016) obtained salivary cortisol information for 18,698 individuals across a range of age groups to generate a comprehensive dataset (Table 4). For the purposes of this study we used data collected on males and females in the age range 11 - 20 at 3.5 hours after awakening at 7:00. This age range and time-frame aligns closely with the demographic of participants and timing of sampling in this study, highlighted in red (female percentiles: 5th, 1.1; 50th 3.9; 95th, 14.0; male percentiles: 5th, 1.0; 50th, 3.5; 95th, 12.4).

			1 hou	r		3.5 hou	rs		6 hour	s	1	8.5 hou	rs		11 hou	rs	1	3.5 hou	ırs		16 hou	rs
Age	Sex	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>
< 5	F	1.3	4.7	16.7	0.7	2.6	9.1	0.4	1.5	5.4	0.3	1.0	3.5	0.2	0.7	2.4	0.1	0.5	1.9	0.1	0.4	1.6
< 5	М	1.4	4.8	17.2	0.7	2.6	9.4	0.4	1.6	5.5	0.3	1.0	3.6	0.2	0.7	2.5	0.2	0.5	1.9	0.1	0.5	1.6
5 - 10	F	1.3	4.7	16.8	0.7	2.6	9.1	0.4	1.5	5.4	0.3	1.0	3.5	0.2	0.7	2.4	0.1	0.5	1.9	0.1	0.4	1.6
5 - 10	М	1.1	3.9	14.0	0.6	2.1	7.6	0.4	1.3	4.5	0.2	0.8	2.9	0.2	0.6	2.0	0.1	0.4	1.6	0.1	0.4	1.3
11 - 20	F	2.0	7.2	25.8	1.1	3.9	14.0	0.7	2.3	8.3	0.4	1.5	5.3	0.3	1.1	3.8	0.2	0.8	2.9	0.2	0.7	2.4
11 - 20	М	1.8	6.4	22.8	1.0	3.5	12.4	0.6	2.1	7.3	0.4	1.3	4.7	0.3	0.9	3.3	0.2	0.7	2.6	0.2	0.6	2.1
21 - 30	F	2.1	7.5	26.7	1.1	4.1	14.5	0.7	2.4	8.6	0.4	1.6	5.5	0.3	1.1	3.9	0.2	0.8	3.0	0.2	0.7	2.5
21 - 30	М	2.0	7.1	25.3	1.1	3.9	13.7	0.6	2.3	8.1	0.4	1.5	5.2	0.3	1.0	3.7	0.2	0.8	2.8	0.2	0.7	2.4
31 - 40	F	1.8	6.5	23.3	1.0	3.6	12.6	0.6	2.1	7.5	0.4	1.4	4.8	0.3	1.0	3.4	0.2	0.7	2.6	0.2	0.6	2.2
31 - 40	М	1.8	6.6	23.3	1.0	3.6	12.7	0.6	2.1	7.5	0.4	1.4	4.8	0.3	1.0	3.4	0.2	0.7	2.6	0.2	0.6	2.2
41 - 50	F	1.8	6.3	22.5	1.0	3.4	12.3	0.6	2.0	7.3	0.4	1.3	4.7	0.3	0.9	3.3	0.2	0.7	2.5	0.2	0.6	2.1
41 - 50	Μ	1.8	6.3	22.6	1.0	3.4	12.3	0.6	2.0	7.3	0.4	1.3	4.7	0.3	0.9	3.3	0.2	0.7	2.5	0.2	0.6	2.1
51 - 60	F	1.8	6.4	22.7	1.0	3.5	12.3	0.6	2.0	7.3	0.4	1.3	4.7	0.3	0.9	3.3	0.2	0.7	2.5	0.2	0.6	2.1
51 - 60	Μ	2.0	7.1	25.3	1.1	3.9	13.7	0.6	2.3	8.1	0.4	1.5	5.2	0.3	1.0	3.7	0.2	0.8	2.8	0.2	0.7	2.4
61 – 70	F	1.9	6.8	24.2	1.0	3.7	13.1	0.6	2.2	7.8	0.4	1.4	5.0	0.3	1.0	3.5	0.2	0.8	2.7	0.2	0.6	2.3
61 – 70	М	2.1	7.3	26.0	1.1	4.0	14.1	0.7	2.3	8.4	0.4	1.5	5.4	0.3	1.1	3.8	0.2	0.8	2.9	0.2	0.7	2.4
71 - 80	F	2.0	7.2	25.7	1.1	3.9	13.9	0.7	2.3	8.3	0.4	1.5	5.3	0.3	1.1	3.7	0.2	0.8	2.9	0.2	0.7	2.4
71 - 80	М	2.2	7.9	28.2	1.2	4.3	15.3	0.7	2.5	9.1	0.5	1.6	5.9	0.3	1.2	4.1	0.2	0.9	3.2	0.2	0.7	2.6
> 80	F	2.2	7.9	28.1	1.2	4.3	15.2	0.7	2.5	9.0	0.5	1.6	5.8	0.3	1.1	4.1	0.2	0.9	3.1	0.2	0.7	2.6
> 80	Μ	2.5	8.8	31.2	1.3	4.8	16.9	0.8	2.8	10.0	0.5	1.8	6.5	0.4	1.3	4.5	0.3	1.0	3.5	0.2	0.8	2.9

Table 4. Percentiles of diurnal salivary cortisol concentrations (nmol/l) at various hours after awakening at 7:00\*

\* From Miller et al., (2016).

## **Discussion & Findings**

## **Research Question 1. Can we measurably decrease anxiety and depression scores in at-risk adolescents?**

Yes. We found a reduction in anxiety and depression in post-test scores in both Term 1 and Term 2. Although not statistically significant, the mean anxiety score dropped from 10 to 9.03 and mean depression score dropped from 12 to 11.5 in Term 1. In Term 2 there was a statistically significant drop in mean anxiety score from 11.6 to 9.84 and depression score from 13.64 to 11.24 (P < 0.05). Due to COVID restrictions suspending our study halfway through the intervention period (2 weeks) we did not conduct a pre-test/post-test analysis on Term 3 scores. However, we did compare scores from Term 1 and Term 3 pretest scores on a subsample of students present for both sampling periods (n=20). When we compared pre-test scores between Term 1 and Term 3 we found statistically significant drops in anxiety and depression score dropped from 13.45 to 9.9. Based on these results we are confident that we can reject our null hypothesis (H1:0) that there is no decrease in anxiety and depression scores after a school-based intervention and accept our alternative hypothesis (H1:1) that there is a decrease in anxiety and depression scores after a school-based intervention.



#### Figure 6. Pre and post test GAD-7 and PHQ-9 scores from Term 1

We found measurable decreases consistently throughout this study. The main contributing factors to these decreases however, is not clear cut. Although we found significant drops in both anxiety and depression in Term 2, exercise was found to contribute to a significant drop in anxiety only (P < 0.05). Our small sample size within each group impacts our statistical power, making it challenging to discern the true causes. It is likely each group was having a positive impact on participants and we cannot discount residual effects from interventions from the previous term. We know that the benefits of therapeutic writing for

example, may take weeks or even months to emerge (Pennebaker, 2004). The culture of the school is undoubtedly another contributing factor to overall levels of depression and anxiety. Throughout the course of the year students establish meaningful connections with staff and peers, which are nurtured and deepened with each passing term.



Figure 7. Pre and post test GAD-7 and PHQ-9 scores from Term 2.



Figure 8. Pre test GAD-7 and PHQ-9 in Term 1 and in Term 3.

Perhaps the most striking result we found was between Term 1 and Term 3 pre-test scores and the related shifts in severity. In Term 1 60% of participants would have been considered as having clinical levels of anxiety, by Term 3 only 35% would be remain in this category. Similarly, in Term 1 65% of participants would have been considered clinically depressed reduced to only 35% by Term 3. This study demonstrates that school-based interventions can significantly improve adolescent anxiety and depression within a relatively short-time frame. The interventions are brief, flexible and most importantly effective. If schools could replicate similar drops in severity amongst their own student populations the ramifications for students, parents, families, communities and health care providers could be significant.



Figure 9 - Percentage of participants present in both Term One pre test and Term Three pre test considered to have clinical and non-clinical anxiety (n=20).



**Depression Severity Term 1** 

**Depression Severity Term 3** 

Figure 10 - Percentage of participants (n = 20) considered clinically depressed from term 1 pre-test data and term 3 pre-test data.

General Anxiety Disorder Severity Term 1

Our results warrant further exploration and investigation, the authors would recommend replicating this study across a range of schools. This would ensure the results found in this study are reliable across different contexts and environments.

## Research Question 2. Are medical self-report questionnaires useful and valid when working with at-risk adolescents?

# Yes. We found the GAD-7, PHQ-9 and Warwick Edinburgh Mental Well-being questionnaires valid, consistent and unidimensional. This gives us confidence that our results are indeed valid and reliable measurements of anxiety, depression and wellbeing.

We found a strong positive correlation between anxiety and depression pre scores, indicating participants who reported high levels of anxiety also reported high levels of depression (P < 0.05). We also found strong negative correlations between anxiety and wellbeing scores and depression and wellbeing scores (P < 0.05). The link between anxiety and depression in children and young people is well-reported (Seligman & Ollendick, 1998; Axelson & Birmaher, 2001) However, the relationship between the two disorders is complex. Anxiety and depression may be considered co-morbid, i.e. both disorders are present together and may or may not be related to one another. It seems likely given the overlap in some of the exhibited emotions and behaviours that there is a relationship between the two. It is unclear in this study however, if high levels of anxiety result in higher levels of depression or vice versa or if there is a relationship at all. What is clear from our results is that anxiety and depression are particularly high in this cohort of participants. From our Term One pre test data 54% of students would be considered as having clinical levels of anxiety and 58% clinical levels of depression (n=59). According to Beyond Blue (2022), 6.9% of children and young people (4 to 17 years) suffered from an anxiety disorder in the past 12 months and 5% of young people (12-17 years) had a major depressive disorder. One explanation for such elevated levels of anxiety and depression in this group of young people (14-19 years) could be related to some of the additional socioemotional support needs required by participants. Importantly, many of the participants may have experienced or are still experiencing some form of trauma. A final hypothesis may be that there is lag time between reported national statistics and the reality of many young Australians in 2021/2022. Given the increased waiting times for psychological support services nationally, accessibility issues (particularly in rural Australia) and the unfolding global pandemic, it is likely published statistics on adolescent anxiety and depression at best, are conservative.



Figure 11 - Percentage of participants considered to have clinical and non-clinical levels of anxiety and depression from Term One pre test data (n=59).

## Research Question 3. Are there differences in levels of depression and anxiety between distinct groups (gender, ethnic groups) at Skillset Senior College?

Yes. We found females reported significantly higher levels of anxiety and depression than males and significantly lower levels of wellbeing (P < 0.05) We therefore reject our H2:0 null hypothesis that there is no difference between anxiety and depression sores between male and female participants and accept our H2:1 alternative hypothesis that there are differences in anxiety and depression scores between male and female participants.

This finding is well supported by the literature. Given participants may have experienced some form of family upheaval, it is highly likely many will have been exposed to forms of intergenerational and transgenerational transmission. As generational transmission affects each gender differently, this may explain some of the sex differences observed. Research also suggests females are more likely to exhibit higher levels of expressive emotion both positive and negative compared with males, who are more likely to express higher levels of anger and aggression (Chaplin, 2015). If females are therefore more likely to experience higher levels of negative emotions than males, they are more likely to report this in questionnaires.

#### Indigenous versus non-indigenous

We found no significant difference in anxiety and depression scores between indigenous and nonindigenous Australians in this study (P > 0.05), therefore we fail to reject our H3:0 null hypothesis that there is no difference in anxiety and depression scores between indigenous and nonindigenous participants. As Indigenous Australians are much more likely to experience some form of psychological stress (31.7%) than non-indigenous Australians (12.3%) throughout their life (Beyond Blue, 2022), it is pleasing that Indigenous Australians cannot be separated by anxiety of depression scores within this study. As there is a significantly high population of participants in this study who identify as indigenous Australians (32%) this may have contributed to the higher overall levels of anxiety and depression observed.



Figure 12. Depression (PHQ-9), anxiety (GAD-7) and wellbeing (WWE) scores by gender, females represented by red and males represented by blue. Figure 2. (a) PHQ-9 and GAD-7 scores by gender, (b) WWE and GAD-7 scores by gender and (c) WWE and PHQ-9 scores by gender

## Research Question 4. Can school-based wellbeing activities impact adolescent cortisol levels?

We found no significant difference in salivary cortisol levels between males and females. We therefore fail to reject our H4:0 null hypothesis that there is no difference in cortisol levels after a school-based intervention.

We did find a significant negative correlation between cortisol level and depression score across both genders. As cortisol level increased, depression score decreased. Although we found no statistical difference between cortisol levels at any sampling period, there was a noticeable shift in both female and male cortisol levels (Figure 12). For example, in the first sampling period (Term 1 pre-test) only 43% of females were above median ranges (Miller et al., 2016). By the final sampling period (Term 3 post-test) 71% of females were above the median level (Table 10). Males began with 60% above median level and ended with 74% above median levels (Table 11). The relationship between cortisol level and associated disorders such as anxiety and depression is complex. Studies have found no relationship between cortisol and depressive symptoms (Psarraki et al., 2021) others have found correlations between high levels of cortisol and high levels of depression (Lupien et al., 1999; Goodyer et al., 2000; Dockray et al., 2009; Owens et al., 2014) and some have found correlations between low levels of cortisol and high levels of depression (Suzuki et al., 2014; O'Conner et al., 2018). Our study provides further evidence to the latter, i.e. a negative relationship between cortisol and depression. Our results align closely with studies which report low baseline levels of cortisol in individuals who may have suffered childhood trauma or are currently experiencing post-traumatic stress disorder (Hinkelmann et al., 2013; Suzuki et al., 2014; O'Conner et al., 2018). A study by Lumeny et al., (2014) also found children living in more chaotic homes had lower cortisol levels.

Interestingly, we found variation (standard deviation) in male cortisol levels decreased over time. Less variation or spread in cortisol levels within males may indicate less chaotic cortisol release being expressed throughout this study (Yehuda et al., 1996). Lower fluctuations in cortisol release may have beneficial effects on an individual as high fluctuation or dysregulation has been linked to high levels of depression (Lopez-Duran et al., 2009).



Figure 13. Salivary cortisol concentration (nmol/L) over six sampling periods One (first) and Sixth (last). Females (red) and males (blue). Dotted lines represent 5th and 95th percentiles, solid black line represents 50th percentile taken from Miller et al., (2016).

## **Research Question 5. Does participating on an overnight hike impact levels of anxiety and depression?**

We found a significant difference in depression scores between participants who completed an overnight hike and a control group (P < 0.05). We did not find a significant difference in anxiety scores between participants who completed and overnight hike and a control group. We therefore reject our H5:0 null hypothesis that there is no difference in depression scores between participants who completed an overnight hike and a control group however, fail to reject our H6:0 null hypothesis that there is no difference in anxiety scores between participants who completed an overnight hike and a control group however, fail to reject our H6:0 null hypothesis that there is no difference in anxiety scores between participants who completed an overnight hike and a control group.

We found significant differences in anxiety and depression scores between participants and the control group (P < 0.05) *prior* to the hike taking place. Although we anticipated participants to report lower levels of depression and anxiety after the hike, we did not expect to find a difference before the hike. We therefore cannot suggest that the hike alone is what contributed to differences in depression scores. It appears that students who were willing to put themselves into the 'groan zone' between comfort and panic were already in a better mental state than those that did not. What we have potentially discovered is an indirect tool to gauge student mental health, without explicitly discussing anxiety and depression. Given that an overnight hike requires participants to forward plan, voluntarily put themselves into challenging situations and ultimately step into the 'unknown', this may be too much to ask for participants already in a diminished state of mind.



Figure 14. Anxiety and depression pre scores between control group and hike group



Figure 15. Anxiety and depression post scores between control group and hike group

## Limitations

There are a number of limitations in this study that should be acknowledged. Perhaps the most important limitation is sample size. Our sample size is small, like most school-based research projects. This does not detract from our findings however, it does give us fairly low statistical power and reduces our chances of finding true effects. For example, we found our interventions to be significant in reducing levels of anxiety and depression however, we could not discern conclusively which activity was the primary contributor to observed change. This is likely due to our small sample sizes within each intervention group. Another limitation is related to experimental design. Ideally, this study would have been a randomised control trial (RCT). This would have increased the reliability and validity of our results. Given the limitations imposed by COVID-19 regarding mixing of year groups and the ethical implications of potentially denying a control group from positive mental health outcomes, it is unlikely in the current climate that a RCT could be implemented at this moment in time. Finally, our cohort of participants are fairly unique regarding socioeconomic status and socio-emotional needs. This may limit the relevancy of our data to the wider community, however it still serves as an important contributor to the field of education and adolescent mental health.

## Implications

The findings of this study contribute to the hypothesis that school-based interventions can have a positive impact on adolescent mental health. Our research findings contribute to the current knowledge base surrounding adolescent mental health by providing strong evidence that schools can implement relatively brief activities into their daily routine to measurably reduce feelings of anxiety and depression. Moreover, our methodology provides a practical blue-print that can enable schools to adopt elements of this study in an effort to improve mental health outcomes within their own context. Practitioners may have multiple uses for the findings in this study, such as;

- Evidence to establish their own school-wide wellbeing strategy
- A document to share with colleagues and school leaders to initiate conversations about existing mental health strategies and policies
- A resource to use with students to generate conversations around mental health
- A resource to provide practical tools/ strategies for adolescents to improve feelings of anxiety and depression

It is likely the findings of this study will provide a platform for future investigations.

### **Recommendations and directions for future research**

The data from this study may be considered a robust pilot study for future investigations into adolescent mental health. Schools receptive to adopting the strategies outlined in this study could replicate the methodology described. Ideally, multiple schools across a range of socio-economic areas would replicate this study at the same time, during the same academic year. Larger schools, may also be in a position to establish control groups, which would enhance our ability to establish true ' cause and effect '. By increasing the sample size, across a more diverse cross-section of adolescents, we would strengthen the evidence base for school-based activities that can improve adolescent mental health.

The authors would recommend exploring additional options to saliva collection for cortisol analysis in future studies. Hair sampling, for example, would enable researchers to investigate long term changes in cortisol levels, rather than the 'snapshot' provided by salivary cortisol levels. Hair sampling also may present less risk, particularly in a post-Covid world, when collecting physiological data across an entire school.

We found an interesting shift in cortisol levels in this study, suggesting there may have been some physiological impact on students. Recent studies have shown children of parents with a history depression have measurable differences in subcortical volume within their own brains, increasing the likelihood of developing depression themselves (Pagliaccio et al., 2020). Replicating this study, while using structural magnetic resonance imaging (MRI) of participants could provide a window into any underlying structural changes taking place as a result of school-based activities.

Something of note the authors discovered during the statistical analysis phase, was the lack of consensus on the appropriate method of analysis regarding questionnaire data. While some authors conducted validation tests on their questionnaire data, others did not. In addition to this some authors conducted non-parametric tests on questionnaire data while others used parametric testing. Given that data taken from Likert questionnaires would be considered ordinal and violates normality, non-parametric tests should be utilised. Although this is the approach the authors of this report undertook, it may be an interesting area of future investigation.

## Conclusion

Improving the mental health status of adolescents in Australia should be the responsibility of federal and state governments, communities, school management and administrative staff, teaching staff and learning support to parents and carers. Mental health does not live in a vacuum, it is impacted by our environment and this is perhaps more pronounced in adolescents navigating a particularly tumultuous developmental period. Schools are in the privileged position of working with young people day in, day out during the most important years of their lives. K-12 schools may be solely responsible for a child's learning for a staggering 13 years. Although students will rightly be taught literacy and numeracy skills throughout their entire school career, it is not uncommon that hundreds of thousands of students leave school having never discussed once how they feel, why they think a certain way or how they can learn to regulate their own mood and emotions. Our study demonstrates that effective activities can be implemented easily across an entire school, producing improvements in anxiety and depression in a relatively short amount of time. Our study also demonstrates that mental-health and wellbeing activities can be implemented across numerous Key Learning Areas (KLAs) such as English, Art, CAFS, Sport and Science. Discussion and activities related to mental health should therefore not be relegated to a single unit or topic in a specific subject, but incorporated across KLAs to foster a true school culture of wellbeing. Schools, as an institution, are perhaps the most powerful places in the world that influence the future direction and complexion of young people's lives, which in turn shapes our society. In an increasingly volatile geo-political, ecological and economic landscape, equipping young people with the skills and abilities to become more self-reliant and resilient, while reducing their risk of developing serious mental illness, is of paramount importance.

## **Research to Practice Impact**

The impact of this project are already being felt.

- Staff from the school have presented to the governing body of Occupational Therapists in Australia
- The project team has been invited to discuss future projects with universities across Australia and Europe.
- The school has been contacted by schools in New South Wales, Queensland and Victoria who wish to implement aspects of the study within their own schools following the publication of an article in ACER and national media coverage through the Australian Broadcast Corporation (ABC).

The team anticipate interest to grow further after publication of our data in peer-reviewed journals. We also aim to enhance current practices by delivering professional development on our school-based interventions, led by teachers in our research team, after completion of the project.

The School Based Research Project has had a profound impact on Skillset Senior College. It has raised our awareness of other fascinating, school-based research taking place across New South Wales and beyond and broadened the schools existing network. Since the inception of our project we have engaged with an extensive number of organisations including The Evidence Institute, St Philip's Christian College DALE, Queenwood School for Girls, Roseville College, Warrakirri College, Minarah College, Charles Sturt University, the University of Wollongong, Curtin University, the University of New England, Newcastle University, the University of Aberdeen, the University of Edinburgh and the University of Glasgow. In 2021, we were invited to join a group of 30+ schools from across Australia in a Research Invested Schools group, connecting us with a number of research-oriented organisations.



#### 30+ 'Research-Invested Schools' since 2005

Figure 16. Research-Invested Schools from across Australia. Source: www.researchinvestedschools.net

This study has also increased the willingness of staff and students to conduct their own research. Our team regularly discuss potential projects and one of our staff has already initiated a future research project working alongside Wollongong University investigating atmospheric chemistry within the school. As each staff member was involved in the research in some capacity each member of staff has gained practical experience executing a real-life research investigation. Due to this process discussions around experimental design, ethics and analysis are now commonplace. Many staff members are also regularly consulting the research literature and sharing this with others. This has generated more discussion around future projects that could be implemented within the school. Amazingly, some of our students have now expressed an interest in conducting their own research projects. One student has already presented a robust experiment to staff with a view to begin collecting their own data.

We have already begun to translate our findings into practice within the school. In 2022, we have embedded elements of the study into the school day such as maintaining a weekly 'wellbeing walk' and our science teacher has replicated some of the practical sensory engagement lessons with students.

We will disseminate our findings in multiple ways to maximise the impact of our study. We aim to publish our results in peer-reviewed journals to provide a level of academic legitimacy to our results. Most importantly however, is designing resources that can be used by education practitioners. We aim to create hands-on resources that can be used by practitioners globally, such as a 'teacher toolkit' created by staff involved in this study. In addition to this we aim to create an online module that can be used by pre-service teachers and existing teachers as formal professional development. We have approached universities with global reach to assist in this process to once again maximise the impact of our knowledge transfer.

DRAFT

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## Appendices

#### Questionnaire Validation

#### GAD-7

For testing the unidimensionality of the GAD-7, all 7 items were specified as indicators of a single factor. This model fitted the data well, as indicated by the robust  $\chi^2$  goodness-of-fit index  $\chi^2$ = 37.09, *df* = 14, *P* <0.001, explaining 67% of the variation. As shown in Table 4, factor loadings were high ranging from 0.56 to 0.93 with a mean of 0.78. Internal consistency of the GAD-7 was acceptable ( $\alpha$ =0.92).

#### PHQ-9

For testing the unidimensionality of the PHQ-9, all 9 items were specified as indicators of a single factor. This model fitted the data well, as indicated by the robust  $X^2$  goodness-of-fit index  $X^2$ = 58.92, df = 27, P <0.001, explaining 58% of the variation. As shown in Table 5, factor loadings were high ranging from 0.55 to 0.80 with a mean of 0.72. Internal consistency of the PHQ-9 was acceptable ( $\alpha$ =0.91).

#### Warwick-Edinburgh Mental Well-being Scale

For testing the unidimensionality of the Warwick-Edinburgh Scale, all 14 items were specified as indicators of a single factor. This model fitted the data well, as indicated by the robust  $X^2$  goodness-of-fit index  $X^{2}$ = 137.85, *df* = 77, *P* <0.001, explaining 60% of the variation. As shown in Table 6, factor loadings were high ranging from 0.57 to 0.89 with a mean of 0.77. Internal consistency of the Warwick-Edinburgh Scale was acceptable ( $\alpha$ =0.95).

Table 5. Characteristics of items of the Total Generalised Anxiety Disorder Scale (GAD-7) in participants (n = 59).

No.	Item	M (95% CI)	SD	Corrected Item-Total Correlation <sup>1</sup>	Factor Loading	Cronbach's $\alpha$				
1	Feeling nervous, anxious or on edge	1.68(1.4-1.95)	1.07	0.80	0.88					
2	Not being able to stop or control worrying	1.37(1.09-1.64)	1.07	0.85	0.93					
3	Worrying too much about different things	1.65(1.37-1.92)	1.09	0.82	0.89					
4	Trouble relaxing	1.48(1.43-1.99)	1.08	0.80	0.77					
5	Being so restless that it is hard to sit still <sup>2</sup>	1.45(1.73-1.17)	1.10	0.56	0.56					
6	Becoming easily annoyed or irritable	1.71(2- 1.42)	1.15	0.58	0.56					
7	Feeling afraid as if something awful might happen	1.21(1.02-1.5)	1.15	0.81	0.85					
		-	-	-	-	0.92				
<sup>1</sup> Correlation	Correlation between the respective item and the total sum score (without the respective item)									

Table 6.	Characteristics of items	of the Patient Healthcare	Questionnaire	(PHQ-9) in participants (	(n = 59).
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No.	Item	M (95% CI)	SD	Corrected Item- Total Correlation <sup>1</sup>	Factor Loading	Cronbach's $\alpha$
1	Little interest or pleasure in doing things	1.29(1.02-1.56)	1.08	0.72	0.76	
2	Feeling down, depressed or hopeless	1.52(1.24-1.80)	1.10	0.74	0.80	
3	Trouble falling or staying asleep, or sleeping too much	1.92(1.04-2.19)	1.04	0.54	0.55	
4	Feeling tired or having little energy	1.77(1.5-2.05)	1.08	0.76	0.77	
5	Poor appetite or overeating	1.63(1.32-1.93)	1.20	0.59	0.59	
6	Feeling bad about yourself- or that you are a failure or you have let yourself or your family down	1.42(1.11-1.73)	1.22	0.70	0.75	
7	Trouble concentrating on things, such as reading the newspaper or watching television <sup>2</sup>	1.24(0.96-1.52)	1.10	0.73	0.76	
8	Moving or speaking so 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	1.06(0.77-1.36)	1.16	0.69	0.74	
9	Thoughts that you would be better off dead, or of hurting yourself	1 (0.71-1.29)	1.13	0.72	0.79	
		-	-	-	-	0.91

<sup>1</sup>Correlation between the respective item and the total sum score (without the respective item)

Table 7.	Characteristics	of items of the	Warwick-	Edinburgh	in participants	(n = 59)
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No.	Item	M (95% CI)	SD	Corrected Item-Total Correlation <sup>1</sup>	Factor Loading	Cronbach's $\alpha$
1	I've been feeling optimistic about the future <sup>2</sup>	2.66 (2.33-2.99)	1.31	0.57	0.57	
2	I've been feeling useful	2.65(2.33-2.96)	1.24	0.77	0.78	
3	I've been feeling relaxed	2.61(2.31-2.96)	1.19	0.78	0.80	
4	I've been feeling interested in other people	2.66(2.32-3.01)	1.35	0.69	0.71	
5	I've had energy to spare <sup>3</sup>	2.47(2.16-2.78)	1.22	0.65	0.68	
6	I've been dealing with problems well	2.65(2.31-2.98)	1.32	0.79	0.81	
7	I've been thinking clearly	2.66(2.33-2.99)	1.31	0.83	0.85	
8	I've been feeling good about myself	2.71(2.37-3.05)	1.35	0.88	0.90	
9	I've been feeling close to other people	2.53(2.21-2.85)	1.25	0.77	0.78	
10	I've been feeling confident	2.65(2.29-3.00)	1.40	0.79	0.81	
11	I've been able to make up my own mind about things	3.03 (2.70-3.36)	1.29	0.71	0.73	
12	I've been feeling loved	3.23(2.87-3.58)	1.38	0.63	0.66	
13	I've been interested in new things	2.94 (2.58-3.29)	1.41	0.73	0.76	
14	I've been feeling cheerful	2.81(2.46-3.16)	1.38	0.87	0.89	
		-	-	-	-	0.95

<sup>1</sup>Correlation between the respective item and the total sum score (without the respective item)

#### **Correlation tests**

GAD-7 & PHQ-9

There was a strong positive correlation between anxiety and depressions scores, r = 0.81, P < 0.01.

PHQ-9 & Warwick-Edinburgh

There was a strong negative correlation between depression and wellbeing scores, r = -0.58, P < 0.001.

GAD-7 & Warwick-Edinburgh

There was a strong negative correlation between anxiety and wellbeing scores, r = -0.61, P < 0.001.

PHQ-9 & Cortisol levels

There was a significant negative correlation between cortisol level and depressions scores, r = -0.30, P = 0.047.

GAD-7 & Cortisol levels

There was no correlation between cortisol and anxiety score, r = -0.21, P = 0.17.

Warwick-Edinburgh & Cortisol Level

There was no correlation between cortisol and wellbeing scores, r = 0.18, P = 0.23.

#### Comparison between independent groups

GAD-7 scores between males and females

A Mann-Whitney U test showed that there is a significant difference between male (mean = 7.72, SD = 5.9) and female (mean = 12.15, SD = 5.82) anxiety scores (W=600.5, P < 0.01).

PHQ-9 scores between males and females

A Mann-Whitney U test showed that there is a significant difference between male (mean = 9.04, SD = 7.24) and female (mean = 15.09, SD = 6.97) depression scores (W=655, P < 0.001).

Warwick-Edinburgh scores between males and females

A Mann-Whitney U test showed that there is a significant difference between male (mean = 44.12, SD = 14) and female (mean = 34, SD = 13.82) wellbeing scores (W=249.5, P < 0.001).

#### Cortisol levels between males and females

A Mann-Whitney U test showed that there was no significant difference between male (mean = 0.2, SD = 0.16) and female (mean = 0.16, SD = 0.11) cortisol levels (W=238.5, P = 0.8). We therefore fail to reject our HO: That there is no difference between male and female cortisol levels.

#### Comparison of participants who took part in overnight hike

Pre-test scores (prior to hike)

GAD-7 scores between participants who did and did not participate in an overnight hike

A Mann-Whitney U test showed that there is a significant difference between anxiety scores of participants who wanted to go on a hike (mean = 4.4, SD = 3.78) and those that did not (mean = 10.58, SD = 7.25) anxiety scores (W=84.5, p = 0.05, r = 0.24).

PHQ-9 scores between participants who did and did not participate in an overnight hike

A Mann-Whitney U test showed that there is a significant difference between depression scores of participants who wanted to go on a hike (mean = 5.13, SD = 4.36) and those that did not (mean = 15.21, SD = 8) depression scores (W=97.5, p < 0.01, r = 0.38).

Warwick-Edinburgh scores between participants who did and did not participate in an overnight hike

A Mann-Whitney U test showed that there is a significant difference between wellbeing scores of participants who wanted to go on a hike (mean = 53.25, SD = 9.05) and those that did not (mean = 35.35, SD = 14.31) wellbeing scores (W=13, p < 0.01, r = -0.4).

Post-test scores (after hike)

GAD-7 scores between participants who did and did not participate in an overnight hike

A Mann-Whitney U test showed that there is no significant difference between anxiety scores of participants who went on a a hike (mean = 5.33, SD = 4.92) and those that did not (mean = 9.83, SD = 7.13) anxiety scores (W=74, p = 0.16).

PHQ-9 scores between participants who did and did not participate in an overnight hike

A Mann-Whitney U test showed that there is a significant difference between depression scores of participants who went on a a hike (mean = 6.22, SD = 4.82) and those that did not (mean = 14, SD = 8.93) depression scores (W=83.5, p < 0.05, r = 0.27).

Warwick-Edinburgh scores between participants who did and did not participate in an overnight hike

A Mann-Whitney U test showed that there is a significant difference between wellbeing scores of participants who went on a a hike (mean = 43.56, SD = 14.98) and those that did not (mean = 33.83, SD = 15.54) wellbeing scores (W=35, p = 0.19).

#### Comparison between paired groups

#### Term 1

Pre/post test scores for GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre anxiety scores (mean = 10, SD = 6.84) and post anxiety scores (mean = 9.03, SD = 5.87) in Term 1 (V = 326.5, P = 0.25).

#### Pre/post test scores for PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre depression scores (mean = 12, SD = 7.5) and post depression scores (mean = 11.5, SD = 7.55) in Term 1 (V = 288.5, P = 0.89).

#### Pre/post test scores for Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 38.01, SD = 14.31) and post wellbeing scores (mean = 36.91, SD = 12.89) in Term 1 (V = 336.5, P = 0.51).

#### Pre/post test scores in Exercise group

#### GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre anxiety scores (mean = 8.89, SD = 7.35) and post anxiety scores (mean = 7.94, SD = 6.32) in the exercise group in Term 1 (V = 66.5, P = 0.73).

#### PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre depression scores (mean = 11.75, SD = 8.35) and post depression scores (mean = 10.56, SD = 8.12) in the exercise group in Term 1 (V = 48, P = 0.54).

#### Warwick Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 42.13, SD = 14.77) and post wellbeing scores (mean = 40.44, SD = 16.35) in the exercise group in Term 1 (V = 77, P = 0.35).

Pre/post test scores in Resilience Training group

#### GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre anxiety scores (mean = 11.82, SD = 6.88) and post anxiety scores (mean = 11.55, SD = 4.91) in the resilience group in Term 1 (V = 27, P = 0.63).

#### PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre depression scores (mean = 14.55, SD = 7.54) and post depression scores (mean = 15.36, SD = 5.80) in the resilience group in Term 1 (V = 25.5, P = 0.87).

#### Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 14.55, SD = 7.54) and post wellbeing scores (mean = 15.36, SD = 5.80) in the resilience group in Term 1 (V = 25.5, P = 0.87).

Pre/post test scores in Occupational Therapy group

#### GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre anxiety scores (mean = 9.75, SD = 5.97) and post anxiety scores (mean = 7.75 SD = 5.75) in the occupational therapy group in Term 1 (V = 27.5, P = 0.2).

#### PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre depression scores (mean = 9.75, SD = 5.97) and post depression

scores (mean = 7.75 SD = 5.75) in the occupational therapy group in Term 1 (V = 27.5, P = 0.2).

#### Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 37.63, SD = 10.57) and post wellbeing scores (mean = 37.75 SD = 9.68) in the occupational therapy group in Term 1 (V = 16, P = 0.83).

#### Term 2

Pre/post test scores for GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was a significant difference between pre anxiety scores (mean = 11.16, SD = 5.6) and post anxiety scores (mean = 9.84, SD = 6.43) in Term 2 (V = 150.5, P = 0.03), effect size, r = -0.28.

#### Pre/post test scores for PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was a significant difference between pre depression scores (mean = 13.64 SD = 8.68) and post depression scores (mean = 11.24, SD = 7.64) in Term 2 (V = 230.5, P = 0.02), effect size, r = -0.29.

Pre/post test scores for Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 41.08 SD = 14.08) and post wellbeing scores (mean = 40.88, SD = 12.04) in Term 2 (V = 149.5, P = 1).

Pre/post test scores in Exercise group

#### GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was a significant difference between pre anxiety scores (mean = 12.87 SD = 5) and post anxiety scores (mean = 10.13, SD = 5.11) in the Term 2 exercise group (V = 28, P = 0.02), effect size r = -0.51.

#### PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre depression scores (mean = 16.63 SD = 8.86) and post depression scores (mean = 11.63, SD = 7.33) in the Term 2 exercise group (V = 25, P = 0.08).

#### Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 34.88, SD = 8.22) and post wellbeing scores (mean = 39.38, SD = 8.47) in the Term 2 exercise group (V = 6.5, P = 0.12).

Pre/post test scores in Resilience Training group

GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre anxiety scores (mean = 9.14 SD = 5.27) and post anxiety scores (mean = 7.71, SD = 6.92) in the Term 2 resilience training group (V = 16, P = 0.3).

#### PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre depression scores (mean = 7.33 SD = 5.27) and post depression scores (mean = 7.71, SD = 6.92) in the Term 2 resilience training group (V = 16, P = 0.3).

#### Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 43.29 SD = 11.26) and post wellbeing scores (mean = 41.86, SD = 13.12) in the Term 2 resilience training group (V = 19.5, P = 0.4).

#### Pre/post test scores in Occupational Therapy group

#### GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre anxiety scores (mean = 11.2 SD = 6.3) and post anxiety scores (mean = 11.1, SD = 7.25) in the Term 2 occupational therapy group (V = 10, P = 1).

#### PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre depression scores (mean = 13.8 SD = 9.27) and post depression scores (mean = 12.3, SD = 7.89) in the Term 2 occupational therapy group (V = 43, P = 0.12

#### Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference between pre wellbeing scores (mean = 44.5 SD = 18.46) and post wellbeing scores (mean = 41.4, SD = 14.6) in the Term 2 occupational therapy group (V = 30, P = 0.41).

#### Comparison of pre-test scores in Term 1 vs pre-test scores in Term 3

#### GAD-7

A paired samples Wilcoxon signed-ranked test showed that there was a significant difference (V = 166, P = 0.004, effect size, r = -0.41) between Term 1 anxiety scores (mean = 11.2 SD = 6.69) and Term 3 anxiety scores (mean = 7.35, SD = 6.84).

#### PHQ-9

A paired samples Wilcoxon signed-ranked test showed that there was a significant difference (V = 122, P = 0.03, effect size, r = -0.29) between Term 1 depression scores (mean = 13.45 SD = 7.62) and Term 3 depression scores (mean = 9.9, SD = 8.3).

#### Warwick-Edinburgh

A paired samples Wilcoxon signed-ranked test showed that there was no significant difference (V = 81.5, P = 0.39) between Term 1 wellbeing scores (mean = 37.3 SD = 14.85) and Term 3 wellbeing scores (mean = 41.25, SD = 15.6).

#### Severity of disorders

Table 8. General Anxiety Disorder - 7 scores for participants present in first Term 1 pre-test and Term 3 pre-test (n = 20).

	Term 1			Term 3	
Score	Category	Frequency	%	Frequency	%
0 to 4	Minimal	4	20	9	45
5 to 9	Mild	4	20	4	20
10 to 14	Moderate	5	25	3	15
>15	Severe	7	35	4	20

Table 9. Patient Healthcare Questionnaire - 9 scores for participants present in first Term 1 pretest and Term 3 pre-test (n = 20).

Score	Category	Term 1 Frequency	%	Term 3 Frequency	%
0 to 4	None	2	10	5	25
5 to 9	Mild	5	25	8	40
10 to 14	Moderate	6	30	1	5
15 to 19	Moderately Severe	2	10	3	15
20 to 27	Severe	5	25	3	15

#### **Cortisol Levels**

A one-way ANOVA was performed to compare the effect of sampling period on cortisol level. A one-way ANOVA revealed that there was not a statistically significant difference in cortisol level between any groups df = 277, F = 0.833, P = 0.527).

#### Mean Cortisol Level and Standard Deviation

Table 10. Female cortisol levels and standard deviation from six sampling period.Females

Sample	n	Mean	SD	% < 3.9 nmol/l	% > 3.9 nmol/l
1	28	4.4	2.9	57	43
2	25	4.4	2.5	52	58
3	28	5.3	5.5	57	43
4	26	5.4	4.3	50	50
5	18	5.9	3.5	33	67
6	21	5.9	3.7	29	71

Table 11. Male cortisol levels and standard deviation from six sampling period.

Males

Sample	n	Mean	SD	% < 3.5 nmol/l	% > 3.5 nmol/l
1	25	5.1	4.0	40	60
2	22	4.8	4.0	55	55
3	23	4.8	3.1	39	61
4	18	4.6	2.6	39	61
5	19	4.2	3.2	63	37
6	19	5.6	2.7	26	74

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