NURSING STUDENTS

The Physiological Changes Pre and Post Examination among Nursing Students

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ABSTRACT

Objective: **The aim of this study is to investigate the physiological changes involved in pre and post examination.**

Design: **The cross sectional study design was applied in this study.**

Material and Methods: **Sixty participants of first year nursing students from Universiti Sultan Zainal Abidin were participated. Physiological parameters such as serum cortisol, systolic and diastolic blood pressure, heart rate and respiration rate were assessed. The data were presented in descriptive data and analyzed using paired t-test.**

Results: **The mean (*SD*) score of exam anxiety was 54.42 (7.39). The mean (*SD*) difference of serum cortisol, respiration rate and heart rate for pre and post examination were statistically significant respectively; [364.50 (104.85) and 252.87 (82.68), $p < 0.001$], [20.08 (1.630) and 18.93 (1.99), $p < 0.001$] and [81.72 (12.38) and 18.93 (1.99), $p < 0.05$]. However, systolic and diastolic blood pressure was not significant.**

Conclusions: **In conclusion, exam can cause the physiological changes in serum cortisol, heart rate and respiration rate. Systolic and diastolic blood pressure showed not much variation.**

KEY WORDS

nursing students, physiological changes, exam

INTRODUCTION

Anxiety among students is universal. In general, anxiety is a normal reaction to stress and it can be a good thing that can help person to meet demands of life. Anxiety is a common emotional reaction to a threatening situation such as when individuals face problem at work, threat perceived before taking a test or difficulties confronted making an important decision (Yan 2006). Experiencing anxiety is normal reaction to the situations especially when the situation is demanding. The examination or exam anxiety is one of the situations that the students have to adapt with. Prolonged anxiety considered as a problem and can get worse over time. It has learnt from previous literature that increase level of anxiety can affect daily activities such as job performance, school work and interpersonal relationships and lead to anxiety disorder or illness (Nutt *et al*. 2008).

The exam anxiety refers to profound level of fear and apprehension about underperformance before, during and/or after examination. It is common in threatening situations particularly in the academic environment (Herzer *et al*. 2014). Exam anxiety can give an effect to the students' physical and psychology. It has been learnt that exam anxiety can influence students' physically, emotionally, cognitively and can negatively impact academic performance (Shapiro 2014). The physical or autonomic reactivity to the threatening situation leads to ill-disposed reactions one supporting study reveals the stress induced reactions are unpleasant such as perspiration, increased heart rate, headaches and gastrointestinal symptoms (Poorman *et al*. 2010). Another example study reports that the emotional components such as nervousness, uneasiness, fear, dreads and panics are common in facing exam anxiety (Poorman *et al*. 2010). To add on to this aspect, a study reveals that cognitive components on exam anxiety can induce impaired concentration, easy distractibility, difficulty recalling stored information and misreading exam information increases students' existing fears associated with failure (Poorman *et al*. 2010).

The psychological and physiology responses facing stress situations are a known fact. Studies have shown that anxiety can stimulate psychological and physiology responses that can be observed in cardiovascular and hypothalamic-pituitary-adrenal axis activity (Bardi *et al*. 2011; Conley and Lehman 2012). It has been learnt through the literature studies that stress and anxiety produce elevations of heart rate, blood pressure and also changes in breathing pattern (Oermann and Gaberson, 2009; Zhang *et al*. 2011). Furthermore, literature studies had indicated that blood pressure and changes in breathing patterns elated when person is under stress and feeling anxious (Bystritsky and Kronemyer 2014). The other study found that systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate showed significant increased compared to baseline before examination (Anandarajan *et al*. 2013).

Cortisol is released into the bloodstream when persons become anxious facing stressful situations (Hamer and Steptoe, 2012). Cortisol releases in bloodstream to support sympathetic nervous system in pro-

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Table 1. Socio-demographic data of first year nursing students (n = 60)

Variables	Frequencies (Percentage)	Mean (*SD*)
Age		17.93 (0.25)
Gender		
Female	51 (85)	
Male	9 (15)	
Race		
Malay	60 (100)	
Non- Malay	0	
Status of Residence		
Urban	16 (26.7)	
Rural	44(73.3)	

Table 2. First year nursing students' response to test anxiety inventory (n = 60)

Variables	Measurement, Mean (SD)
TAI Total	54.42 (7.39)
TAI Worry	22.28 (3.61)
TAI Emotionality	22.80 (3.54)

Table 3. Comparison of Serum Cortisol, Systolic and Diastolic Blood Pressure, Heart Rate and Respiration Rate pre and post exam (n = 60)

Physiology Parameters	Measurement Mean (SD)		Difference Mean (*SD*)	*p*-value
	Pre	Post		
Cortisol (nmol/L)	364.50 (104.85)	252.87 (82.68)	111.63 (84.74, 138.52)	0.001
SBP (mmHg)	116.55 (8.43)	114.1 (8.85)	2.45 (-0.07, 4.97)	0.56
DBP (mmHg)	71.62 (6.42)	69.78 (7.88)	1.83 (-0.71, 4.37)	0.154
Heart rate (beats/ min)	81.72 (12.38)	77.18 (13.57)	4.53 (0.52, 8.55)	0.027
Respiration rate (breath/ min)	20.08 (1.63	18.93 (1.99)	1.15 (0.53, 1.77)	0.001

ducing stress responses such as increased blood pressure, heart rate and respiration pressure (Lee *et al*. 2015). A previous study indicated that increased level of cortisol hormone over a long period of time can cause chronic stress and also pave a way to develop hypertension (Hamer and Steptoe, 2012). Furthermore, it also can cause depression and other cognitive impairments like disturbances in simple and complex memory (Kirschbaum *et al*. 1996). Thus, measuring cortisol levels among students when they face stress and developing awareness regarding stress and anxiety is among students is serviceable issue to help student population. One of the literatures reveals the fact that increased the levels of serum cortisol significantly higher among the students before examination period (Joshi *et al*. 2012). One of the supporting studies reveals the cortisol level was increased from relaxed state compared with stress state on the day of viva examination due to exam stress (Singh *et al*. 2012). One of the literatures had reported serum cortisol was significantly increased one or two days before the final examination (Myint *et al*. 2017). Literature supports that theorizing the fact that cortisol was released in response to a situation such as examination and there is higher level of serum cortisol was released before examination than after examination (Chinedum 2014). There are various physiological changes during exam anxiety that can also affect students achievements and also may lead to ill health (Shamsdin *et al*. 2010; Maduka *et al*. 2015).

The nursing students are exposed to a variety of tests such as theory exam, clinical assessment, performing nursing procedures with patients and also in Objective Structured Clinical Examination. Indeed, nursing training and nursing courses in the universities are more demanding and students experience more stress. Reviewed literature had supported this fact by theorising that nursing students experience higher levels of exam anxiety; in this study researchers have identified the effects of exam anxiety on nursing students found to be double the rate when compared to the students of general public school (Driscoll *et al*. 2009).

On observation of previous studies prevalence shown 52.3% of nursing students had experiencing severe exam anxiety (Gerwing *et al*. 2015). Exam anxiety levels were different between the years of study at the university or college. It has been suggested that anxiety disorder is more common for first year students. This can be explained by the fact that university is a totally new environment for students which therefore delay their adjustment to the academic, social, personal and lifestyle challenges (Mudhovozi 2012). After joining university, the students need to do a lot of adjustments in demanding situations of the university and they lack coping skills; as the year pass their coping skill increases. This fact has been observed in one of the previous research first year nursing students stress responses indicated difficulties in coping than that of their seniors in their adaption to the new environment (Aysan *et al*. 2001).

It has been learnt that difficulties in coping can lead to psychological difficulties such as cognitive difficulties and emotional disturbances with regard to university students it is more commonly observed in year one students. This datum has objectified in reviewed literature that reports first year students most commonly reveal psychological changes that correlate with students' adaption with new environment of university life (Cooke *et al*. 2006).

MATERIALS AND METHODS

The present study was conducted at School of Nursing Science, Faculty of Medicine, and Universiti Sultan Zainal Abidin, Terengganu, Malaysia. Out of 60 first year nursing students 2015-2016, male (n = 9) and female (n = 51) participated in this study. Ethical approval was obtained from Universiti Sultan Zainal Abidin Research Ethical Committee. The study was briefed and the written consent was obtained from participants prior to the study. Day before the exam three trained staff nurses specifically appointed to collect the serum cortisol of 60 participants.

Participants were asked to fast from 12 midnights until the time of the serum cortisol was drawn. The serum cortisol of the participants was taken from 8.30 am until 10.00 am from vein antecubital fossa right arm in the sitting position. Three millimetres of blood was collected into plain vacumtainer with gel and clot activator containers were used. The samples were analysed by medical laboratory technologist. Reagent that used for analysed is chemiluminescent immunoassay method.

Systolic and diastolic blood pressure and heart rate of the students was recorded using machine model NIHON KOHDEN OPV-1500K, Serial No. 09081 in sitting position. They were asked to rest for 10 minutes before monitoring. Furthermore, respiration rate was measured by counting it manually within one minute. Then, serum cortisol, systolic and diastolic blood pressure, heart rate and respiration rate were measured again after examination using same methods.

The participants also required to answer the questionnaire of Test Anxiety Inventory was developed by Spielberger et.al. (1980). The questionnaire consists of twenty items that was in English version. The average time to complete this questionnaire is 8 to 10 minutes. Test Anxiety Inventory has two major components which are worry and emotionality as measure and also gives the overall score. Worry relates

to the cognitive concerns about the effects of failure. Emotionality relates to the reactions of the autonomic nervous system that are evoked by evaluative stress. Total score is the results of all 20 items which measure both worry and emotionality. The minimum TAI Total score is 20 and the maximum is 80. Exam anxiety level score was categorized according to previous study (Dawood et al. 2016). Participants were distributed to four different levels of anxiety according to their test anxiety inventory scores: scores between 20 and 35 no anxiety, 36 to 50 mild anxieties, 51 to 65 moderate anxiety and 66 to 80 severe anxieties. The reliability analysis of Test Anxiety Inventory this study was determined by calculating Cronbach's Alpha is 0.917. The reliability values of Cronbach's Alpha for subscales 0.839 - worry and 0.869 - emotionality.

The data collected were analysed using SPSS statistical software package version 22. Demographic data were presented using descriptive statistics in the form of frequencies and percentages. The variations in serum cortisol, systolic and diastolic blood pressure, heart rate and respiration pre and post examinations are compared using paired t-test. Significant values were recorded at a level where of $p < 0.05$ with 95% confidence interval (CI).

RESULTS

Table 1 shows the socio-demographic data of the participants. All participants are of age 17.93 (0.25) years. Out of 60 students, 15 % were males and 85 % were females. All students are from Malay background. The statuses of residence among participants are 73.3% is rural and urban is 26.7%.

Table 2 presents the mean score of exam anxiety of first year nursing students. The total of mean score is 54.42 (7.39). The majority of nursing students had moderate exam anxiety. The mean score of the elements worry was 22.28 (3.61) and emotionality was 22.80 (3.54) in the Test Anxiety Inventory.

Table 3 shows the difference between mean (*SD*) of serum cortisol for pre and post exam started was statistically significant [364.50 (104.85) versus 252.87 (82.68), $p < 0.001$]. Mean (*SD*) of respiration rate for pre and post exam statistically significant [20.08 (1.63) versus 18.93 (1.99), $p < 0.001$]. Mean (*SD*) of heart rate 81.72 (12.38) pre and post 18.93 (1.99) exam, statistically significant $p < 0.05$. However, systolic and diastolic blood pressure reduce but not significant.

DISCUSSION

Majority of participants had moderate exam anxiety. These results are much allied to the study done by Dawood *et al*. (2011) had moderate exam anxiety. The main purpose of present study was to investigate the physiological changes of serum cortisol, systolic and diastolic blood pressure, heart rate and respiration rate one day pre and post exam among first year nursing students.

The current study had found that serum cortisol level was increased significantly one day before exam. This fact has been further supported by one of the previous research results that was much similar to the current study that had indicated one or two days before examination is more stressful and that causes rise in serum cortisol level in these exam going students; although exam anxiety can induce stress in different levels among students prior to examination (Myint *et al*. 2017).

The heart rate and respiration rate pre and post exam were statistically significant. This also supported by previous literature study revealed that stress and anxiety produce elevations of heart rate (Lucini *et al*. 2002). Further in the reviewed fact it had also observed that exam anxiety influences respiratory system and impact of breathing patterns with increase respiratory rate has been actualized (Bystritsky and Kronemyer, 2014).

The current research study resulted in no significance in systolic and diastolic blood pressure among the studied sample. However, systolic and diastolic blood pressure and heart rate slightly increased pre and one day of exam though not significant. Thus it has been learnt that there is association between physiological changes and anxiety when during stress facing situations. However, the previous literature studies reveal that stress and anxiety produce elevations of heart rate, blood pressure and also changes in breathing pattern. Physiological changes in response to mental stress influence of cardiovascular reactivity that activates sympathetic nervous system (Lucini *et al*. 2002).

The results of the current study found that the exam anxiety in year one students was more obvious than the senior students. This fact has been further supported by previous literature that had speculated that students are new in first year and they experience higher degrees of exam anxiety has been proved by comparing the results of undergraduate students with post graduate students (Duraku *et al*. 2016). This can be explained by the fact that the university is totally a new environment for students which therefore delay their adjustment to the academic, social, personal and lifestyle challenges (Mudhovozi 2012). According to Cooke *et al*. (2006) that first year students most commonly reveal psychological changes that correlate with students need to do to adapt to the new environment of university life. In addition, exam anxiety can be detrimental to the successful pursuit of career paths and aspirations, particularly in stringent programs such as nursing, where students must perform well on all assessments (Khalaila 2014). The students are not exposed to the techniques of test and exam. Educators should expose the students about the exam format and techniques. These results are in accordance with other research findings, which have revealed that the most common psychological concerns have been identified in students throughout their first years of study. It has been suggested that anxiety disorder was more common for first year students (Cooke *et al*. 2006).

CONCLUSION

The study concludes the majority where under the stress and anxiety prior to examination. This study has learned anxiety during exam had produced the elevation of serum cortisol, heart rate and respiration rate and also found that systolic and diastolic blood pressure showed not much variation. The study suggests that, introducing strategies like mind-body exercise, mindfulness during their preparatory period and with the guidance of teachers or mentors may help the student to overcome the exam anxiety and enrich their performance.

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