

**RESEARCH ARTICLE**

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**EFFECT OF ACADEMIC EXAMINATION STRESS ON SOME PHYSIOLOGICAL PARAMETERS OF MEDICAL TECHNOLOGY STUDENTS****ABSTRACT:**

Chronic stressors may induce maladaptive responses leading to psychiatric diseases, such as anxiety and major depression. They alter the normal body homeostasis and hence, lead to the development of various human pathologies, which might involve alterations in the antioxidant defense system. Several reports have proposed that the concentration of secretory immunoglobulin A (S-IgA) in saliva is an indicator of psychological stress. Subjects were undergraduate medical technology students in second and third year attending their midyear exams at King Abdulaziz University. They include twenty-two male students (age range 20-23 years). The blood samples were taken just before a difficult exam (stressful condition). For comparison another sample was taken for the same students but several weeks after examination (natural post condition). Total protein TP, albumin ALB, globulin GLB, albumin to globulin ratio, immunoglobulin G, A, and M in the sera of in adult male students were measured. The results recorded that total protein (TP), albumin (ALB) and immunoglobulin G, A, and M (Ig G, A, and M) were significantly higher examination stress students. The study showed that midyear examinations stimulated adrenergic activity, which in the long run depressed immune function for students with a strong power motive which are most aroused adrenergically by the examination.

**KEY WORDS:**

Stress- Total protein -albumin - globulin -albumin to globulin ratio-Immunoglobulins G, A, M.

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**E-mail:** halnahari7@gmail.com**ARTICLE CODE:** 54.01.09**INTRODUCTION:**

The stress alters biological processes and chronic stressors may induce maladaptive responses leading to psychiatric diseases, such as anxiety and major depression (Kozicz *et al.* 2008). It alters the normal body homeostasis and, hence, leads to the development of various human pathologies. These might involve alterations in the antioxidant defense system (Kaushik and Kaur, 2003; Gonçalves *et al.*, 2008). Several reports have proposed that the concentration of secretory immunoglobulin A (S-IgA) in saliva is an indicator of psychological stress (Otsuki *et al.*, 2004).

McClelland *et al.* (1985) found that stress of an examination was associated with an increase in salivary immunoglobulin A (S-IgA), with an increase in norepinephrine (NE) concentrations in the saliva. Janssen *et al.* (1989) reported that the training program decreased plasma albumin concentration while total protein did not change. Mouton *et al.* (1989) suggested that a weak negative correlation between the level of salivary immunoglobulin A (IgA) and the stress rating was observed only at the final examinations and the assaying immunoglobulin A in saliva to measure stress may not be as useful in psychophysiological research as expected. Maes *et al.* (1995) reported that major depressed subjects showed significantly lower total serum protein and albumin concentrations and a higher percentage of the alpha 1 globulin fraction than normal controls. Major depressed subjects had significantly higher and lower percentages, respectively of alpha 2 and gamma globulin fractions than normal controls. Basal plasma cortisol values were significantly and positively related to serum alpha 2 globulin. Muldoon *et al.* (1995) mentioned that short-term psychological stress showed significant increases in blood pressure and total protein concentration. Bosch *et al.* (1996) investigated the effect of psychological stress (academic examination) and the results showed a significant increase of salivary total protein concentration.

Van Hunsel *et al.* (1996) found that the levels of serum albumin, gamma- and beta-globulin were significantly lower in major depression than in normal controls. The

percentages of the alpha 1- and alpha 2-globulin fractions were significantly higher in major depressed subjects than in normal controls. There were no significant effects of subchronic treatment with antidepressants on the percentage of the major electrophoretically separated protein fractions, i.e. alpha 1-, alpha 2- and beta-globulin. There was a significant increase in percentage of serumgamma-globulin fraction after subchronic treatment with antidepressants.

Maes *et al.* (1997) reported that academic examination stress induced significant increases in serum IgA, IgG, IgM. The stress-induced changes in serum IgA, IgM, and IgG were normalized a few weeks after the stress condition. The author suggested that psychological stress is accompanied by an altered secretion of serum Igs, complement factors and some acute phase proteins. Van Hunsel *et al.* (1998) demonstrated that significant alterations in total serum protein patterns obtained using serum protein electrophoresis and serum proteins have been recorded in patients with major depression and in subjects submitted to a combination of psychological and physical stress. They found that academic examination stress increased total serum protein. Academic examination stress reduces the percentage of albumin in the stress-reactors. Fallon *et al.* (1999) concluded that in ultramarathon running a 1600 km foot race before, after 4 and 11 days of running caused significant increases in total serum protein and albumin.

Hansen *et al.* (2003) demonstrated that participants having repetitive work had higher concentrations of IgA compared to participants having non-repetitive work. Bosch *et al.* (2004) found that academic exams decrease salivary S-IgA. Petibois and Délérès (2003) reported that a physical stress induced a raise in protein and albumin concentrations. Ng *et al.* (2004) studied the relationship between students perceived stress levels and salivary IgA. They found that students had decrease in IgA secretion rates. An inverse correlation was noted between perceived stress scale and log IgA secretion rates. Academic work was also significantly inversely correlated with salivary IgA. Salivary IgA secretion rate correlated inversely with self perceived stress.

Otsuki *et al.* (2004) reported that academic examinations stress increased the saliva -IgA level on the day before academic examinations and during them and they were lower on the days between these examinations. In addition, daily variations in the S-IgA concentration seemed, sometimes to be disturbed by other academic stress. Therefore it may be possible to use this saliva component to monitor psychological stress in

students and workers. Segal *et al.* (2006) concluded that acute stress did not cause changes in the lymphocyte subpopulations, phagocytic activity of neutrophils, monocytes, and serum immunoglobulins in students. Moreira *et al.* (2008) reported the effects of physical training programme (stress) on children total immunoglobulin E. They concluded that it was decreased in the exercise group.

## MATERIAL AND METHODS:

Subjects were undergraduate medical technology students in second and third year attending their midyear exams at King Abdulaziz University. Twenty two male students were used on age range 20-23 years. The blood samples were taken just before a cited exam (stressful condition). For comparison another sample was taken for the same student but several weeks after examination (natural post condition). Total protein (TP), albumin (ALB), globulin (GLB), albumin to globulin ratio, immunoglobulin G, A, and M using the Behring Nephelometer 100 Analyzer (Behringwerke AG, Marburg, Germany) in adult male students were measured. The sample was assayed using Boehringer Mannheim system (Hitachi, 917) in clinical chemistry lab in King Abdulaziz University for all the analyte.

## RESULTS AND DISCUSSION:

From the table 1 and figure 1 the mean total protein at rest (out of stress) was ( $78.83 \pm 0.91$  g/l) and at stress situation (just few minutes before the exam) the mean total protein was ( $80.42 \pm 0.96$  g/l) which are significantly higher due to examination stress.

From the table 1 and figure 2, the albumin (35-50 g/l) at rest (out of stress) showed a mean of  $47.50 \pm 0.34$  g/l. At stress situation (just few minutes before the exam) albumin showed a  $48.46 \pm 0.41$  g/l albumin which is significantly higher due to examination stress.

From the table 1 and figure 3 the mean globulin normally ranges 20-35 g/l level at rest (out of stress) was ( $31.33 \pm 0.74$  g/l), and at stress situation (just few minutes before the exam) albumin was ( $31.95 \pm 0.67$  g/l) which was significantly higher than that of the control. Globulin was not significantly changed due to examination stress.

From table 1 and figure 4, the albumin to the globulin ratio at rest (out of stress) was  $1.53 \pm 0.03$ , and at stress situation (just few minutes before the exam), it was  $1.52 \pm 0.03$ . This ratio was not significantly changed due to examination stress.

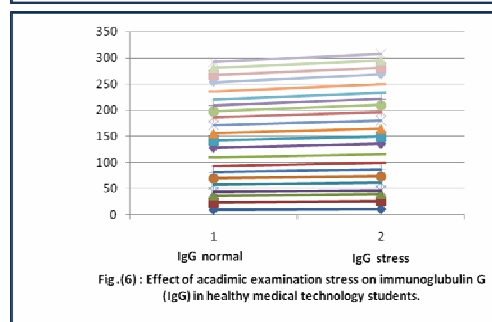
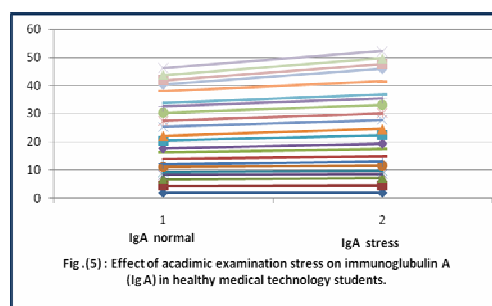
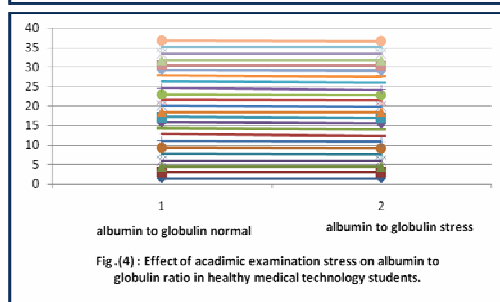
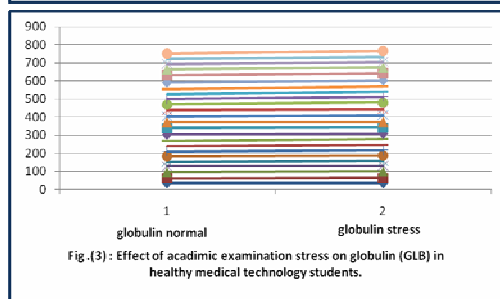
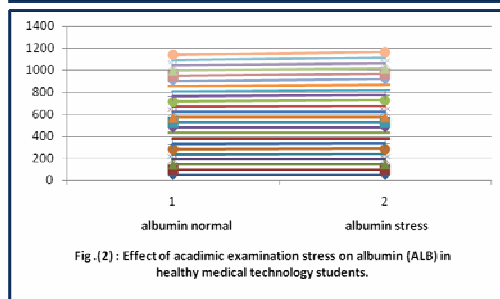
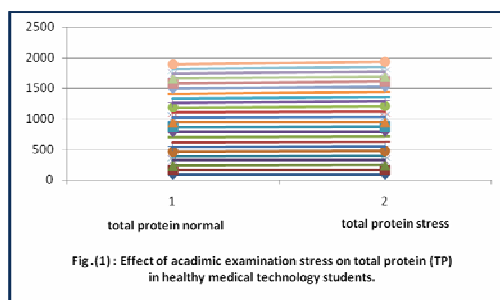
From table 1 and figures 5-7, the immunoglobulins ranges; G (5.4-16.1 g/l), A (0.8-2.8 g/l), M (0.5-1.9 g/l) at rest (out of stress) recorded  $13.27 \pm 0.54$  g/l,  $2.10 \pm 0.15$

g/l, and  $1.06 \pm 0.09$ . At stress situation (just few minutes before the exam) immunoglobulins G, A, and M levels were  $13.97 \pm 0.57$ ,  $2.37 \pm 0.18$ , and  $1.22 \pm 0.09$ , respectively. It is clear that immunoglobulin G, A, M levels were significantly higher due to examination stress.

Table 1. Effect of academic examination stress in healthy medical technology students

	Normal Mean $\pm$ S.E	Stress Mean $\pm$ S.E
<b>Total Protein</b>	78.83 $\pm$ 0.91	80.42 $\pm$ 0.96*
<b>Albumin</b>	47.50 $\pm$ 0.34	48.46 $\pm$ 0.41**
<b>Globulin</b>	31.33 $\pm$ 0.74	31.95 $\pm$ 0.67
<b>Albumin To Globulin Ratio</b>	1.53 $\pm$ 0.03	1.52 $\pm$ 0.03
<b>Immunoglobulin G</b>	13.27 $\pm$ 0.54	13.97 $\pm$ 0.57***
<b>Immunoglobulin A</b>	2.10 $\pm$ 0.15	2.37 $\pm$ 0.18**
<b>Immunoglobulin M</b>	1.06 $\pm$ 0.09	1.22 $\pm$ 0.09**

The mean  $\pm$  S.E. P < 0.05 \*, p < 0.01\*\*, p < 0.001\*\*\*.



The results recorded in the present study show that academic examination stress significantly increased serum total protein. This is in agreement with Van Hunsel *et al.* (1998). They found that academic examination stress increased total serum protein. The present results are in agreement with Fallon *et al.* (1999) who reported that serum albumin was significantly above the pre-race level on day 4 and at the end of the race. Increases in serum albumin have been described after marathon running (15, 26, 100, and 160 km runs). Total protein increased significantly by day 4, but was not different to baseline values on day 11 and at the conclusion of the event. Plasma proteins are thought to play an important role in maintaining plasma volume during exercise. Increases in plasma volume are consistent with maintenance of intravascular albumin and total protein during the race. Calculations indicate that a net influx of proteins into the intravascular space occurs during the event and this had increased considerably after the run.

Boch *et al.* (1996) reported an increase in serum total-protein concentration during stress and suggested that this increase is caused by an increased sympathetic tone and catecholamine output. This assertion is supported by several independent lines of evidence. Higher catecholamine levels are generally related to a decrease in s-IgA production. However, the increase in total protein observed was correlated with an increase of s-IgA levels. This suggests that these results cannot be explained by an assumed increase in catecholamine levels only. Therefore, other humoral factors may also be involved. Bosch *et al.* (2003) found that sympathetic activation is the main stimulus for glandular protein secretion; these sympathetic effects are strongly augmented

by concurrent parasympathetic activity. Thus, the effects of a moderate sympathetic drive during the passive stressor were likely enhanced by a concurrent parasympathetic coactivation. Correlation analyses showed several associations between secretory reactivity and reactivity of cardiovascular measures that may be interpreted as reflecting sympathetic nervous system activation of the secretory glands. This interpretation may be consistent with the fact that protein secretion is largely under sympathetic control and evoked by  $\beta$ -adrenergic stimulation in particular (Garrett, 1987). Correlation analyses further indicated that enhanced autonomic and cardiovascular responsiveness during acute stress are also related to a prolonged activation of this type of immunity. Various significant correlations were observed particularly within the active coping condition between cardiovascular reactivity and elevated protein levels after the stressor. These findings suggest that the effects of everyday stressors on secretory immunity may endure well beyond the actual stressful encounter depending on autonomic and cardiovascular responsiveness to the stressor. Petibois and Dél  ris (2003) reported that a physical stress induces a raise in protein and albumin concentrations and these concerts with the present results.

The results show that academic examination stress caused significant

increase in immunoglobulins G, A, and M. These results are in agreement with Segal *et al.* (2006) and Tuchscherer *et al.* (2009) who concluded that acute stress cause alterations in immune function. Webster Marketon and Glaser (2008) found that examination stress causes significant increases in IgG, IgM, and IgA. Maes (1996) reported that the increase in immunoglobulin G, A, and M is due to the body's natural alert system, which is triggered by increase in adrenaline levels. Such an increase may also prepare the body's defense system to combat any possible foreign body such as bacteria, which may attack under stressful circumstances. McClelland *et al.* (1985) found that stress of an examination was associated with an increase in salivary immunoglobulin A (S-IgA), with an increase in norepinephrine (NE) concentrations in the saliva. The increase in NE was greater for those for whom power was greater than in affiliation rather than for those whose the reverse was true. Greater increases in and levels of NE at and after examinations were associated with greater subsequent drops in S-IgA, which reached below baseline levels for those whose power was stronger. The examination stimulated adrenergic activity, which in the long run depresses immune function for those with a strong power motive who had been most aroused adrenergically by the examination.

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## تأثير التوتر الناتج عن الاختبار على بعض القياسات الفسيولوجية في طلاب التقنية الطبية حليمة النهاري

كلية التربية للبنات الأقسام العلمية جامعة الملك عبد العزيز ، قسم علم الحيوان

الاختبار بعدة اسابيع لنفس الفرد (الحالة الطبيعية) وأظهرت النتائج حدوث زيادة معنوية في مستوى البروتين الكلي والألبومين و الأمينوجلوبولين G,A,M في حالة التعرض لتوتر الاختبار . وقد وجد أن التوتر الناتج من الاجهاد يؤدي إلى تحفيز النشاط الأدرينالي والذي يؤدي على المدى الطويل لتنشيط النشاط المناعي.

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يؤدي التوتر المزمن إلى الأمراض النفسية مثل القلق والاكتئاب ويغير التوازن الطبيعي وبالتالي يؤدي إلى تطور لمختلف الأمراض التي قد تنطوي على تغييرات في نظام مضادات الأكسدة وقد اقترحت عدة تقارير أن كمية افراز اللعاب للأمينوجلوبولين A هو مؤشر للضغط النفسية وتم اجراء هذا البحث على 22 طالب من الذكور للسنة الثانية والثالثة في مرحلة البكالوريوس في قسم التقنية الطبية (جامعة الملك عبد العزيز) والتي تتراوح أعمارهم من 20-23 سنة في فترة امتحانات منتصف العام وقد تم قياس مستوى كلا من البروتين الكلي والألبومين والجلوبولين ونسبة الألبومين للجلوبولين والأمينوجلوبولين G,A,M قبل أداء الاختبار (حالة توتر) وبعد أداء