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Correspondence concerning this article should be addressed to Dr. Norhayati Mohd Noor; Department of Family Medicine, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia / Tel: 013-9388 416 / Fax. No.: 09-7642172 / Email: hayati@kk.usm.my

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Stress and salivary biomarker among assistant medical officers in Ministry of Health (MOH) hospitals in Kelantan and Terengganu, Malaysia

Norhayati Mohd Noor (1) *, Mohd Azman Yacob (2), Aziah Daud (2), Wan Mohd Zahiruddin Wan Mohammad (2)

1) Department of Family Medicine , School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kelantan, Malaysia

2) Department of Community Medicine, School of Medical Sciences, Universiti Sains Malaysia, Kelantan, Malaysia

* *Corresponding author*

ABSTRACT

Background: Assistant medical officers are the first liners in handling patient in health clinics, hospital accident and emergency units and stress is one of the factors that could affect their quality of work and patient relationship.

Aims and Objectives: To determine the prevalence of stress and its correlation with salivary biomarker among assistant medical officers in Ministry of Health hospitals.

Methods: A cross-sectional study was conducted on 194 randomly selected assistant medical officers in all Ministry of Health hospitals. The questionnaire was a self-administered questionnaire on socio-demographic data, Depression, Anxiety and Stress Scale-42 (DASS-42) and Job Content Questionnaires (JCQ). Salivary cortisol level was measured using Expanded Range High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics LLC, State College, PA, USA).

Results: The prevalence of stress was 13.7% (95% CI: 8.61, 18.79). There was no significant (P=0.393) correlation between salivary cortisol and stress score. The observed Spearman correlation was 0.066 suggest no correlation. Salivary cortisol was significantly higher (P=0.033) among stressed compared to non-stressed assistant medical officers (0.78 versus 0.67 µg/dL respectively)

Conclusions: There was no correlation between salivary cortisol and stress score. However, salivary cortisol was significantly higher among stressed compared to non-stressed assistant medical officers in Ministry of Health hospitals.

Keywords: Stress, salivary cortisol, JCQ, DASS

Introduction

Healthcare staff can suffer from job stress as a result of organizational factors and an imbalance of job demands, skills and social support at work place[1]. Many studies had shown that healthcare staff has high prevalence of stress[2-5]. Increased stress has been associated with heavy workload and its effect of home life[3], pressure of work, complaints from patients and relatives, risk of violence, poor management style[4], inadequate resources, insufficient training, lack of control over work, low involvement in decision-making [5], low job satisfaction and harassment[2].

Several studies had shown job stress has correlation with several salivary biomarkers[6,7] such as salivary cortisol, salivary alpha amylase and chromogranin A. Activation of the hypothalamic–pituitary–adrenal (HPA) axis which measured by salivary cortisol reflects the chronic stress where as activation of the sympatho–adreno–medullary (SAM) system, which measured by salivary alpha-amylase and chromogranin A reflects acute stress exposure[8]. The use of saliva as a diagnostic fluid has many advantages. It is non-invasive compared with phlebotomy, does not have the risk of needle-stick injuries and able to minimize stress compared with other invasive procedures such as phlebotomy. This will also alleviate the stress from fear of needles during collection, which may bias the results[9]. Process for obtaining saliva is simple and easy, self-collection after instruction is possible and there is no need for special trained staff for its collection [10].

Assistant medical officers are the first liners in handling patient in health clinics, hospital accident and emergency units, and thus, stress is one of the factors that could affect their quality of work and patient relationship. Hence, the objectives of this study were to determine the prevalence of stress, to determine the relationship between salivary cortisol and stress and to compare the salivary cortisol between stressed and non-stressed assistant medical officers in Ministry of Health hospitals.

Methods

Study design

A cross-sectional study was conducted as it was the best design to determine the relationship of the variables of interest at one particular time. Data collection was conducted from July till December 2008 on assistant medical officers in all Ministry of Health hospitals.

Data collection procedure

A list of assistant medical officers working in all departments in Ministry of Health hospitals were obtained from State Health Department. Assistant medical officers in-charge for each department were contacted via phone to obtain appropriate particulars with regards to the selection of subjects. All assistant medical officers who were randomly selected were recruited for this study. During visits to the hospitals, the researcher obtained permission from the hospital directors and briefed the assistant medical officers regarding the survey. Confidentiality of the information was assured. Self-administered questionnaire were distributed. Assistant medical officers attending both shift and non-shift work were included in this study. Those who were on prolonged oral steroid or diagnosed to have any psychiatrics illnesses or chronic medical illnesses were excluded. For salivary cortisol level, information and steps on the collection methods were explained. Morning saliva was

collected between 8.00 am and 10.00 am from each assistant medical officer using Salimetrics Oral Swab (Salimetrics LLC, State College, PA, USA) by keeping it under the tongue for one to two minutes. The specimens were sent in a cool box with ice packs at 4 to 8^{o}C to Immunology Laboratory for storage at -20^{o}C before underwent cortisol immunoassay test using Expanded Range High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics LLC, State College, PA, USA).

Sample size was calculated based on single proportion formula[11] using proportion of stress 34.0% among secondary school teachers in Kota Bharu[12]. Taking the precision of 0.07 at 95% confidence interval, the minimum required sample was 176. The precision was set at 0.07 after considering its clinical importance and feasibility of the study. After considering the non-response rate of 10%, the sample size calculated was 194.

Research tools

Data collection was conducted using questionnaire which consisted of three parts socio-demographic data and Depression, Anxiety and Stress Scale (DASS-42). The DASS-42 is a set of three self-reported scales designed to measure the negative emotional states of depression, anxiety and stress. Each of the three DASS scales contains 14 items, divided into subscales of 2-5 items with similar content. The 42 DASS items are presented to subjects in random order and scored on a Likert scale of 0 to 3 (0=Did not apply to me at all, 1=Applied to me to some degree, or some of the time, 2=Applied to me to a considerable degree, or a good part of the time, and 3=Applied to me very much, or most of the time) to rate the extent to which they have experienced each state over the past week [13]. However, in this study, only Stress Scale of DASS-42 questionnaire will be used. Stress scale consists of items 1, 6, 8, 11, 12, 14, 18, 22, 27, 29, 32, 33, 35, 39. Scores for DASS-Stress were calculated by summing the scores for relevant items and converting these scores into percentile scores which were divided into five levels of severity (normal=0-14, mild=15–18, moderate=19–25, severe=26–33, extremely severe=34+)[13]. In this study, subjects who scored in the 'normal' range on stress were referred as non-stressed, while subjects who scored in the 'mild' to 'extremely severe' ranges were referred to as stressed[14].

Expanded Range High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics LLC, State College, PA, USA) was used for salivary cortisol quantitative assessment. It is a competitive immunoassay kit specifically designed for the quantitative measurement of salivary cortisol. It is not intended for use with serum/plasma or for diagnostic use. It is intended only for research use with saliva[15].

Statistical analysis

Data was entered using SPSS 12.0.1 (SPSS Inc, Chicago IL, USA) and analyzed using STATA 8.0 (StataCorp, College Station, TX, USA) for analyses. Descriptive analysis was done to obtain the frequency and percentage. Correlation analysis was done to determine the relationship between salivary cortisol and stress score. Normal distribution of Y in any point of X and equal variance of Y in any point of X assumptions were met if the scatter plot between salivary cortisol and stress score shows an "elliptical shape". If the assumptions were met, proceed with Pearson correlation analysis. If the assumptions were not met, proceed with Spearman P correlation analysis. Correlation coefficient (r) >0.75 suggests very good to perfect correlation, 0.50 -0.75 suggests moderate to good correlation,

0.25-0.50 suggests fair correlation, and <0.25 suggests little or no correlation. Independent t test analysis was done to compare the salivary cortisol between stressed and non-stressed assistant medical officers. *P* value <0.05 was used as a cut-off for statistical significance.

Results

There were 194 assistant medical officers in the government hospitals this study. However, 175 have responded making a response rate of 90.7%. Those who did not respond have not completed the questionnaire. Posthoc power calculation using linear regression was 91.4%.

There were 24 respondents classified as stressed and hence, the prevalence of stress among assistant medical officers was 13.7% (95% CI: 8.61, 18.79). The sub-analysis of percentages of stress according to the DASS severity ratings were shown in Table 1. Table 2 showed the socio-demographic characteristics and Table 3 showed the job characteristics of 24 stressed and 151 non-stressed assistant medical officers.

Scatter plot between salivary cortisol and stress score indicated that normal distribution of Y in any point of X and equal variance of Y in any point of X assumptions were not met. Hence, Spearman P correlation analysis was done. There was no significant (*P*=0.393) correlation between salivary cortisol and stress score. The observed Spearman P correlation was 0.066 which suggest no correlation. Salivary cortisol was significantly higher (*P*=0.033) among stressed compared to non-stressed assistant medical officers (0.78 versus 0.67 µg/dL respectively) (Table 4). The salivary costisol of stressed assistant medical officers was 0.11 µg/dL (95% CI: 0.218, 0.01) higher compared to non-stressed assistant medical officers.

Discussion

The prevalence of stress among assistant medical officers was 13.7%. The prevalence in the current study was lower compared to study done by Azlihanis (2007) using similar research tools. In her study, she found that the prevalence of stress among secondary school teachers in Kota Bharu, Kelantan was 33.9%. The prevalence of stress was also lower compared to study done by Harmy (2001), among other group of health care workers. In his study, he found the prevalence of job strain was 23.7% among nurses in government teaching hospital in Kelantan[16]. Though they are different subgroups of health care workers, they have the similarity in providing care to patients.

One study done on occupational stress, found that women appear to experience significantly higher level of job stress compared to men[17]. This was supported by Aziah *et al.* (2004) where the proportion of high job strain among male was lower compared to female laboratory technicians in MOH and USM (36.8% versus 63.2%, 35.7% versus 64.3% respectively)[18]. In Taiwan, 17.2% of nurses working in psychiatric institutions had self-perceived stress[19].

In Japan for example, male occupational physician had 0.37 times at odds (95%CI: 0.19, 0.70) of job stress compared to females[20]. This was supported by another study which found that male general practitioners had less job stress compared to females[3]. Stress was positively correlated with health problems for both women and men, but perceived stress were strongly correlated with women[21]. Hence, being a male, was one of the probable reasons for low prevalence of stress in this study.

However, Michael *et al.* (2009) found that sex differences in stress do not stem from a

genetic or biological difference, but from social and psychological differences which were associated with age, marital status and education[17]. Hence, it was the gender differences, which was a social construct that may have a more significant effect on stress compared to sex, which was biologically determined.

Another possible reason for the lower prevalence of stress was age. Although not significant, the average age for stressed assistant medical officers was younger compared to those non-stressed (35.0 years versus 37.8 years). This was supported by a study done in Japan where younger (20 to 39 years) occupational physicians had more stress compared to those aged more than 59 years. As age had a significant positive correlation with tenure or duration of employment, this reason was considered reasonable, as younger occupational physicians may lacked of practical skills which usually acquired with tenure [20].

The differences in the prevalence were not directly comparable because of different periods of time, methods of data collection and reference values. DASS was used to assess stress based on score scale but JCQ was used to assess job strain based on the median cut-off of the JCQ value [22].

There was no significant correlation between salivary cortisol and stress score. The observed Spearman correlation was 0.066 suggest of no correlation. The non-significant finding in the correlation was probably due to the low prevalence of stress among assistant medical officers. However, salivary cortisol was significantly higher (P=0.033) among stressed compared to non-stressed assistant medical officers (0.78 versus 0.67 µg/dL respectively). This was supported by Kirschbaum *et al.* (1995) where he found high cortisol response among healthy men who were exposed to repeated psychological stress. Elevated level of salivary cortisol among stressed assistant medical officers was probably due to their commitment in providing best care to the patients, as care giving behaviour may reflects the caregivers' cortisol levels [7].

In contrast, study done among nurses in emergency department in Singapore revealed that although they perceived their job was stressful compared to general ward nurses, their salivary cortisol was lowered compared to latter [23]. Study on self-perceived stress among patients attending breast cancer clinic too, unable to show correlation between stress and salivary cortisol [24].

Study done among middle aged men and women on workdays and weekends to determine the association between cigarette smoking and salivary cortisol found that cigarette smoking was associated with elevated cortisol level which was probably due to nicotine exposure [25]. In the current study, smoking was not controlled in determining the relationship between salivary cortisol and stress score. This is because, the assumptions for linear regression between the two variables were not met and, hence, the linear regression analysis between salivary cortisol and stress score cannot be done.

One of the factors that could affect the level of salivary cortisol was the diurnal variation of salivary cortisol. Physiologically, salivary cortisol secretion, similar to serum cortisol, displays marked circadian rhythm, characterised by low levels towards evening, steady increase during early morning and peaking just after awakening, levels then decline rapidly[9]. However if a person was stressed, adrenocorticotropic hormone (ACTH) and the cortisol secretion will be elevated regardless of the time of day. Stress overrides the circadian rhythm as well as the negative feedback mechanism [26].

Decreased daytime cortisol decline was associated with higher level of stress in male. The decreased daytime cortisol decline indicates the hypathalamo-pituitary-adrenal (HPA) axis negative feedback loop was disrupted in chronic stress, thus resulting in elevated cortisol level[27]. It implies that there was absent of diurnal variation. Another study done among white collar workers to determine the relationship between long term job stress and morning and evening salivary cortisol revealed that there was a sharp drop of morning salivary from weekdays to weekends. A possible explanation for the failed findings may be that increased morning cortisol reactivity was influenced more by acute rather than by chronic stress exposure [28]. Hence, a relationship between acute stress and salivary cortisol level may give a more valid result.

Limitations

The main limitation was the cross-sectional design of this study. The validity of study results was compromised by factors such as the single time point measurements and difficulties in ascertaining the causal relationship. Studies permitting temporal sequence such as cohort or case-control studies would be useful. However, it would be beyond the resources available for this study. Secondly, the validity of the data related to the variables cannot be determined because the information obtained was solely through self-reported measure. As defined in the literature, self-reported data cannot be viewed as objective[29]. Thirdly, the sample consisted of a specific group of employees, and therefore the generalizability of the results beyond the study population should be cautiously done. However, the usefulness of recruiting specific groups may expand our understanding of the stress process for that particular group of workers. Hence, the organization would be able to make use of the results for further action in prevention of stress among their workers.

Recommendation

Joint workplace initiatives should be taken by both employees and employers (the organization) in accordance to International Labour Organization (ILO) convention concerning safety and health and working environment[30]. Designing jobs to give assistant medical officers more decision-making authority and skill discretion are indicated to reduce stressor, hence decrease their stress. Practising team-oriented approaches will also contribute to employee well-being among health care workers. Further study to determine relationship between acute stress and salivary cortisol level may give a more valid explanation regarding these relationships.

Conclusions

The prevalence of stress among assistant medical officer was 13.7%. Salivary cortisol, the biomarkers of stress was significantly higher among stressed compared to non-stressed assistant medical officers. However, there was no correlation between salivary cortisol and stress score which was probably due to the low prevalence of stress among assistant medical officers in Ministry of Health hospitals in Kelantan and Terengganu.

Competing Interest

None of the authors has any conflict of interest by publishing this article.

Authors' Contribution

All the authors have contributed significantly in the supervision, analysis, drafting and revising the article to its completion. They take full responsibility for its content and have read the manuscript fully.

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Ethical Policy

The research protocol was approved by the Research and Ethical Committee Universiti Sains Malaysia [USMKK/PPP/JePeM[202.4.(2.5)]] and Ministry of Health Malaysia [bil.(38)dlm.JKN.TR.7/23/2Pt.6] and informed consent was obtained from each subject prior to inclusion in the study.

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Table 1: Percentages of stress according to the DASS severity ratings

Stress severity ratings	n	(%)
Normal	151	(86.3)
Mild	13	(7.4)
Moderate	7	(4.0)
Severe	4	(2.3)
Extremely severe	0	(0.0)
Total	175	(100.0)

Table 2: Socio-demographic characteristics of 24 stressed and 151 non-stressed assistant medical officers

Variables	Stressed			Non-stressed			*P* value
	mean	(SD [a])	n (%)	mean	(SD [a])	n (%)	
Age (yrs)	35.0	(7.08)		37.8	(8.08)		0.114 [b]
Personal income (RM)	2545.2	(475.32)		2589.8	(604.59)		0.731 [b]
Number of children	2.8	(1.96)		3.0	(1.82)		0.595 [b]
Marital status							
Married			22(91.7)			143(94.7)	
Unmarried			2 (8.3)			8 (5.3)	0.354 [c]
Smoking status							
Smoker			9(37.5)			46(30.5)	
Non smoker			15(62.5)			105(69.5)	0.476 [c]

[a] Standard Deviation
[b] Independent t test
[c] Chi squared test

Table 3: Job characteristics of 24 stressed and 151 non-stressed assistant medical officers

Variables	Stressed			Non-stressed			*P* value
	mean	(SD [a])	n (%)	mean	(SD [a])	n (%)	
Duration of employment (yrs)	9.8	(4.67)		11.8	(7.59)		0.223 [b]
Duration of work (hrs/day)	8.1	(1.21)		7.7	(0.99)		0.087 [b]
Skill discretion	34.5	(4.39)		34.9	(3.66)		0.632 [b]
Decision authority	29.7	(6.66)		30.5	(5.05)		0.480 [b]
Decision latitude	64.2	(9.49)		65.5	(7.08)		0.457 [b]
Psychological job demand	34.4	(3.96)		33.3	(3.61)		0.148 [b]
Job insecurity	5.5	(1.59)		5.1	(1.42)		0.152 [b]
Coworker support	11.7	(1.73)		12.1	(1.60)		0.289 [b]
Supervisor support	11.1	(1.93)		11.5	(2.37)		0.360 [b]
Social support	22.8	(3.02)		23.6	(3.14)		0.220 [b]
Physical exertion	2.9	(0.58)		2.7	(0.81)		0.371 [b]
Hazardous conditions	8.5	(2.90)		7.6	(2.50)		0.127 [b]
Toxic exposures	5.7	(1.20)		5.3	(1.39)		0.161 [b]
Total physical hazards	14.2	(3.98)		12.9	(3.55)		0.106 [b]
Service grade							
U29			19(79.2)			120(79.5)	
U32			5(20.8)			31(20.5)	0.001 [c]
Overtime							
No			6(25.0)			42(27.8)	
Yes			18(75.0)			109(72.2)	0.082 [c]
Shift work							
No			8(33.3)			57(37.8)	
Yes			16(66.7)			94(62.2)	0.173 [c]

[a] Standard Deviation
[b] Independent t test
[c] Chi squared test

Table 4: Salivary cortisol of 24 stressed and 151 non-stressed assistant medical officers

Variables	Stressed		Non-stressed		*P* value [b]
	mean	(SD [a])	mean	(SD [a])	
Salivary cortisol (µg/dL)	0.78	(0.187)	0.67	(0.236)	0.033

[a] Standard Deviation
[b] Independent t test