Effect of occupational stress among nurses on salivary α-amylase

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ABSTRACT. Objective: To explore the effect of occupational stress among nurses on the level of salivary α-amylase. **Methods:** We carry out cross-sectional study on 145 in-service nurses chosen from 6 township hospitals of Yangzhong City with the cluster sampling method and 131 valid samples; evaluate the level of occupational stress with questionnaire method; and measure the concentration of salivary α-amylase with enzyme-linked immunosorbent assay (ELISA). **Results:** The difference in the concentration of salivary α-amylase among nurses at different ages and different length of service is statistically significant; baseline concentration is positively correlated with workload, role conflict, role ambiguity, and negatively correlated with task strategy, family and work relationship ($P<0.05$); working phase concentration is negatively correlated with task control, decision control, technology availability, logicality ($P<0.05$), and positively correlated with workload, job routinization, social support, job involvement ($P<0.05$); convalescent concentration has significantly negative correlation with job control, technology availability, task strategy ($P<0.01$); average concentration is negatively correlated with job control, technology availability, decision-making participation opportunities, promotion opportunities, task strategy, logicality, family and work relationship ($P<0.05$), and positively correlated with quantitative load, load change, workload, role ambiguity, colleague support, family support, job involvement ($P<0.05$). **Conclusions:** Occupational stress among nurses is correlated with the level of α-amylase, and to some extent will affect the concentration of salivary α-amylase.

INTRODUCTION

Nurses belong to a special occupational population, who, due to heavy workload, frequent work in shifts, high concentration of attention, tense doctor-patient relationship, and long-term excessive work pressure, are prone to occupational stress, and even job burnout. Under intense stress of the hypothalamus - pituitary - adrenal cortex (HPA) axis, the organism, through psychological - nervous - endocrine mechanism, can activate the sympathetic - adrenal medulla axis, release a large number of catecholamine, DA, E and NE secretions, and cause a series of physiological responses [1, 2]. Relevant studies show that salivary α-amylase (SAA) is mainly generated by serous gland acinar cells of parotid and submandibular gland, accounting for 40%~50% of salivary proteins, whose generative process is jointly dominated by the sympathetic nerve and the parasympathetic nerve, known as the immediate sign of activation of the sympathetic - adrenal medulla system [3,4].

There are many studies on stress and SAA concentration, including acute stress (such as exams and emergency simulation events) and chronic stress, but the findings are not consistent. This study

takes some in-service nurses as the research objects, evaluates occupational stress level with the Occupational Stress Indicator (OSI), and analyzes the impact of occupational stress on the concentration of SAA in saliva.

METHODS

Study Objectives We adopt cluster sampling method and select 148 in-service nurses without medical history of oral diseases, upper respiratory tract infections, lung diseases, endocrine and immune system diseases from 6 township hospitals of Yangzhong City. The average age was 33.69±4.90 years old. The average length of service was 13.67±5.10 years, 0 with junior high school background (accounting for 0%), 42 with senior high school/technical secondary school background (accounting for 32.06%), 82 with university/junior college background (accounting for 62.60%), and 7 with master's degree (accounting for 5.34%). All respondents, after informed consent, are voluntary to participate in the research without any financial reward.

The study was approved by the Ethics Committee of the School of Public Health at Southeast University. All participants signed an informed consent form.

Questionnaire The questionnaire used this time mainly consists of two parts: (1) General demographic characteristics information, such as job number, work unit, age, length of service, gender, education background, serving department, title, work in shifts, etc.; (2) Sensible occupational stress level.

For appraisal of occupational stress degree, we make use of the Occupational Stress Indicator (OSI) originally researched and developed by Cooper and Baglioni[5] from the University of Manchester in 1988 and then introduced and repeatedly revised by Yu Shanfa and Zhang Yue et al. [6-7] according to domestic conditions, including those for occupational stress factors (job control, job demand, job routinization, job hazard, job responsibilities, workload, role conflict, role ambiguity, job prospects, promotion and participation opportunities); and those for palliative factors (social support, strategy). We carry out reliability analysis on the OSI adopted by this study, according to which the occupational stress indicator's Cronbach's α coefficient is 0.69~0.94, the social support indicator's Cronbach's α coefficient is 0.85, and the strategy indicator's Cronbach's α coefficient is 0.93.

Collection and testing of saliva samples Respondents are required not to do exercise, brush teeth, smoke, nor take any coffee, tea and food 1h before sampling. We use Salivette collection tube (Sarstedt, Aktiengesellschaft & Co., Nümbrecht, Germany) to collect nurses' saliva samples at four time points in two working days, respectively the baseline concentration (8:00hrs), morning session (10:00hrs), afternoon session (15:30hrs), and convalescence (17:30hrs). Respondents, under the guidance of professionals, place the sliver inside the collection tube into their mouths for 1min to collect natural secretion of saliva. And then saliva samples are refrigerated and transported to the laboratory, stored at -20℃ after being centrifuged (4000 rpm, 5min, 20℃) for testing. After thawing the saliva, ELISA method is used to test lysozyme concentration, and the kit is purchased from Nanjing Senbeijia Biological Technology Co., Ltd. The ELIASA used is LabsystemsMultiskan MS Model 352 from Finland.

Quality control Investigators receive unified training before investigation to master filling-in methods and precautions; during field investigation, investigators provide unified presentation of the questionnaire contents and requirements, let respondents fill in the questionnaire themselves and collect back such questionnaire in time; specially-assigned persons are responsible for summarizing,

entering and auditing. Saliva collection and testing are carried out in strict accordance with operational requirements, reaction time and reaction conditions.

Statistical analysis We build an database with EXCEL and analyze information with SPSS18.0 software. The normality test of all test data distribution basically conforms to normal distribution requirements, so test data are directly used for analysis without data conversion. We use the mean and the standard deviation respectively for statistical description of continuous data, and use t test, single-factor difference analysis and partial correlation analysis on the effect of occupational stress on salivary α-amylase. The difference in $P<0.05$ is of statistical significance.

RESULTS

Comparison of the concentration of salivary α-amylase among nurses with different demographic characteristics were shown in Table 1. The baseline concentration, working phase concentration, convalescent concentration and average concentration of the group ">35" are all lower than the other two groups ($P<0.05$); the working phase concentration of the group "≤10" is higher than the other two groups ($P<0.01$); the convalescent concentration of the group ">15" is lower than the other two groups ($P<0.05$); the average concentration of the group "≤10" is higher than the other two groups ($P<0.05$); the difference among different education backgrounds is not statistically significant.

Table 1. Concentration of salivary α-amylase among nurses with different demographic characteristics ($\bar{x}$ ±s, U/ml)

	N(%)	Baseline concentration	Working phase concentration	Convalescent concentration	Average concentration
Age (years old)					
≤30	42(32.06)	92.51±3.01	131.12±3.36	146.69±3.59	125.36±2.70
30～35	51(38.93)	93.39±2.77[a]	131.52±2.38[a]	146.24±3.18[a]	125.67±1.91[a]
>35	38(29.00)	90.75±3.12[a]	129.28±2.05[a]	144.39±3.07[a]	123.43±1.15[a]
P value		＜0.001	＜0.001	0.005	＜0.001
Length of service (years)					
≤10	55(41.98)	92.95±3.55	132.71±3.00[b]	147.40±4.34	126.44±2.90
10～15	35(26.72)	92.43±2.71	130.64±2.51[b]	146.39±3.19[c]	125.03±2.03[c]
>15	41(31.30)	91.92±3.51	130.15±2.80	144.56±2.96[c]	124.20±1.96[c]
P value		0.327	＜0.001	0.001	＜0.001
Education background					
Senior high school (technical secondary school) or below	42(32.06)	92.07±3.03	130.56±2.50	145.61±3.32	124.70±1.94
University (junior college) or above	89(67.94)	92.75±3.34	130.96±3.30	146.13±3.54	125.20±2.70
P value		0.265	0.487	0.425	0.284

Note: compared with "≤30" group: ap<0.05; compared with ">15" group, bp<0.05; compared with "≤10" group cp<0.05.

To analyze the correlation between salivary α-amylase and occupational stress factors, considering that age and length of service have certain influence on the concentration of salivary α-amylase, we take them as concomitant variables, take occupational stress factors as independent variables, and take salivary α-amylase as the dependent variable for partial correlation analysis. The results show that baseline concentration is positively correlated with workload, role conflict and role ambiguity ($P<0.05$); working phase concentration is negatively correlated with task control, decision control, technology availability ($P<0.05$), and positively correlated with quantitative load, load change, job routinization, workload ($P<0.05$); convalescent concentration is negatively correlated with task control, decision control, resource control and technology availability ($P<0.01$);

average concentration is negatively correlated with task control, decision control, resource control, technology availability, decision-making participation opportunities, promotion opportunities (P<0.05), and positively correlated with quantitative load, load change, workload, role ambiguity (P<0.05), as shown in Table 2.

Table 2. Correlation between the concentration of salivary α-amylase (SAA) and occupational stress factors(r)

	Baseline concentration	Working phase concentration	Convalescent concentration	Average concentration
Task control	-0.03	-0.31**	-0.28**	-0.34**
Decision control	0.04	-0.20*	-0.28**	-0.25**
Environment control	-0.04	-0.15	-0.12	-0.17
Resource control	-0.01	-0.11	-0.27**	-0.22*
Quantitative load	0.07	0.241**	0.16	0.25**
Load change	-0.08	0.29**	0.12	0.18*
Technology availability	0.03	-0.19*	-0.30**	-0.26**
Job routinization	0.02	0.18*	0.05	0.13
Job hazards	0.01	0.06	0.02	0.05
Job responsibilities	0.10	0.07	-0.08	0.04
Workload	0.18*	0.25**	0.02	0.23**
Role conflict	0.20*	-0.02	-0.10	0.03
Role ambiguity	0.31**	0.13	0.03	0.25**
Job prospects	0.17	0.01	-0.01	0.09
Decision-making participation	-0.12	-0.08	-0.13	-0.18*
Promotion opportunities	-0.09	-0.11	-0.15	-0.20 *

* $P<0.05$, ** $P<0.01$

After controlling age and length of service, we carry out partial correlation analysis of palliative factors and salivary α-amylase. The results show that baseline concentration is negatively correlated with task strategy, family and work relationship (P <0.05); working phase concentration is positively correlated with colleague support, superior support, family support, job involvement (P<0.05), and negatively correlated with logicality (P<0.01); convalescent concentration is negatively correlated with task strategy (P<0.05); average concentration is positively correlated with colleague support, family support, job involvement (P<0.05), and negatively correlated with task strategy, logicality, family and work relationship (P<0.05), as shown in Table 3.

Table 3. Correlation between the concentration of salivary α-amylase (SAA) and palliative factors (*r*)

	Baseline concentration	Working phase concentration	Convalescent concentration	Average concentration
Colleague support	-0.01	0.37**	0.04	0.21*
Superior support	-0.07	0.30**	0.02	0.13
Family support	0.08	0.20*	0.11	0.21*
Task strategy	-0.19*	-0.10	-0.21*	-0.28**
Logicality	-0.11	-0.26**	-0.17	-0.29**
Family and work relationship	-0.22*	-0.10	-0.03	-0.18*
Time management	0.00	-0.02	-0.04	-0.03
Job involvement	0.03	0.31**	0.16	0.27**

* $P<0.05$, ** $P<0.01$

DISCUSSION

Currently, many studies show that acute stress (such as exams and emergency simulation events) may cause increase of SAA concentration, and is closely related to catecholamine concentration [8-11]. The effect of chronic stress on SAA has not been determined yet, but considering that SAA is the immediate sign of activation of the sympathetic - adrenal medulla system, its high concentration is likely to further prove the excessive activation function of long-term pressure on the sympathetic - adrenal medulla system. Reasonable regulation mechanism may be: mental stress may simulate the sympathetic - adrenal medulla system, increase release of catecholamine, act on corresponding β-adrenergic receptor of the parotid and the submandibular gland, promote cAMP secretion, which may activate intracellular protein kinase, result in receptor-related protein phosphorylation (or dephosphorylation), and thus promote secretion of SAA.

Studies made by Nater UM et al. [12] show that excessive job demands may lead to heavier workload, greater mental stress, less social support, lower personal accomplishment, higher SAA concentration; and people with high chronic stress show higher SAA concentration at all time points. This study finds that the greater workload, the more role conflict, the severer role ambiguity, the higher baseline SAA concentration; the worse task control and decision control capabilities, the more quantitative load, the faster load change, the higher technology availability, the more monotonous work, the heavier workload, the higher working phase SAA concentration; the worse task control, decision control and resource control capabilities, the higher technology availability, the higher convalescent SAA concentration; the worse task control, decision control and resource control capabilities, the more quantitative load, the faster load change, the higher technology availability, the heavier workload, the severer role ambiguity, the less decision-making participation and promotion opportunities, and the higher average SAA concentration.

Palliative factors include social support and strategy two aspects, known as methods and measures for individuals to deal with and ease occupational stress. The results of this study also show that the lower task planning and organization, the worse family and work relationship, the higher baseline SAA concentration; the fewer colleague, superior and family support and help, the worse logicality problem handling, the more job involvement, the higher working phase SAA concentration; the worse logicality in problem handling, the higher convalescent SAA concentration; the fewer colleague and family support and help, the lower task planning and organization, the worse logicality in problem handling, the worse family and work relationship, the more job involvement, the higher average SAA concentration.

Conclusion

In summary, our findings suggest that for predominantly female nurses, the more occupational stress factors, the worse coping strategies, the higher salivary α-amylase concentration. Our investigation is only based on cross-sectional study, the results only show that occupational stress has certain correlation with the level of SAA, difficult to explain if there is a clear causal link between the two.

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