

RESEARCH ARTICLE

Effect of *salat* (prayer) activity on salivary status and cortisol level

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ABSTRACT

The majority of Indonesian people are Muslim who perform the obligatory prayers five times each day known as *salat*. The series of activities in *salat* begins with *wudu* with a gargle movement that increases salivary secretion through mechanical stimulation. The movement of *ruku* and *sujood* when *salat* causes oxygen-rich blood to flow to the brain is well suited. When a person feels calmer and more psychologically relaxed after performing *salat* and *wudu*, the parasympathetic nerves increase so normal cortisol levels can secrete more saliva which is aqueous with normal acidity (pH). Oral health will affect the overall health of the body. This study aimed to determine the effect of *salat* and *wudu* on the salivary flow rate, pH, and cortisol level as an indicator of oral health. The design of this study was the static group pretest and posttest design. The study was conducted by comparing the value of salivary flow rate, pH, and cortisol levels in 20 subjects consisting of 10 subjects as the treatment group and 10 subjects as the control. Saliva was collected without stimulation before and after *salat* activity for five minutes, followed by measurement of salivary flow rate and pH level. Salivary cortisol level was measured using Cortisol Assay Elisa kit with λ 540 nm. The results showed an increase in salivary pH, flow rate and cortisol level after the *salat* activity but there was no significant difference by Kruskal-Wallis test but there was a strong correlation using Kendall's tau_b test. In conclusion, *salat* activity may have correlation with an increase in salivary pH, flow rate and cortisol level.

Keywords: cortisol; flow rate; pH; *salat*; *wudu*

INTRODUCTION

The prevalence of dental and oral disorders in Indonesia is about 25.9%.¹ According to the RISKERDAS 2013 results, people who did dental health care and hygiene counseling were only 5.3%.² On the other hand, Indonesia is a big country with various ethnic groups, languages, cultures, and religions. Based on the census data in 2010, 87.51% of Indonesian citizen were Muslim.³ In Islamic religion there is an obligation to pray which is known as *salat* in the form of repetitive movement (standing, *ruku* or bowing, *sujood* or prostration, and sitting), preceded with *wudu*. *Salat* is performed at least five times a day. In *salat* movement there is *ruku* and *sujood* that causes oxygen-rich blood to flow to the brain. The hemodynamics varies with the position of head. The activity of *sujood* has similarity with prone position. However, when the head is lower than the heart, there is venous congestion

leading to an increase in intracranial pressure. The oxygenation improves with *sujood* positioning.⁴

Saliva is a hypotonic fluid secreted by the major and minor salivary glands which have functions to maintain oral conditions. Volume, acidity (pH), and protein components of saliva are important factors that play a role in maintaining the equilibrium in the oral cavity.⁵ When salivary volume and salivary acidity are lower than normal, it can reduce the function of saliva as a tissue protector in the oral cavity, teeth lubricant, antibacterial activity, buffer effects, and others. A decrease in salivary function can be used as an early detector for abnormalities in the oral cavity.⁶ In addition, there is cortisol as a component of saliva that can be used as an indicator of oral health. Cortisol in the hypothalamus pituitary adrenal axis (HPA Axis) is a hormone produced in the zona fasciculata and the zona reticularis of the adrenal cortex. Circumcision

rhythms and stressor cause the hypothalamus to increase the production of corticotropin releasing hormone (CRH) to the anterior pituitary gland then increase adrenocorticotrophic hormone (ACTH) targeted at the adrenal cortex cortisol.⁷ The highest cortisol level is found early in the morning especially shortly after waking up.⁸ Higher cortisol levels are associated with trauma and depression.⁹ When someone feels more relaxed and calmer after taking prayer in the morning, it will lower cortisol level. Thus, salivary secretion at the parasympathetic nerve pathway that produces aqueous saliva will be optimum. Sufficient salivary secretion results in an appropriate acidity (pH) to maintain oral health.¹⁰ For instance, *salat* can decrease the sympathetic component and increase the parasympathetic component in autonomic nervous system (ANS).¹¹

Based on the description, there is a hypothesis that *wudu* and *salat* have effect on increasing salivary secretion through mechanical stimulation especially by gargling, *ruku*, and *sujood* which increase the flow of oxygen-rich blood. A series of *salat* ends with *dhikr* or praying that psychologically increases the peace of mind, maintains cortisol levels in normal range, and increases parasympathetic nerves in secreting aqueous saliva with normal acidity (pH). This study aimed to reveal the effect of *salat* and *wudu* on the salivary flow rate, pH, and cortisol level as an indicator of oral health.

MATERIALS AND METHODS

This study used static group pretest and posttest design. The subjects were 20 men, with an age range of 18 to 25 years old, healthy, did not suffer from any systemic diseases, did not use parasympathomimetic drugs, and did not use orthodontics or denture. The subjects were instructed to brush their teeth and eat for 30 minutes before collecting saliva sample. The subjects were divided into two groups, 10 men each. The first group consisted of those who did *salat* and *wudu*, while the other group as the control consisted of non Muslim who did not perform *salat* and *wudu*. The procedure of this study was approved by the Ethics Committee of the Faculty of Dentistry, Universitas Gadjah Mada (Ethical Clearance

No. 001417 / KKEP / FKG-UGM / EC / 2018). An informed consent was signed from each subject who participated in this study.

Saliva sample was collected without stimulation for five minutes in the morning before and after *salat* and *wudu*. In the control group, saliva was collected at 04.30 am. Salivary flow rate was measured by weighing the salivary sample in a graded balance. Salivary pH level was measured by pH meter. Salivary cortisol level was measured by Cortisol Assay Elisa Kit (R & D Systems Inc., USA) and read by *Elisa reader* with λ 540 nm.

Data normality and homogeneity of variance were verified by the Shapiro-Wilk and the Levene's test, respectively. Statistical analysis was done by Kruskal-Wallis test and Kendall's tau_b correlation. Significance level was set at $p < 0.05$. The data were processed using SPSS IBM Version 22 for Windows (SPSS Inc; Chicago, IL, USA).

RESULTS

The results of salivary flow rate, pH, and cortisol levels are shown in Table 1. Data normality, homogeneity, and Kruskal-Wallis are demonstrated in Table 2.

Table 2 indicates some data $p < 0.05$ or it could be assumed that the data had skewed distribution but the Levene's test showed $p > 0.05$ meaning that the data were homogenous. The Kruskal-Wallis test showed $p > 0.05$, indicating that *salat* and *wudu* had no significant difference. The analysis was continued to determine the correlation between the activity of *salat* and *wudu* with salivary flow rate, pH and cortisol levels by Kendall's tau_b as shown in Table 3.

Table 3 shows $p = 0.744$ and $p = 0.695$, meaning that there was a strong correlation between salivary pH and flow rate; salivary pH and cortisol level but a weak correlation between salivary flow rate and cortisol levels ($p = 0.473$). This indicates that the activity of *salat* and *wudu* may have correlation to increase salivary pH, flow rate, and cortisol level.

DISCUSSION

The activity of *salat* and *wudu* increases the pH, shown in the mean of the treatment group of

Table 1. Mean and standard deviation (SD) of salivary flow rate, pH and cortisol level

	Mean \pm SD	
	Treatment	Control
pH	7.80 \pm 0.31	7.75 \pm 0.27
Flow rate (ml/minutes)	0.45 \pm 0.29	0.37 \pm 0.25
Cortisol levels (ng/ml)	4.95 \pm 2.88	4.25 \pm 3.16

Table 2. Result of data normality (Shapiro-Wilk), homogeneity (Levene's test) and Kruskal-Wallis test

		n	Shapiro-Wilk	Levene's test	Kruskal-Wallis test
			Sig	Sig	Sig
pH	Treatment	10	0.396	0.391	0.481
	Control	10	0.003		
Flow rate (ml/minutes)	Treatment	10	0.315	0.494	0.529
	Control	10	0.085		
Cortisol (ng/ml)	Treatment	10	0.002	0.688	0.315
	Control	10	0.015		

Table 3. Result of Kendall's tau_b test between *salat* and *wudu* to salivary pH, flow rate and cortisol levels

		pH	Flow rate (ml/minute)	Cortisol levels (ng/ml)
pH	Correlation Coefficient	1.000	0.055	-0.065
	Sig. (2-tailed)	-	0.744	0.695
	n	20	20	20
Flow rate (ml/minutes)	Correlation Coefficient	0.055	1.000	-0.118
	Sig. (2-tailed)	0.744	-	0.473
	n	20	20	20
Cortisol (ng/ml)	Correlation Coefficient	-0.065	-0.118	1.000
	Sig. (2-tailed)	0.695	0.473	-
	n	20	20	20

7.80 \pm 0.31 which is higher than that of the control. Increased salivary flow rate and cortisol levels were also seen in the treatment group although the results did not have any significant difference. This is probably due to the gargle activity during *wudu* which stimulates salivary secretion repeatedly.⁶ The increase in salivary volume is directly proportional to the increase in the salivary flow rate, therefore maintaining the pH within the normal range.

Ruku and *sujood* movement during *salat* could increase oxygen-rich blood flow to the brain to be more optimal so as to minimize stress due to lack of oxygen supply.⁴ Optimal blood supply and minimal stress lead to a decrease in cortisol hormone levels which stimulates parasympathetic nervous system, resulting in more salivary secretion which is aqueous and rich in enzymes.⁹

However, there are many factors influencing salivary secretion that could not be controlled in this study such as stress and psychic condition.

This is because stress could lower the secretion of salivary.⁶

The cortisol levels are higher in the treatment group than the control group (4.95 \pm 2.88). The comparison between the cortisol levels in the treatment group and those in the control group showed no significance difference despite the apparent increase in cortisol levels after *wudu* and *salat*. Increased levels of cortisol are affected by circadian rhythms and stress.⁷ However, due to lack of study about the correlation between *salat* and *wudu* with cortisol level, we still did not know about this phenomenon. In accordance with previous study, the lack of oxygen supply to organs could increase stress, thereby increasing cortisol levels.¹⁰

Based on the analysis of the correlation between *salat* and *wudu* on pH, flow rate and cortisol levels, it is found that an increase in pH is correlated with an increase in salivary flow rate, and cortisol level. An increase in salivary secretions

increases pH to maintain oral health in order to retain homeostasis.⁵ Thus, an increased salivary flow rate will increase salivary pH. In addition, changes in cortisol levels may be characterized by an increase in salivary pH level.

The results of this study showed that elevated cortisol levels will be correlated to increased pH as well. These results indicate that *salat* and *wudu* have a strong effect on the salivary pH, flow rate and cortisol level in saliva which has a role to maintain oral health.

CONCLUSION

Salat activity may have correlation with an increase in salivary pH, flow rate, and cortisol level as an indicator of oral health

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