International Journal of Dentistry Scientific
Volume 4, Issue 1, Page 31-38, June 2026
p-ISSN: 3031-7142

Comparison of The Effects of Classical Music and Gamelan Music on The Salivary Flow Rate

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Article info: Received : 18-3-2026 ; Revised : 16-4-2026 ; Accepted : 12-6-2026 ; Publish : 23-6-2026

ABSTRACT

Background: Hyposalivation can negatively affect oral health by increasing the risk of dental issues such as dental cavities. To counter this, auditory cues like music can help boost salivary flow. Classical music, renowned for its soothing tones, is said to enhance saliva flow. Originating from Indonesia, gamelan music boasts serene qualities with slow harmony, synchronized tones, and low pitch. Despite this, its influence on saliva flow has not yet been explored. This study seeks to compare how classical and gamelan music affect saliva flow rates.
Methods: The research employed a pre-experimental design with a post test only approach, involving 20 participants. Saliva samples were gathered before music exposure via the spitting method over 5 minutes. Participants listened to classical and gamelan music for 10 minutes each, followed by another saliva collection. The collected saliva was measured as the rate of saliva flow per minute (mL/minute). Analysis utilized Repeated Measures ANOVA and Pairwise Comparison methods for data evaluation.
Results: The results indicated that the average salivary flow rate increased after listening to both classical music and gamelan music compared to before music was listened to baseline values ($p<0.05$). There was no significant difference observed between classical music and gamelan music in terms of increasing the salivary flow rate ($p>0.05$).
Conclusion: Gamelan music is as effective as classical music in boosting saliva flow rates.

Keywords: classical music, gamelan music, salivary flow rate

INTRODUCTION

Saliva is a viscous fluid produced by the salivary glands and is a crucial component in the oral cavity, playing a significant role in maintaining oral health.[1] The stimulated saliva flow rate averages around 1.5-2.0 mL/minute, whereas unstimulated flow rate is approximately 0.3-0.4 mL/minute.[2] When the salivary flow decreases below 0.1 mL/minute, it is defined as hyposalivation.[2] Hyposalivation can lead to xerostomia, which indicates a subjective sensation of mouth dryness.[3] Both hyposalivation and xerostomia are commonly encountered issues in the community.[4] In Mexico[4], the prevalence of hyposalivation is 59.7%, and xerostomia is 25.2%. In Indonesia, the prevalence is high as well, with hyposalivation at 25.3% and xerostomia at 59.5%.[5]

Several factors can influence hyposalivation, including hormonal changes in menopausal women, systemic diseases like diabetes mellitus, and the use of medications such as antihypertensives. Emotional conditions like stress, anxiety, and depression can also affect

saliva secretion. Individuals experiencing stress show a significant in their decrease in saliva flow rate.[6] Studies, such as that by Polimpung et al., demonstrated that saliva volume over 5 minutes among dental preclinical students at Hasanuddin University decreased significantly to 1.94 mL/minute under high-stress conditions compared to 2.90 mL/minute under normal conditions.[7]

Hyposalivation has several negative effects on the oral cavity, including oral candidiasis, a fungal infection caused by Candida albicans.[8] Infections occur when the protective function within the oral environment diminishes due to hyposalivation.[8] The saliva flow rate also strongly correlates with dental caries; lower saliva flow rates correlate with higher caries prevalence.[9] A significant association between dysphagia and the saliva flow rate has also been reported.[10]

Efforts to stimulate saliva secretion need to be undertaken to counteract the negative impact of hyposalivation.[10] One non-pharmacological approach to increase the saliva flow rate is through mechanical means, such as chewing gum, or chemical stimulation, by providing stimuli like sour, sweet, salty, bitter, and spicy tastes.[11] Another alternative method to stimulate saliva flow rate is through auditory stimuli. The auditory stimulus most commonly tested include music.[11]

Music is recognized as a safe, inexpensive, and effective non-pharmacological relaxation stimulus and that has long been acknowledged as a therapeutic tool.[11] Classical music, known for its tranquil and soothing tones, is often tested in health therapy.[12] Classical music is reported to enhance mood and happiness.[13] The relaxation effects induced by music occur due to changes in the autonomic balance, which becomes dominated by the parasympathetic nervous system.[14] Stimulation of the parasympathetic or sympathetic nervous system will trigger salivary gland secretion, but the parasympathetic stimulation has a stronger and longer-lasting effect.[14] Dewi et al. showed that saliva secretion in xerostomia patients increased from a flow rate of 0.087 mL/minute to 0.204 mL/minute after listening to Mozart's classical music for 13 minutes.[11]

Indonesian music, specifically gamelan music, features slow harmony, synchronized tones, and low pitch.[15] Gamelan music has also been tested in mental health, showing a decrease in stress levels among students after listening to Javanese gamelan music, as demonstrated by Abdullah et al.[16] Yusli et al. also reported a reduction in anxiety levels among the elderly after gamelan music therapy.[17] Despite its similarity to classical music, gamelan music has not been studied for its effects on saliva flow rate. The purpose of this study is to compare the effect of classical and gamelan music on the saliva flow rate.

METHOD

This is an analytical study with a a pre-experimental design and a post test only approach involving 23 students from the Dentistry Study Program, Faculty of Medicine, Sriwijaya University. **The inclusion criteria were as follows**: All subjects had normal body weight, normal hearing, were non-smokers, and were in good physical condition.[18] **The exclusion criteria included**: Dry mouth conditions, subjects who smoked, had a history of systemic diseases causing dry mouth, women menstruation, and obesity (≥ 30 kg/m2).[19,20] This study was approved by the ethics committee of the Faculty of Medicine, Sriwijaya University, with the ethical eligibility certificate number 268-2023, and written informed consent was been obtained from all subjects."

Subject preparation

A screening questionnaire was given to all research subjects using Google Forms to collect data regarding their identities and medical histories. Subjects who met the inclusion and exclusion criteria were briefed about the study procedures and asked to sign an informed consent form if they agreed to participate in the research. All tools and materials used in this study met clinical the standards and were in hygienic condition. The research was conducted between 8:00 AM to 11:00 AM at room temperature (20-25°C) with adequate lighting, in a calm environment, and efforts were made to minimize surrounding noise. This research was conducted face-to-face and lasted for approximately 20-30 minutes, adhering to health protocols by maintaining a minimum seating distance between subjects of over 1 meter. Subjects were instructed to wear masks except during the research sessions and to use hand sanitizer upon entering and leaving the research space.

The subjects were instructed to refrain from brushing their teeth, engaging in physical activity, and consuming food or beverages for 2 hours before the study. Research supervision was directly conducted by the researcher. Each subject was asked to sit and was provided with a plastic cup for rinsing, distilled water, and plastic containers for disposal. They were given headphones (TWS, China), a 15 mL centrifuge tube (Pyrex, Indonesia), and a 50 mm funnel (Pyrex, Indonesia).

The auditory stimuli used in this study were classical music titled "Sonata for Two Pianos in D major, K.448/375a 2nd" and gamelan music titled "Kutut Manggung." The music files were provided to the subjects via Google Drive. [16,20] The presentation of music stimuli was randomized, with some groups of subjects receiving the classical music stimulus first and others starting with the gamelan music. Subjects were instructed to connect the provided headphones to their smartphones, which were adjusted to a standardized volume level of 70% as set by the researcher.

Salivary Flow Rate Collection Process

The subjects were asked to rinse with distilled water to clean any remaining food and beverages from their mouths. They were directed to swallow any remaining saliva in the oral cavity before the measurement of the saliva flow rate began. Saliva was collected using the spitting method, in which the subjects sat calmly, kept their heads slightly tilted down, and held a tube with their right hand. During saliva collection in the mouth, subjects were instructed to close their lips, refrain from moving their tongues, and not swallow. Afterwards, the saliva was collected into the centrifuge tube every 60 seconds for 5 minutes.

Ten minutes later, subjects were asked to listen to classical music for 10 minutes, and in the last 5 minutes of listening to the music, they were instructed to collect saliva in the same manner as before. Ten minutes after that, subjects were asked to listen to gamelan music for 10 minutes, and in the last 5 minutes of listening to the music, they were instructed to collect saliva in the same manner as before.The volume of saliva in the centrifuge tube was weighed using a digital scale, and its flow rate was measured in units of g/minute, equivalent to mL/minute, and the results were recorded.

Data analysis

The data were analyzed using the mean value and tested for normality using the Shapiro-Wilk test. Data with a normal distribution ($p>0.05$) were analyzed using the parametric Repeated measures ANOVA test and followed by a post hoc paired-wise comparison if the significance value was less than 0.05 ($p<0.05$).

CASE REPORT

The research comparing the effects of classical music and gamelan music on the saliva flow rate was conducted over two days. The study involved 20 subjects who were preclinical students in the Department of Dental and Oral Medicine, Faculty of Medicine, Universitas Sriwijaya, who met the inclusion and exclusion criteria. The number of female subjects exceeded the number of male subjects. The participants in this study were aged between 19 and 22 years, with an average age of 20.25 years, and had normal hearing conditions.

The normality of saliva flow rate values was tested, showing a p-value of >0.05, which indicated a normal distribution of the data. Subsequently, the data underwent Repeated MeasuresANOVA to assess the comparison between the effects of classical music and gamelan music on the saliva flow rate, and the results were presented in Table 1.

Table 1. Mean Salivary Flow Rate (g/minute) Stimulated by Classical Music and Gamelan Music

Stimulus Type	N	Mean (g/minute) ± SD	*p-value*
Before listening to music	20	0.521± 0.136	0,000*
After listening to classical music	20	0.741± 0.210	
After listening to gamelan music	20	0.707 ± 0.176	

*Repeated ANOVA, significant difference (p<0.05); standard deviation

Table 1 indicates that the mean saliva flow rate stimulated by classical music and gamelan music increased compared to the baseline before listening to music. The Repeated MeasuresANOVA test resulted in a p-value of 0.000 (p<0.05), indicating a significant difference between before listening to music, after listening to classical music, and after listening to gamelan music.

Further pairwise comparison tests were conducted to compare the mean saliva flow rate values among the three stimulus groups. The difference in mean values between these stimuli is displayed in Table 2.

Table 2. Pairwise Comparison Test Results of Saliva Flow Rate (g/minute) Stimulated by Classical Music and Gamelan Music

		Difference in salivary flow rate (g/minute)	***p-value***
Before listening to music	After listening to classical music	0,221	<0,01*
	After listening to gamelan music	0,187	<0,01*
After listening to gamelan music	After listening to classical music	0,034	0.665

*Pairwise comparison, significant difference (p<0.05)

Table 2 demonstrates a significant difference in the difference in the saliva flow rate after listening to both classical and gamelan music compared to before listening to music (p<0.05). Gamelan music did not exhibit a significant difference in saliva flow rate enhancement compared to classical music (p>0.05).

DISCUSSION

The results of this research indicate that auditory stimulation using classical music and gamelan music can both increase saliva flow rate. These findings are supported by the study of Jin et al.'s study, which showed that individuals listening to classical music experienced a higher increase in saliva flow rate, measuring at 0.515 mg/minute compared to silence, which was 0.329 mg/minute.[21] The study by Dewi et al.'s also demonstrated that saliva secretion in

xerostomia patients increased from a flow rate of 0.087 mL/minute to 0.204 mL/minute after being exposed to Mozart's classical music for 13 minutes.[11] Classical music has calm and relaxing tones, as does gamelan music, which features slow harmony, harmonious tones, and low tones, allowing both types of music to stimulate the saliva flow rate.[12,15]

The mechanism of music in increasing saliva secretion is related to the body's physiological functions, especially concerning the auditory system, central nervous system, and peripheral nervous system. Music, as sound waves, is received by the ears and transmitted through the VIII cranial nerve to the cerebral cortex and then to the hypothalamus. Music characterized by slow tempo, repetitive rhythm, and gentle contour stimulates the parasympathetic nervous system, resulting in a large quantity of enzyme-rich and diluted saliva.[11,14]

The saliva flow rate after listening to classical music is 0.741 g/minute, while for gamelan music, it is 0.707 g/minute. These values are higher compared to the unstimulated saliva flow rate, which ranges from 0.2–0.4 ml/minute.[22] Reported stimulated saliva flow rate values in the Indonesian population show varying results.A study conducted by Fariha et al.'s in Jakarta showed a saliva flow rate of 0.528 ml/minute after chewing paraffin, Savita et al.'s study in Aceh showed a rate of 0.994 ml/minute after chewing non-xylitol gum, and a study by Ramadhani et al.'s in Palembang showed a rate of 1.19 mL/minute after chewing Arabic gum.[23-25] The results obtained in this study still fall within the range of stimulated saliva flow rates in the average Indonesian population. The saliva flow rate after listening to gamelan music can be further increased by combining it with chewing stimuli, such as using mastic gum and sugar-free chewing gum, which have been reported to produce saliva flow rates exceeding 1.5 g/minute.[14,26]

Limitations of this research include some subjects feeling uncomfortable while listening to music due to the 70% volume used, which was considered too loud. Hence, in future research, attention to the volume used can be emphasized. Gamelan music has been proven to increase saliva flow rate, so in the future, it can be developed and broadcast more frequently on television, radio, and public places. Further research on gamelan music should be conducted on individuals experiencing hyposalivation, such as patients undergoing radiotherapy or those with diabetes mellitus, with the hope of increasing their saliva flow rate and overall oral cavity health.

CONCLUSION

The conclusion of this research is that the utilication of gamelan music can increase the saliva flow rate just as effectively as classical music.

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