



Investigating the Correlation Between Oral Contraceptives and Unstimulated Saliva pH and Viscosity Among Women Aged 25 - 35

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Abstract

Background: Saliva is a vital bodily fluid that plays a key role in oral and dental health. Salivary pH reflects buffering capacity, which helps prevent bacterial colonization, and salivary viscosity is directly related to protein content. Changes in these properties can adversely affect oral and dental health.

Objectives: This study aimed to compare mean salivary pH and viscosity between women taking oral contraceptive pills (OCPs) and those not taking OCPs.

Methods: In this cross-sectional study, 41 women participated: 21 OCP users and 20 non-users. Participants were recruited from Mahmoud Abad Health Center and Tahune Health Center in Isfahan using convenience sampling. Inclusion criteria were an age of 25 - 35 years and, for OCP users, at least 6 consecutive months of low-dose contraceptive pill use (OVOSTOP®, Iran Hormone Factory, Iran). Women taking medications that interfere with OCPs and those with gingivitis or periodontitis were excluded. Samples were collected between 9 and 11 AM. Immediately after sampling, salivary pH and viscosity were measured using a digital pH meter and a calibrated thistle tube. Data were analyzed using SPSS version 23. The Kolmogorov-Smirnov test was used to assess normality, and mean saliva movement in the capillary tube and salivary pH were compared between groups using independent t tests.

Results: The mean saliva movement in the thistle tube was 10.76 mm $\pm$ 0.9042 SD in OCP users and 11.77 mm $\pm$ 1.3553 SD in the control group; this difference was significant ($P = 0.008$). The mean pH was 7.2434 $\pm$ 0.5665 SD in the case group and 7.0335 $\pm$ 0.7049 SD in the control group; this difference was not statistically significant ($P = 0.297$).

Conclusions: Salivary viscosity was higher in women taking oral contraceptives. Because these pills are used over prolonged periods, oral health may be affected; therefore, women taking oral contraceptives should be informed about potential oral health effects and appropriate preventive measures.

Keywords: Oral Contraceptive Pills, Salivary Viscosity, Salivary pH

1. Background

Saliva is a complex mixture of organic and inorganic secretory substances released from the salivary glands into the oral cavity and salivary ducts (1). It contains enzymatic and nonenzymatic proteins; minerals such as calcium and phosphorus; sodium salts; dissolved gases, including nitrogen, oxygen, and carbon dioxide; and cellular elements. Microscopic examination of saliva reveals flattened epithelial cells and leukocytes (2).

Saliva plays a critical role in clearing bacteria and food particles, facilitating chewing and swallowing, providing antimicrobial defense, and buffering oral pH. Alterations in salivary composition or flow rate can disrupt the balance between hard and soft oral tissues. Salivary pH reflects buffering capacity, an essential function that protects the oral environment (3, 4) by limiting colonization by acidogenic bacteria and neutralizing acids produced by dental plaque microorganisms during sugar fermentation. These acids contribute to tooth enamel

demineralization. Salivary viscosity is directly related to protein content, and changes in viscosity can adversely affect oral and dental health. Hormones such as cortisol, aldosterone, progesterone, and testosterone are present in saliva and may affect oral health. Exogenous hormonal medications, including oral contraceptive pills (OCPs), may also affect oral and dental health (5, 6).

Salivary secretion can be affected by various local and systemic factors. In patients taking medications who have altered salivary secretion, the differential diagnosis should include the possibility of an adverse drug reaction (7). Drugs may increase or reduce salivary flow and may also alter other salivary properties. Several drugs may cause sialadenitis associated with altered salivary properties. Because many medications are used long term, they may alter salivary properties through changes in the salivary glands themselves (3, 8).

Hormonal changes in women can affect the physiology of the entire body, including the oral cavity. Pregnancy, menstruation, menopause, and hormonal treatments, including oral contraceptives, can directly affect periodontal tissue metabolism and may alter salivary flow, buffering activity, and chemical composition. Medications can also affect the amount and composition of saliva, thereby changing its characteristics (1, 9).

2. Objectives

Given the increasing use of oral contraceptives and their potential effects on saliva, this study evaluated the viscosity and pH of unstimulated whole saliva in women aged 25 - 35 years who used oral contraceptives. To our knowledge, no previous research has addressed this topic. The aim was to determine whether oral contraceptive use is associated with changes in salivary pH and viscosity.

3. Methods

3.1. Study Design and Participants

This cross-sectional study was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences, Yazd (IR.SSU.REC.1396.142). Saliva samples were collected from 21 women using OCPs and compared with samples from 20 women not taking OCPs. Convenience sampling was used. The inclusion criteria were an age of 25 - 35 years and, for OCP users, at least 6 consecutive months of low-dose contraceptive pill use (OVOSTOP®, Iran Hormone Factory, Iran). All participants provided written informed consent. Women with a history of using medications that interfere with OCPs, including phenobarbital, phenytoin, carbamazepine, rifampin,

griseofulvin, *Hypericum perforatum*, and long-term tetracycline or penicillin use, were excluded. Women with gingivitis or periodontitis were also excluded.

3.2. Saliva Collection and Measurements

A total of 41 unstimulated saliva samples (10) were collected from 2 groups: 20 women who did not take OCPs and 21 OCP users, all aged 25 - 35 years and referred to the Mahmoud Abad Health Center or Tahune Health Center in Isfahan. The study design was explained to the participants, and informed consent was obtained. Participants in both groups were age-matched.

Unstimulated whole saliva was collected using the spitting method. Participants were asked to refrain from eating, drinking, smoking, chewing gum, tooth brushing, and other oral habits for 90 minutes before sampling. They then swallowed all saliva in the mouth for 30 seconds and subsequently expectorated the accumulated saliva into a sterile container until 2.5 mL was collected. Because of individual differences in salivary flow, the time required to reach this volume varied among participants. Samples were collected between 9 and 11 AM to minimize diurnal variation in salivary characteristics. Viscosity and pH were measured at room temperature (25 °C). Room temperature and measurement time were monitored using the digital thermometer in the pH meter.

Saliva collection containers were plastic, sterilizable, and large enough to allow immersion of the pH meter electrode. The pH meter was calibrated before measurement. The electrode was placed in each sample, and pH was recorded to 2 decimal places. Each sample was measured twice; the electrode remained in the sample for 60 seconds for each measurement, and the mean value was recorded. After each use, the electrode was washed several times with physiological saline and recalibrated.

To measure saliva movement in the capillary tube, the sample container was placed on a flat surface immediately after collection. The capillary tube was positioned vertically against the side of the container so that it contacted the bottom. After 60 seconds, the height of saliva in the capillary tube was measured in millimeters. The tube was removed slowly and read at eye level. Because the saliva formed a concave meniscus, the lower level was used for all measurements. Salivary pH and viscosity were measured immediately after sample collection (11).

3.3. Statistical Analysis

After data collection, the data were coded and entered into SPSS version 23. The Kolmogorov-Smirnov test was used to assess normality. Mean saliva movement in the capillary tube and salivary pH were compared between

groups using independent t tests. The significance level was set at 0.05.

3.4. Ethical Considerations

The study was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences, Yazd (IR.SSU.REC.1396.142). Written informed consent was obtained from all participants.

4. Results

A total of 41 participants were included: 21 OCP users (case group) and 20 non-users (control group). The mean age was 31.81 years in the OCP user group and 30.70 years in the OCP non-user group ($P = 0.610$) (Table 1).

The mean salivary pH in the OCP user group was 7.2434 ± 0.5665 SD, which was higher than that in the non-user group (7.0335 ± 0.7049 SD); however, the difference was not statistically significant ($P = 0.297$) (Table 2).

The mean saliva movement in the capillary tube was $10.7633 \text{ mm} \pm 0.9042$ SD in the OCP user group and $11.7715 \text{ mm} \pm 1.3553$ SD in the non-user group. The mean rate of saliva movement was higher in non-users than in OCP users ($P = 0.008$), indicating lower salivary viscosity in the OCP non-user group (Table 3).

5. Discussion

Saliva is a vital fluid containing numerous organic and inorganic substances secreted by the major and minor salivary glands into the oral cavity, and changes in salivary quantity and quality may reflect changes elsewhere in the body (12). Salivary characteristics are considered useful markers for diagnosing various diseases and a potential noninvasive alternative to blood for some diagnostic applications (13, 14). One of the most important functions of saliva is buffering activity. Salivary pH is an important indicator of buffering capacity and the ability to neutralize an acidic oral environment, thereby helping to prevent tooth decay and maintain oral health (10, 15). Another important characteristic is viscosity, which is directly related to salivary protein content. Qualitative or quantitative changes in salivary proteins can alter fluidity and, consequently, affect the cleaning capacity of saliva in the oral cavity (16, 17).

Many drugs can affect salivary properties. Oral contraceptives contain estrogen and progesterone and are commonly taken daily for 3 weeks, followed by a 1-week interruption (18, 19). Because these drugs are often used long term, they may affect salivary properties. Estrogen effects are mediated by estrogen receptors (ERs), including ER α and ER β . Although ERs are expressed in many tissues,

the relative expression of these subtypes varies among tissues. ER β is expressed in the oral epithelium and salivary glands, and changes in estrogen exposure associated with hormone replacement therapy, pregnancy, menopause, or OCP use may alter receptor expression and, in turn, salivary properties (19).

In the present study, the mean salivary pH was slightly higher in OCP users than in non-users, although the difference was not statistically significant. Mean saliva movement in the capillary tube was higher in non-users than in OCP users; therefore, salivary viscosity was lower in non-users, and this difference was statistically significant. A previous study by the authors showed that daily systemic corticosteroid use could also affect salivary viscosity, with patients taking more than 15 mg of corticosteroids daily having higher salivary viscosity than controls, consistent with the present findings (11).

During pregnancy, substantial physiological and hormonal changes occur, including marked increases in estrogen and progesterone. The production of these hormones gradually increases during pregnancy until the eighth month. Increased estrogen and progesterone contribute to changes such as weight gain, increased basal metabolism, increased blood volume, and altered respiration (20).

Estrogen is involved in atrophy and apoptosis by binding to estrogen receptors on ductal and acinar cells, and related changes may occur through effects on mitochondrial oxidative stress. Estrogen activates cytoplasmic kinase systems such as MAPK, PI3K, and JNK. Reduced estrogen can damage cell organelles and increase CASP3 gene expression and caspase-3 protein, which plays a key role in apoptosis (19, 21). Because OCP use produces hormonal conditions that share some features with pregnancy, changes observed in OCP users may also occur in the oral cavity and saliva (19).

Several mechanisms have been proposed to explain changes in salivary pH and buffering capacity (7, 10, 21). During pregnancy, progesterone may reduce plasma bicarbonate and bicarbonate secretion by the salivary glands, thereby reducing salivary pH (21, 22). In the present study, however, salivary pH was higher in OCP users than in non-users, although this difference was not statistically significant. A larger sample might yield different estimates, but participation in the present study was limited.

The major salivary protein α -amylase is secreted by the parotid gland. Researchers have reported that α -amylase activity increases during weeks 10 - 21 of pregnancy. This increase may alter microbial replacement and increase bacterial acid production, potentially reducing salivary pH (20, 22). Salivary composition and secretion are influenced by many hormones, although the exact mechanisms are

Table 1. Demographic Characteristics of OCP Users and Non-Users

Subject Groups	Group Size	Mean Age (y)	Standard Deviation	P-Value
OCP users	21	31.81	7.434	0.610
OCP non-users	20	30.70	6.317	

Table 2. Average Salivary pH in OCP Users and Non-Users

Subject Groups	Group Size	Average pH	Standard Deviation	P-Value
OCP users	21	7.2434	0.5665	0.297
OCP non-users	20	7.0335	0.7049	

not fully understood. Increased serum estrogen during pregnancy has been associated with reductions in sialic acid, pH, and salivary buffering capacity (20, 21).

Laine et al. examined the effect of oral contraceptives on salivary pH and reported findings similar to those of the present study (23). They proposed that increased pH in women taking oral contraceptives may reflect differences between synthetic and endogenous steroids. Synthetic steroids may increase salivary pH, whereas endogenous steroids during pregnancy tend to decrease it. Long-term corticosteroid use may decrease salivary pH and increase viscosity, causing qualitative and quantitative salivary changes that can affect oral and dental health (11). Because increased salivary viscosity and reduced pH may adversely affect oral health and quality of life, oral health should be monitored carefully in patients receiving systemic corticosteroids. Regular oral health evaluations may help reduce these adverse effects.

One possible explanation for altered unstimulated saliva in women using OCPs is that estrogen may affect the submandibular glands, contributing to glandular atrophy, reduced salivary secretion, xerostomia, and impaired quality of life (24). Estrogen may also affect beta receptors and reduce salivary gland growth, gland weight, and the number and size of glandular tubules, thereby altering salivary properties. Another proposed mechanism is that exogenous estrogen may alter estrogen levels in the oral mucosa and contribute to salivary gland atrophy (25).

Oral problems are more prevalent in menopausal women than in nonmenopausal women. Dry mouth is common among menopausal and older women, with reported prevalence ranging from 14% to 46% (26). A study of salivary viscosity and pH in premenopausal women, menopausal women, and menopausal women receiving hormone replacement therapy reported the lowest viscosity among menopausal women. Other diseases, including diabetes and hypertension, may also alter

salivary pH and viscosity, as shown in previous studies by our team (27-29). In the present study, salivary viscosity was higher in OCP users, potentially because hormonal effects on salivary ducts reduce secretion and increase viscosity. The current findings were also similar to those reported by Hosseini-mehvar et al., who found reduced unstimulated saliva in women exposed to industrial steroids compared with women who did not use these drugs (30).

The study by Bellagambi et al. reported age-related changes in salivary quantity and quality. To reduce age as a confounding factor, the present study included women aged 25 - 35 years. Because salivary volume can vary throughout the day, samples were collected between 9 and 11 AM. Various methods can be used to measure pH; pH indicator paper can be difficult to read precisely, whereas a digital pH meter reduces this source of error (4). Because viscosity is inversely related to temperature, 25 °C was used as the standard temperature for measuring saliva movement in the capillary tube in mm per 60 seconds. The measurement time was 60 seconds for all samples. Each measurement was repeated twice, and the mean was recorded. Water moved 24 mm in 60 seconds in the capillary tube, whereas glycerin moved 8 mm in 60 seconds; these were used as comparison standards. This simple indirect method for measuring salivary viscosity has previously been used by the author (11, 27, 28). Because the method is indirect, a direct method may yield more precise results.

5.1. Study Limitations

The small sample size was the main limitation of this study.

5.2. Conclusions

The present study showed that women who did not use oral contraceptives had lower salivary viscosity than OCP users. Thus, OCP use was associated with increased salivary

Table 3. Saliva Movement in the Capillary Tube (mm per 60 Seconds) in OCP Users and Non-Users

Subject Groups	Group Size	Average	Standard Deviation	P-Value
OCP users	21	10.7633	0.9042	0.008
OCP non-users	20	11.7715	1.3553	

viscosity, which could affect oral health. Periodic oral health consultations may therefore be useful for women taking OCPs to monitor changes in salivary properties.

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Footnotes

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