EFFECT OF VIRGIN COCONUT OIL PULLING ON SALIVARY BACTERIAL COUNT VERSUS FLUORIDE MOUTHWASH IN A GROUP OF EGYPTIAN TEENAGERS—RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Maintaining oral health is essential for overall well-being, and the use of effective oral hygiene practices is critical for preventing dental diseases. This study investigates the efficacy of virgin coconut oil pulling compared to fluoride mouthwash in reducing salivary bacterial counts among Egyptian teenagers.

Objective: The primary aim of this randomized controlled trial was to compare the impact of virgin coconut oil pulling and fluoride mouthwash on salivary bacterial counts over a 4-week period in a sample of Egyptian adolescents aged 15 to 18.

Methods: A total of 72 participants were randomly assigned to two groups (36 per group): one using virgin coconut oil pulling and the other using fluoride mouthwash. Saliva samples were collected to measure salivary bacterial counts at baseline, 2 weeks, and 4 weeks post-intervention. Statistical analysis was performed using independent t-tests and repeated measures ANOVA, setting the significance level at $p \leq 0.05$.

Results: Both groups demonstrated a statistically significant reduction in salivary bacterial counts over the study period ($p < 0.001$). However, there was no statistically significant difference between the two interventions at any time point ($p > 0.05$).

Conclusion: This study confirms that both virgin coconut oil pulling and fluoride mouthwash are effective in reducing salivary bacterial counts among Egyptian teenagers. Given the cultural preference in Egypt for natural remedies, virgin coconut oil pulling can be considered a viable alternative to fluoride mouthwash. Future studies should explore the long-term effects and broader implications of these practices on oral health.

KEYWORDS: Virgin coconut oil pulling, fluoride mouthwash, salivary bacterial count, oral health, teenagers, randomized controlled trial, Egypt

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INTRODUCTION

Oral health is a fundamental component of overall health and well-being. Poor oral hygiene can lead to the accumulation of dental plaque, which harbors various pathogenic bacteria, contributing to the development of dental caries, gingivitis, periodontitis, and other systemic conditions such as cardiovascular disease and diabetes. Maintaining a low bacterial count in the oral cavity is essential for preventing these diseases (**Teshome et al., 2021**).

Dental caries, a common but preventable disease, is characterized by the destruction of tooth structure and is primarily caused by the interaction between cariogenic bacteria, fermentable carbohydrates, and a susceptible host (**Equbamichael et al., 2010**). The prevention of dental caries presents a significant challenge, particularly among economically disadvantaged populations who may lack access to commercially available oral hygiene products (**Şener, 2019**). Caries caused by the proliferation of harmful bacteria in the oral cavity. Fluoride mouthwash is widely used to reduce salivary bacterial counts and prevent dental caries, but there is growing interest in natural alternatives like virgin coconut oil pulling. Despite the traditional use of oil pulling and its increasing popularity, scientific evidence supporting its efficacy is limited and inconclusive.

In the Egyptian context, where cultural preferences for natural remedies are strong, understanding the comparative effectiveness of these two methods is particularly relevant. However, no comprehensive studies have been conducted to directly compare the impact of virgin coconut oil pulling and fluoride mouthwash on salivary bacterial counts in this population (teenagers). This gap in research creates uncertainty regarding the best practices for oral hygiene, particularly for individuals seeking natural alternatives (**Peedikayil et al., 2015**). The investigation of oral health knowledge, attitudes, and behaviors among school students in Arab nations is an area of ongoing interest, with studies revealing varying degrees of understanding and compliance with oral healthcare practices (**Alkalash et al., 2023**). The aim of this study is to evaluate and compare the effectiveness of virgin coconut oil pulling versus fluoride mouthwash in reducing the salivary bacterial count in a group of Egyptian teenagers.

METHODOLOGY

The clinical trial will be conducted as a multicenter study, primarily based at the Faculty of Dentistry, Cairo University, Egypt, in collaboration with other participating sites. Ethical approval has been obtained from the Research Ethics Committee of the Faculty of Dentistry, Cairo University. Informed consent will be signed by all participants or their legal guardians.

This study will employ a randomized controlled trial (RCT) design, with participants randomly assigned to one of two groups: a virgin coconut oil pulling group or a fluoride mouthwash group. To ensure a statistically significant and representative sample, recruitment will be carried out strategically through partnerships with multiple local schools and community centers across the greater Cairo metropolitan area, enhancing the study's generalizability.

Sample size calculation:

A power analysis was designed to have adequate power to apply a two-sided statistical test of the null hypothesis that no difference would be found between different tested groups regarding bacterial count. By adopting an alpha (α) level of (0.05), a beta (β) level of (0.2) (i.e., power=80%), and an effect size (d) of 0.747) calculated based on the results of a previous study; the total required sample size (n) was found to be (60) cases. The sample size was increased by (20%) to account for possible dropouts to be (72) cases (i.e., 36 cases per group). Sample size calculation was performed using R statistical analysis software version 4.4.1 for Windows (**Kaushik, Mamta, et al 2016**).

Eligibility criteria:

Inclusion Criteria of participants:

1. Teenagers aged 15-18 years

2. No current use of antibiotics or antiseptic mouthwash

3. Good general health with no underlying systemic diseases

4. Willingness to comply with the study protocol

5. Patients should have high ($\geq 10^5$ CFU) to moderate (10^4-10^5 CFU) bacterial count (**Sharma et al., 2016**).

Exclusion Criteria of participants:

1. Allergies to coconut or fluoride

2. Active oral infections or severe periodontal disease

3. Use of any other oral hygiene products during the study period

A total of **72 eligible participants** were enrolled and **randomly assigned** into two equal groups (**n=36 each**) using **computer-generated randomization** (block randomization to ensure balance). To prevent selection bias, **allocation concealment** was maintained using **sequentially numbered, opaque, sealed envelopes (SNOSE)**, which were opened only after participant enrollment.

• **Group A1 (Control):** Received a **fluoride mouthwash** (e.g., 0.05% NaF, twice daily).

• **Group A2 (Intervention):** Performed **virgin coconut oil (VCO) pulling** (10 mL, once daily for 10 minutes).

The study duration was **4 weeks (T)**, with **saliva samples** collected at three intervals:

• **Baseline (T0),**

• **After 2 weeks (T1),**

• **After 4 weeks (T2).**

Streptococcus mutans counts were analyzed to compare the antimicrobial efficacy between the two groups.

-Interventions:

Pre-Intervention Measures (Standardization Protocol)

Prior to the study, all participants underwent:

1. **Professional Oral Prophylaxis:**

o Full-mouth **scaling and polishing** to remove plaque and calculus.

2. **Oral Hygiene Reinforcement:**

o Demonstration of **modified Bass brushing technique** and flossing

· **Intervention Group (Virgin Coconut Oil Pulling):**

Participants will swish 10 ml of virgin coconut oil in their mouths for 15 minutes daily in the morning before breakfast. They will then spit out the oil and rinse their mouths with water.

· **Control Group (Fluoride Mouthwash):**

Participants will use 10 ml of fluoride mouthwash, rinsing for 2 minutes daily in the morning before breakfast. They will then spit out the mouthwash and avoid eating or drinking for at least 30 minutes afterward.

- Saliva Sample Collection:

Unstimulated saliva samples will be collected at baseline, 2 weeks, and 4 weeks.

Participants will be instructed to refrain from eating, drinking, or using any oral hygiene products for at least 1 hour before sample collection.

- Microbiological Analysis:

Baseline Assessment:

• Saliva samples will be collected from all participants at baseline (before the start of the intervention) to measure initial salivary bacterial counts.

- A questionnaire will be administered to assess baseline oral hygiene habits and preferences.

- **Follow-up Assessments:**

- Saliva samples will be collected at the end of weeks 2 and 4 to assess changes in bacterial counts.

- A follow-up questionnaire will be administered at the end of the study to evaluate participant satisfaction, preferences, and any side effects experienced during the intervention.

- **Laboratory Procedures:**

  1. **Saliva Collection:**

- Participants will provide saliva samples in sterile containers in the morning before any oral hygiene activities **(Prohibited Before Sampling)** Participants must refrain from:

- **Toothbrushing** (manual or electric)

- **Mouthwash/rinsing** (including water, antiseptic, or fluoride rinses)

- **Flossing/interdental cleaning**

- **Tongue scraping/cleaning**

- **Oil pulling or any other oral practices**

- **Chewing gum/mints/lozenges**

- **Bacterial Count Measurement:**

- Saliva samples will be cultured on agar plates in a laboratory, and colony-forming units (CFUs) will be counted to quantify bacterial load

RESULTS

Statistical analysis:

Data was analyzed using Medcalc software, version 22 for windows (MedCalc Software Ltd, Ostend, Belgium). Logarithmic transformation was done to bacterial count data. Continuous data was explored for normality using Kolmogrov Smirnov test and Shapiro Wilk test. Continuous data showed normal distribution and was described using mean and standard deviation. Intergroup comparison of bacterial count values was performed using independent t test. Intragroup comparison within each intervention was performed using repeated measures ANOVA followed by Bonferroni corrected pairwise comparisons. The confidence level was set at 95%, with statistical significance of $P \leq 0.05$, 80% power and all tests were two tailed.

TABLE (1) Demographic data

Group	Age	Gender			Smoking Status		
		Male	Female	Row total (RT)	Yes	No	Row total (RT)
Virgin coconut oil	16.20±1.13	17	20		6	31	
		45.9% RT	54.1% RT	37 (51.4%)	16.2% RT	83.8% RT	37 (51.4%)
		50.0% CT	52.6% CT		54.5% CT	50.8% CT	
Fluoride mouthwash	16.31±1.26	17	18		5	30	
		48.6% RT	51.4% RT	35 (48.6%)	14.3% RT	85.7% RT	35 (48.6%)
		50.0% CT	47.4% CT		45.5% CT	49.2% CT	
Column total (CT)		34	38	72	11	61	72
		47.20%	52.80%		15.30%	84.70%	
Significance level	P = 0.695	P = 0.8247			P = 0.8212		

There was no statistically significant difference between both groups regarding age, gender and smoking status (P > 0.05).

TABLE (2) Mean and SD of log bacterial count (CFU/ml) for intergroup comparison between interventions with each follow-up and intragroup comparison within each intervention between follow-up periods:

Variable	Virgin coconut oil		Fluoride mouthwash		Difference	95% CI	P value
	Mean	SD	Mean	SD			
Baseline	4.68	0.12	4.73	0.10	0.049	-0.005 to 0.104	0.0775
2-Weeks	4.43	0.15	4.46	0.12	0.033	-0.033 to 0.100	0.3241
4-Weeks	4.17	0.20	4.22	0.23	0.047	-0.057 to 0.151	0.3686
P value	<0.001*		<0.001*				

Intergroup comparison revealed no statistically significant difference between both groups at baseline, after 2 and 4 weeks ($P > 0.05$). Intragroup comparison showed statistically significant decrease in bacterial count within both groups ($P < 0.001$).
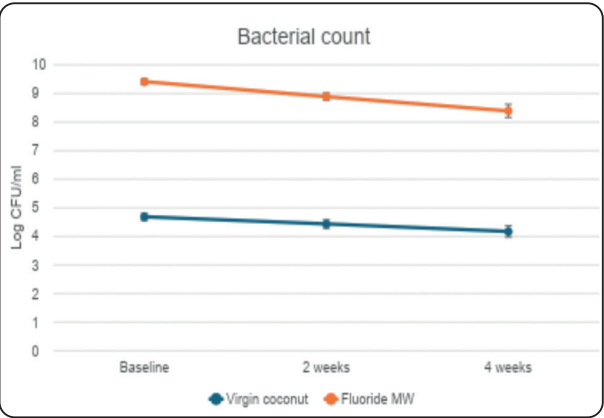

Fig. (1) Line chart showing change in bacterial count within each group through time

DISCUSSION

The present study aimed to evaluate the effectiveness of virgin coconut oil pulling in reducing salivary bacterial counts compared to fluoride mouthwash in a group of Egyptian teenagers. The findings indicated that both interventions led to a statistically significant decrease in bacterial counts over the four-week trial period, but no significant difference was observed between the two methods at any time point. This contributes to the ongoing discourse on the efficacy of natural remedies in oral health and provides critical insights for practitioners and patients alike.

The antibacterial effects of **fluoride mouthwash** primarily stem from:

1. **Enzymatic Inhibition:** Fluoride disrupts bacterial glycolysis by inhibiting enolase, impairing acid production by *Streptococcus mutans* (Hamilton, 1990).

2. **Biofilm Disruption:** Fluoride ions penetrate plaque biofilms, reducing bacterial adhesion and promoting desorption from tooth surfaces (Marquis et al., 2003).

3. **Remineralization:** While not directly antibacterial, fluoride enhances enamel resistance to acid attacks, indirectly suppressing cariogenic bacteria over time (Featherstone, 2008).

In contrast, **VCO pulling** exerts its effects through:

1. **Saponification:** The medium-chain fatty acids (e.g., lauric acid) in VCO react with salivary alkali to form soap-like compounds that mechanically reduce bacterial adhesion (Asokan et al., 2009).

2. **Membrane Disruption:** Lauric acid lyses bacterial cell membranes, particularly against Gram-positive bacteria like *S. mutans* (Bergsson et al., 2001).

3. **Emulsification:** The viscous nature of oil traps biofilm and debris, physically removing microbes during expectoration (Singh & Purohit, 2011).

The favorable outcomes associated with both virgin coconut oil pulling and fluoride mouthwash align with previous research exploring the antibacterial properties of coconut oil. A systematic review by Asokan et al. (2011) suggested that oil pulling could effectively reduce oral bacteria, including Streptococcus mutans, albeit with varying results across different studies. Similarly, fluoride mouthwash is well-documented for its role in cavity prevention and reduction of pathogenic bacteria (Hughes et al., 2017). However, the absence of a statistically significant difference between the two modalities in the current study underscores that while both approaches are effective, they may provide comparable benefits regarding bacterial load reduction.

In the Egyptian context, where traditional practices and natural remedies are valued, this study's findings have practical implications. The prominent reliance on coconut oil as a natural alternative can be supported by research indicating that cultural perceptions significantly influence health behaviors (Alkalash et al., 2023). The study's results may not only validate the continued use of coconut oil pulling within communities that favor natural remedies but also encourage practitioners to recommend it alongside traditional products like fluoride mouthwash.

Despite the positive findings, the study has limitations that warrant discussion. One limitation is the reliance on salivary bacterial counts as the sole measure of efficacy, which may not fully capture the longer-term oral health benefits of either intervention. Future studies could expand the measurements to include clinical parameters, such as changes in plaque score or gingival health, to provide a more comprehensive picture. Additionally, the sample was limited to adolescents in Cairo,

reducing the generalizability of the findings to broader populations. A multi-center study involving diverse demographic groups across Egypt could enhance the external validity of future research.

Lastly, variability in participants' adherence to the intervention protocols may have influenced the results. Detailed monitoring of participant compliance would be essential in future studies to better understand the practical implications and efficacy of these oral hygiene practices.

Limitations and Future Directions

1. **Outcome Measures:** Reliance solely on bacterial counts overlooks clinical endpoints (e.g., plaque/gingival indices).

2. **Generalizability:** The Cairo-centric adolescent sample limits broader applicability.

3. **Adherence:** Unmonitored compliance may have skewed results—future trials should incorporate diaries or biomarkers.

CONCLUSION

In conclusion, natural alternatives may effectively complement traditional oral hygiene practices. Given the cultural preferences for natural remedies in Egypt, the inclusion of coconut oil pulling in oral health recommendations may enhance compliance and promote better oral health outcomes. Further research is needed to explore broader implications and confirm these findings across diverse populations and may target different cariogenic bacteria.

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