

# Exploring the Complex Relationship between Mouthwashes and Cardiovascular Health: A Comprehensive Review of Evidence

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**Abstract:** *This comprehensive review delves into the intricate interplay between oral health and general well-being, focusing on the controversial link between mouthwash use and cardiovascular diseases. While oral care is vital for overall health, recent studies have raised concerns about potential adverse effects of common mouthwashes, particularly their impact on nitric oxide bioavailability and oral microflora disruption. This article critically analyzes existing evidence, discussing mechanisms by which mouthwash use might contribute to cardiovascular risks. The review underscores the need for further research and awareness among healthcare professionals and patients alike to make informed decisions regarding oral care practices.*

**Keywords:** Mouthwashes, Cardiovascular health, Nitric oxide, Oral microflora, Evidence review

## 1. Introduction

Without good oral health you cannot have a good general health also for maintaining and improving oral health oral care is very much essential.<sup>1,2</sup> Mouthwashes are used by a 31% of dentate adults according to The Adult Dental Survey<sup>2,3</sup> as oral hygiene practices and also is one of the foremost component in the daily oral hygiene for decades with assuring benefits. Commonly available over-the-counter oral rinses typically contain antiseptic components like chlorhexidine, alcohol, which helps in reducing bacteria, bad breath and plaque reduction, infections. However recent studies have raised concerns about the potential link between mouthwash use and increased risk of cardiovascular diseases. This review set one's sight on the current evidence around this topic and discusses the persuasive mechanisms suggesting mouthwash use and increased risk of heart diseases on using mouthwash for a long-term. This review article sheds light on available evidences and underlying mechanisms by summarising current data.

### Problem outline-are mouthwashes harmful?

As recent studies suggested that for systemic Nitric Oxide-bioavailability oral microbes are important<sup>4</sup>. Since 99% of mouthwash contains some antibacterial ingredient which helps to reduce oral bacteria and gingivitis<sup>4, 5, 6, 7</sup> but at same time tends to kill NO producing bacteria which reduces plasma nitrite levels resulting in increased Blood pressure. NO is well-know factor in cardiovascular health as it has a direct vasodilation effect<sup>2</sup>.

**Underlying Mechanism:** Possible mechanisms suggested by recent studies.

**Inhibited conversion of nitrate to nitrite and increased BP:** Nitric Oxide plays key role in maintaining Basal vascular tone and Blood

Pressure. There are majorly two pathways which are responsible for the main source of NO in the body. First is the endogenous L-arginine-NOS pathway and the second is exogenous nitrate-nitrite-NO pathway. These two pathways are interlinked too. L-arginine NOS pathway produces NO which is rapidly oxidised to nitrite and nitrate. Together with nitrate from diet this nitrate enters Nitrate-nitrite-NO pathway. Now the nitrate is actively absorbed by the salivary glands from plasma and which is concentrated in saliva. Now this nitrate is converted into nitrite by the oral facultative anaerobic nitrate reducing bacteria. Upon swallowing some nitrite gets absorbed into blood stream which acts as source of vasodilatory NO. Oral nitrate reductase containing bacteria converts Nitrate to Nitrite which stimulates NO-signaling. Mouth-rinsing with Chlorhexidine  $\geq$  twice daily diminishes the effects of exogenous nitrate-dependent increases in plasma and salivary nitrate and nitrite, which leads to increased blood pressure among hypertensive and even in normotensive individuals<sup>4, 8-14</sup>. For the entrosalivary nitrate-nitrite NO pathway Oral facultative bacteria are essential as they have their capacity to reduce nitrate to nitrite. Oral bacterial flora is eradicated by antiseptic mouthwashes because of this nitric oxide-generating pathway is abolished, which may result in nitric oxide-deficient conditions potentially leading to life-threatening complications such as ischemic heart events or sepsis.<sup>2</sup> Mouthwashes containing antiseptic properties against Nitrate reducing oral bacteria can be capable of causing NO bioavailability to decrease which can provoke adverse cardiovascular events.<sup>2</sup>

**Disruption of oral microflora:** Using mouthwash twice or more than that can disrupt the natural balance of oral cavity this leads to change in production of certain metabolites such as nitric oxide which plays exclusive role in cardiovascular health. Reduced nitric oxide bioavailability may contribute to endothelial dysfunction, inflammation, and arterial stiffness, thereby increasing the risk of heart diseases. A 0.12% chlorhexidine antiseptic

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mouthwash destroys up to 94% of the oral bacteria that reduce nitrate and decreases the proportion of reduced nitrate by 85% (from 17 to 4%)<sup>2, 15</sup>.

**Absorption of ingredients systemically:** Certain ingredients like alcohols and other chemical components can be absorbed into bloodstream when oral rinses are used frequently causing blood pressure to rise.

## 2. Discussion

### Current evidences questioning safety of mouthwashes-

**1:** A study from 2020 by Stijn Bolt<sup>2</sup> generated a hypothesis that a disturbance in nitric oxide homeostasis by antiseptic mouthwash may be responsible for increase in mortality risk. In various physiological pressures Nitric oxide is important as it can worsen much pathology such as arteriosclerosis. Nitric oxide generating pathway is terminated because of antiseptic mouthwashes suppresses bacterial flora which leads to critical conditions like heart events and sepsis<sup>2</sup>.

Recent study conducted by San Juan Overweight Adults Longitudinal Study (SOALS) published in 2021 concluded that there is an increased risk of hypertension with frequent constant use of antiseptic over the counter mouthwashes independent of major risk factors for hypertension. People have 85% increased risk of physician-diagnosed hypertension as compared to those with less frequent users to those who use over-the-counter mouthwashes more than twice or equal<sup>4</sup>. Even a weaker antibacterial over-the-counter mouthwash has the capacity to reduced plasma nitrate levels<sup>4, 12, 13</sup>.

Study published in American journal of hypertension May 2015 concluded that that small elevation of systolic blood pressure and interruption of the nitrate-nitrite-NO pathway are parallel with each other in treated hypertensive men and women<sup>16</sup>. Also, the study showed increase in blood pressure with blunt nitrate reduction over 7 days result. The main objective of this study therefore was to assess the effects NO status and blood pressure in treated hypertensive men and women after 3-day use of antibacterial mouthwashes which resulted in significant increase in systolic blood pressure that compared to control<sup>16</sup>.

4. Dental Tribune International published an article on 2018. The researchers used 16S rRNA gene sequencing and analysis to examine whether using chlorhexidine antiseptic mouthwash twice a day for one week would change the oral bacterial communities and blood pressure levels in 26 healthy individuals. And resulted indicated that using chlorhexidine twice a day was associated with a significant increase in systolic blood pressure and that recovery from use resulted in an enhancement in nitrate-reducing bacteria on the tongue. Individuals with relatively high levels of bacterial nitrite reductases had lower resting systolic blood pressure<sup>17</sup>.

### Evidences favoring Mouthwashes-

1. A study published in Singapore medical journal in 2016

concluded the use of chlorhexidine 0.2% significantly reduced oral colonization and is recommended as an easier and more cost-effective alternative for oral hygiene<sup>18</sup>.

2. Another study from international journal of dental hygiene (2018) concluded chlorhexidine was effective for prevention of nosocomial pneumonia and ventilator-associated pneumonia in adult population in cardiothoracic intensive care unit<sup>19</sup>.

3. Recent UK National Institute for Health and Clinical Excellence guidelines state that there is no longer a need for oral antibiotic prophylaxis in patients undergoing dental procedures who are at risk of infective endocarditis (IE), and advocate the importance of maintaining good oral health. As viridian group streptococci (VGS) are common etiological agents of Infective endocarditis and inhabitants of the mouth. The study concluded that such mouthwashes are able to completely kill VGS organisms tested in planktonic solution, where their use would promote good oral hygiene in patients at risk of IE<sup>20</sup>.

Also, A study published in American Journal of Hypertension, Volume 28, by Catherine P. Bondonno, et. al mentioned that use of toothpaste containing an antibacterial agent Triclosan had no effect on oral nitrate reduction<sup>21, 16</sup> which can be a alternative to mouthwashes.

## 3. Limitations

Most of the studies are observational and don't directly assess oral nitrate reducing activity with mouthwash use<sup>3</sup>. Also researchers should conclude result by considering other factors responsible for high blood pressure such as lifestyle, habits such as smoking, age, gender, genetics to establish a definitive link.

Further studies need to investigate does different antibacterial agent mouthwashes has same effect or not on cardiovascular diseases also the consequence of mouthwash in population with high risk for cardiovascular diseases. So that healthcare professionals and consumers can make informed decisions about oral care practices.

## 4. Conclusion

In the realm of oral health and cardiovascular well-being, the association between mouthwashes and heart diseases remains an evolving and multifaceted subject. This review underscores the complexity of the relationship and the need for more extensive research to establish a conclusive connection. Healthcare professionals and patients should exercise caution and remain informed about this emerging area of study. As research advances, a deeper understanding of the impact of mouthwash use on cardiovascular health will empower oral professionals to guide the public in making informed choices about their oral care routines.

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