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AN OBSERVATIONAL STUDY ON THE EFFECTS OF BETEL NUT CHEWING ON MASTICATION MUSCLES AND THE DEVELOPMENT OF TRISMUS

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ABSTRACT

Background: Betel nut (areca nut) chewing is a common habit in many Asian countries and is associated with several oral health disorders, including oral submucous fibrosis (OSMF), muscle stiffness, and trismus. Prolonged chewing may adversely affect the muscles of mastication, leading to restricted mouth opening and impaired oral function.

Objective: To investigate the effects of betel nut chewing on mastication muscles and its role in the development of trismus among adult individuals.

Methods: A cross-sectional observational study was conducted on 120 participants, comprising 60 chronic betel nut chewers and 60 non-chewers. Participants aged between 21 and 80 years were assessed using the Maximum Mouth Opening (MMO) test and the Vertical Three-Finger Test (Ruler Test). Data were analyzed using descriptive statistics and the Mann–Whitney U test to compare oral function between the two groups.

Results: The mean age of participants was 41.49 ± 21.71 years. Betel nut chewers demonstrated significantly reduced oral function compared to non-chewers. The mean MMO was lower among chewers (2.18 cm) than non-chewers (2.93 cm). Similarly, the mean Ruler Test score was lower in chewers (30.94 mm) compared to non-chewers (45.65 mm). Mann–Whitney U analysis revealed statistically significant differences in both MMO ($U = 674.000$, $p < 0.001$) and Ruler Test scores ($U = 170.000$, $p < 0.001$) between the groups. Male participants were more likely to be habitual betel nut chewers than females.

Conclusion: Chronic betel nut chewing is significantly associated with reduced mouth opening, impaired mastication muscle function, and an increased risk of trismus. Early identification of oral functional limitations and awareness programs aimed at reducing betel nut consumption may help prevent long-term oral health complications.

Keywords: Betel Nut Chewing, Areca Nut , Mastication Muscles, Trismus, Maximum Mouth Opening (MMO), Oral Submucous Fibrosis (OSMF), Oral Function, Jaw Muscle Dysfunction, Physiotherapy, Oral Health Assessment.

INTRODUCTION

Betel nut (Areca nut) is commonly consumed in many Asian countries, especially in India, Bangladesh, Sri Lanka, and parts of Southeast Asia. It is often chewed alone or mixed with tobacco, lime, or betel leaves. While it provides a mild stimulant effect, chronic betel nut chewing is linked to serious oral health issues, including oral sub mucous fibrosis (OSMF), muscle stiffness, and truisms (restricted mouth opening). Truisms is a condition where the jaw muscles become stiff and fibro-tic, leading to reduced mouth opening, difficulty in chewing, and speech problems. It is often associated with progressive fibrosis of the masseter, temporalis, and pterygoid muscles, which are essential for normal jaw function. Early detection of muscle dysfunction is crucial to prevent irreversible jaw restriction and functional impairment. The custom of chewing betel nut (or areca) is a very old tradition. Its use is universally acceptable in all parts of society, including the disabled, including women and children. [1] While chewing is a defining characteristic of mammals, there is significant variation among all its elements. Excluding highly specialized feeding mechanisms like those found in whales and anteaters, This conversation will focus on the usual process of chewing in anteaters, highlighting the variations among species that are frequently studied. The activation and coordination of mastication muscles influence the movement of the jaw, regulate the pressure during occlusion, and cause various changes in the structure of the skull. This discussion will focus on standard chewing processes, highlighting variations among species often utilized in research. The activation and coordination of mastication muscles dictate jaw movement direction, manage occlusion force, and influence skull deformation in various ways. Therefore, the essential aspects to comprehend are the action line, force generation, and their connection to the cranium. The dynamics of action and force generation in the complex mastication muscles are less clear-cut compared to limb muscles, which typically have a more linear arrangement. The irregular shape of the skull presents similar challenges, making it difficult to accurately model how muscles exert influence on the bones.[2] The practice of chewing betel (or areca) nut is an age-old tradition. Its consumption is widely recognized and accepted across various social groups, including women. Betel nut ranks as the fourth most frequently used psychoactive substance worldwide, following caffeine, alcohol, and nicotine Betel nut can be found-in various chewing products such as mawa, paan, guttural, khaini, and paan masala. The purposes of using betel nut include inducing euphoria, alleviating 2 fatigue, enhancing salivation, achieving satiation, and even providing relief from toothaches. [4 ;5] Consuming betel nut regularly is recognized as harmful to human health. [6] The World Health Organization and the International Agency for Research on Cancer have categorized betel nut as a group 1 human carcinogen. [7] The International Agency for Research on Cancer identifies paan and guttural recognized human as products that contain carcinogens, with betel nut thought to be the primary offender. [8] The lack of tobacco or lime betel could possibly lead to detrimental impacts on the oral cavity. These impacts can be categorized into two main groups: Those influencing the dental hard tissues, which encompass teeth, their supporting periodontics, and TMJ , and the soft tissues, which constitute the mucous that lines the oral cavity. [9] The rate of chewing the behavior. Root and fractures the length of have also been shown in long-term betel chewers, and this is probably due to the heightened mastication stress that is exerted on the teeth, rather than a direct impact of betel. [10]

1. **TEMPORALIS MUCSCLE**

   The temporal-is muscle originates. After the temporal-is muscle fibers converge inferior, a tendon emerges from the temporal fossa, travels beneath the zygomatic arch, and attaches to the mandibular coronoid process. The mandible is raised by the anterior and mid fibers of the temporal-is muscle.[11]

2. **MEDIAL PTERYGOID MUSCLE**

   The thick, rectangular medial pterodactyl muscle has both a superficial and a deep head. The maxillary tuberosity of the inferior maxilla is the origin of the superficial head of the medial pterodactyl. The mandible can be raised and protruded with the help of the medial pterodactyl muscle. Additionally, it helps the lateral pterodactyl muscle with side-to-side mandibular action, which aids in food crushing.[12]

3. **LATERAL PTERYGOID MUSCLE**

   The components of the lateral pterodactyl. The inferior temporal side of the greater wing of the spheroid bone is where the upper head of the lateral pterodactyl muscle originates. The lateral portion of the spheroid bone's lateral pterodactyl plate is where the lower head begins. The only mastication muscle that can produce mandibular depression is the lateral pterodactyl muscle. Given this, gravity is mostly to blame for mandibular depression. Additionally, it facilitates the mandible's protrusion and side-to-side motion. [13]

4. MASSETER MUSCLE

The three levels of the masseter muscle are superficial, deep, and intermediate, and it has a rectangular shape. With a connection to the posterior portion of the zygomatic bone, the masseter muscle originates from the inferior zygomatic arch and the anterior two-thirds of the zygomatic arch. A tendon that inserts the exterior of the mandibular ramus and coronoid process of the mandible is formed by the inferior convergence of the masseter muscle fibers. The mandible is raised and the teeth are approximated by the masseter muscle; the mandible is also retracted by the masseter's intermediate and deep muscle fibers. Additionally, the mandible is protruded by the superficial fibers.[14, 15].

2. OBJECTIVES

AIM: To investigate the effects of betel nut chewing on mastication muscles and its role in the development of trismus.

OBJECTIVES: To assess the severity of jaw muscle dysfunction in long-term betel nut chewers. .To evaluate the harmful effect of betel nut chewing .

NEED FOR STUDY:

- Limited research exists on how betel nut chewing specifically affects the mastication muscles and leads to trismus. Early identification of muscle changes can help in timely physiotherapy intervention, preventing severe complications.

- This study aims to provide clinical evidence regarding the functional impact of betel nut chewing on the jaw muscles.

3. REVIEW OF LITERATURE

1. Chang C. K, Lee J. I, Chang C. F ET AL in 2021 demonstrated in their research that chewing betel nut is linked to the risk of kidney stone disease. They evaluated and categorized their data into two groups: never-chewer and ever-chewer groups. The average age of the individuals in the current study was 50 years, and 16% were identified as ever-chewers. Kidney stone disease was noted in 3759 (10. 3%) and 894 (12. 6%) individuals in the never-chewer and ever-chewer groups, respectively. An increased risk of kidney stone disease was identified in participants who chewed betel nut compared to those who did not chew betel nut.

2. Lin W. Y, Sunyer F. X. Pi, Liu C. S et al in 2009 also examine in their research that the link between betel nut chewing and overall obesity (BMI ≥25kg/m2) and central obesity (waist circumference (WC) ≥90 cm). A total of 1,049 male participants, aged ≥40 years. The connections between betel nut chewing and

overall and central obesity were analyzed using multiple linear and logistic regression techniques. The rates of current and former betel nut chewing were 7. 0 and 10. 5% among males. Current/former betel nut chewers exhibited a greater rate of overall and central obesity in comparison to individuals who had never engaged in betel nut chewing.

3. C. R. TRIVEDY, G. CRAIG2 and S. WARNAKULASURIYA in 2002 discovered that the harmful effects of areca nut on oral soft tissues are widely documented in major oral diseases, yet are less thoroughly investigated. Areca-induced lichenoid lesions primarily on the buccal mucosa or tongue are noted at sites where quid is retained. In chronic dental literature. Its impact on dental caries and periodontal tissues, two chewers a condition referred to as betel chewer's mucosa, a discolored areca nut-encrusted alteration, is frequently observed where the quid particles remain. Areca nut chewing is associated with oral leukoplakia and sub-mucous fibrosis, both of which can be potentially malignant within the oral cavity. Oral cancer often develops from such precancerous alterations in Asian populations.

4. SUSAN W. HERRING MASTICATORY MUSCLES AND THE SKULL: A COMPARATIVE PERSPECTIVE Arch Oral Biol. 2007 April ; 52(4): 296–299. The action of muscles and the biomechanics of the skull are fundamentally connected. From an evolutionary standpoint, the masticatory muscles are adapted alongside dental structure and jaw movements to generate chewing patterns that are specific to each species. In terms of physiology, the mastication muscles represent the primary load on the skull, affect - ing its development and regulating its strength. The action of muscles and the biomechanics of the skull are fundamentally connected. From an evolutionary standpoint, the mastication muscles are adapted alongside dental structure and jaw movements to generate chewing patterns that are specific to each species. In terms of physiology, the mastication muscles represent the primary load on the skull, affecting its development and regulating its strength.

5. Anand R, Dhingra C, Prasad S, Menon I. J Can Res Ther2014;10:499-505. . The tough fibrous quality of the betel nut leads to broken teeth and significant wear of the occlusal surface of teeth in regular users. The molars, premolars, and canine teeth often entirely lose their cuspal shape, and the incisors become shortened. Glycogen utilization is biologically connected to the cellular activity of muscle fibers. Excessive activity of muscles results in too much glycogen utilization, which causes its depletion. In individuals who chew betel nut, there is increased muscular activity due to ongoing, repetitive chewing and the application of strong force to crush the tough nut.

6. Kaur et al. (2018) documented instances where people with long-term betel nut chewing habits experienced considerable limitations in jaw movement. The research highlighted that these subjects exhibited fibrosis of the masseter muscle, resulting in pain and restricted opening.

7. Bali et al. (2015) analyzed the physical changes in the masseter muscle among regular betel nut chewers. Their research indicated significant enlargement and heightened muscle tension in people who habitually chewed betel nuts, with some experiencing difficulty fully opening their mouths, a potential precursor to trismus.

8. Gandhi et al. (2012) explored the relationship between regular betel nut chewing and the occurrence of TMJ disorders. They discovered that those who chew regularly often face limited mouth opening due to

muscle stiffness, pain, and discomfort, which might progress to trismus.

9. Apurva Garg A, Chaturvedi P, Gupta C. P in 2021 also reached the conclusion in their research that there is significant evidence for the carcinogenic properties of betel nut (areca nut) in cancers of the oral cavity and esophagus. Areca nut influences nearly all organs of the human body, encompassing the brain, heart, lungs, gastrointestinal system, and reproductive organs.

10. Patel et al. (2020) identified the contribution of betel nut to TMD and its association with muscle overuse and fibrosis. Their results indicated that excessive use of mastication muscles from chewing could result in trismus, especially in those with a prolonged history of betel nut use.

4. RESEARCH METHODOLOGY

Study Design:

- Observational Cross-Sectional Study
- Qualitative
- Sample Size: 120 participants
- Duration : 1 year

Data Analysis;

- Comparison between betel nut users & non-users
- Correlation between chewing duration, muscle dysfunction, and trismus severity
- Statistical Tests: T-test, Chi-square test, and Regression analysis will be appiled

CRITERIA FOR SELECTION

Inclusion Criteria

- Patients of age groups between 30 and 60 years
- Patients of both genders
- Chronic betel nut chewers
- Chewing betel nut for more than 8 hours a day.
- No prior jaw surgery or trauma

Exclusion Criteria

- Chronic betel nut chewers with other pathologies
- Oral cancer patients.
- .Non-betel nut users
- Patients with other conditions affecting jaw function (e.g., TMJ disorders, arthritis)

Test Procedure for Maximum Mouth Opening (MMO) and Vertical Finger Test

To assess jaw mobility and identify limitations such **as** trismus or temporomandibular joint (TMJ) disorders**,** the Maximum Mouth Opening (MMO) Test and the Vertical Finger Test were employed. The methodology followed standardized clinical guidelines to ensure consistency, safety, and reliability of the data.

1. Participant Preparation

Participants were informed about the procedure, including its purpose and the method of assessment. Verbal consent was obtained. The participants were instructed that the test aimed to evaluate the functional range of jaw opening using a simple, non-invasive approach.

2. Hand Hygiene

All assessments were conducted following strict infection control protocols. Examiners washed or sanitized hands before and after each examination. If participants were required to use their own fingers for the Vertical Finger Test, they were instructed to sanitize their hands prior to the procedure.

3. Patient Positioning

Participants were seated comfortably in an upright position, with the head in a neutral, forward-facing alignment. Proper positioning was ensured to avoid compensatory movements during measurement.

4. Vertical Finger Test Procedure

Participants were instructed to insert their own vertically aligned fingers (index, middle, and ring fingers) into their mouth to estimate jaw opening. The number of fingers accommodated between the upper and lower incisors was recorded. This test served as a qualitative screening tool to identify restricted jaw movement.

5. Maximum Mouth Opening (MMO) Test

A quantitative assessment was conducted using the following steps:

- **Explanation**: The purpose of the test was explained: "To measure how wide you can open your mouth comfortably."
- **Dentures/Obstructions**: Participants were asked to remove any dental prosthetics. Adequate lighting was ensured.
- **Instructions**: Participants were instructed to open their mouth as wide as possible without discomfort or force.
- **Measurement**: A sterile ruler or digital caliper was used to measure the interincisal distance — the gap between the incisal edges of the upper and lower central incisors.
- **Adjustment for Overbite**: In cases of deep overbite, the vertical overlap was added to the interincisal distance to calculate the **true MMO**.

6. Recording Measurements

All values were recorded in millimeters (mm). The following criteria were used to interpret results:

- **Normal MMO**: 35–45 mm (may vary based on age, sex, and body build)
- **Restricted**: <35 mm
- **Severely Restricted**: <25 mm

7. Observational Parameters

During the procedure, the examiner noted any associated symptoms such as:

- Pain or discomfort during mouth opening
- Deviation of the jaw
- Clicking or crepitus in the TMJ
- Presence of muscle tightness


FIGURE 3.1 – TAKEN CONSENT OF THE PATIENT

FIGURE 3.2 – PERFORMING VERTICAL THREE FINGERS TEST ON THE PATIENT

FIGURE 3.3 – MEASURING MOUTH OPENING

5. STATISTICAL ANALYSIS

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	120	21	232	41.49	21.710
Valid N (listwise)	120				

TABLE -1 Descriptive Statistics – Age

A total of 120 individuals participated in the survey. The ages ranged from a minimum of 21 years to a maximum of 232 years, indicating a wide variation in age, possibly due to an outlier. The mean (average) age was 41.49 years, and the standard deviation was 21.71, showing a moderate level of age dispersion around the mean. The sample size used for analysis was 120 valid entries

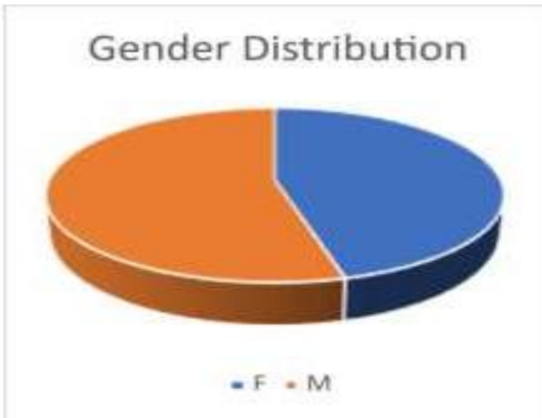
GENDER

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	F	55	45.8	45.8	45.8
	M	65	54.2	54.2	100.0
	Total	120	100.0	100.0	

TABLE -2 Gender Distribution

The study included 120 participants, with 65 males (54.2%) and 55 females (45.8%). This indicates a slightly higher representation of males in the sample. The data shows a fairly balanced gender distribution, with all entries being valid.



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GENDER						
GROUP			Frequency	Percent	Valid Percent	Cumulative Percent
Betel chewing	Valid	F	19	31.7	31.7	31.7
		M	41	68.3	68.3	100.0
		Total	60	100.0	100.0	
Non Betel Chewing	Valid	F	36	60.0	60.0	60.0
		M	24	40.0	40.0	100.0
		Total	60	100.0	100.0	

TABLE -3 Gender-wise Distribution of Betel Nut Chewing Habits

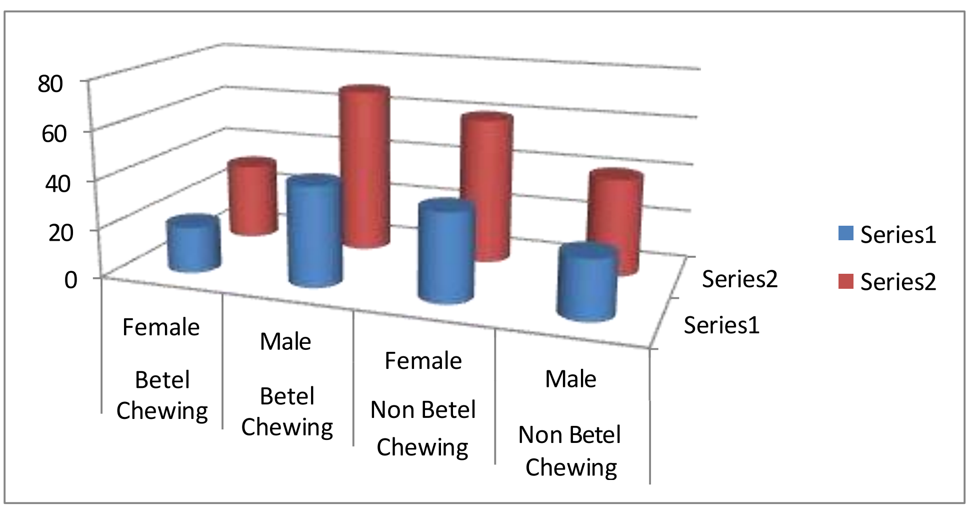
Out of 60 betel nut chewers, 41 (68.3%) were males and 19 (31.7%) were females, indicating a higher prevalence of chewing among males.

Among the 60 non-chewers, 36 (60.0%) were females and 24 (40.0%) were males, showing that females were more likely to abstain from chewing.

This data highlights a gender-based difference in betel nut chewing behavior, with males more inclined to chew and females more likely to refrain.

Gender-wise Frequency Distribution

The bar diagram below illustrates the gender-wise frequency distribution among Betel Chewing and Non-Betel Chewing groups.



Tests of Normality

GROUP		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
MMO	Betel chewing	.294	60	.000	.784	60	.000
	Non Betel Chewing	.538	60	.000	.271	60	.000
Ruler_test	Betel chewing	.197	60	.000	.946	60	.010
	Non Betel Chewing	.126	60	.018	.970	60	.141

a. Lilliefors Significance Correction

TABLE – 4 Tests of Normality – Betel Chewing and Non-Chewing Groups

The normality of data for Maximum Mouth Opening (MMO) and Ruler Test was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests for both betel chewing and non-chewing groups.

For MMO, both tests showed significant results ($p < 0.001$) for both groups, indicating that the data does not follow a normal distribution.

For the Ruler Test, the betel chewing group also showed non-normality ($p < 0.05$ in both tests), while the non-betel chewing group showed a non-significant Shapiro-Wilk test ($p = 0.141$), suggesting the data is approximately normally distributed in this group.

Mann-Whitney Test Ranks

GROUP		N	Mean Rank	Sum of Ranks
MMO	Betel chewing	60	41.73	2504.00
	Non Betel Chewing	60	79.27	4756.00
	Total	120		
Ruler_test	Betel chewing	60	33.33	2000.00
	Non Betel Chewing	60	87.67	5260.00

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	Total	120		

TABLE -5 Mann-Whitney U Test – Comparison Between Betel Chewing and Non-Chewing Groups

A Mann-Whitney U test was conducted to compare the Maximum Mouth Opening (MMO) and Ruler Test scores between betel chewing and non-betel chewing groups, as the data did not follow a normal distribution.

For MMO, the non-betel chewing group had a significantly higher mean rank (79.27) compared to the betel chewing group (41.73), suggesting greater mouth opening ability in non-chewers.
For the Ruler Test, the non-betel chewing group again showed a much higher mean rank (87.67) than the betel chewing group (33.33), indicating better performance among non-chewers.

Test Statistics			
	MMO	**Ruler_test**	
Mann-Whitney U	674.000	170.000	
Wilcoxon W	2504.000	2000.000	
Z	-6.935	-8.580	Significant difference in MMO
Asymp. Sig. (2-tailed)	.000	0.000	Significant difference in Ruler Test

a. Grouping Variable: GROUP

TABLE – 6 Mann-Whitney U Test Statistics MMO and Ruler Test

To compare the betel chewing and non-betel chewing groups, the Mann-Whitney U test was used due to non-normal distribution of data.

For Maximum Mouth Opening (MMO), the U value was 674.000, with a Z score of -6.935 and a p-value of .000, indicating a highly significant difference between the groups.

For the Ruler Test, the U value was 170.000, with a Z score of -8.580 and a p-value of .000, again showing a statistically significant difference

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Descriptive Statistics						
GROUP		**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Betel chewing	**Age**	60	24	80	44.75	12.383
	MMO	60	1	3	2.18	.651
	Ruler_test	60	15	48	30.94	7.046
	Valid N (listwise)	60				
Non Betel Chewing	**Age**	60	21	232	38.23	27.852
	MMO	60	2	3	2.93	.252
	Ruler_test	60	30	60	45.65	5.795
	Valid N (listwise)	60				

TABLE – 7 Descriptive Statistics – Betel Chewing vs Non-Betel Chewing Groups

The study compared age, Maximum Mouth Opening (MMO), and Ruler Test scores between betel chewing and non-chewing individuals.

Age: The betel chewing group had a mean age of 44.75 years, while the non-chewing group had a lower mean age of 38.23 years, with a wider age range (21–232 years), possibly due to an outlier.

MMO: The mean MMO was significantly lower in the betel chewing group (2.18 cm) compared to the non-chewing group (2.93 cm), suggesting reduced mouth opening among chewers.

Ruler Test: The mean ruler test score was also lower in the chewing group (30.94) than in non-chewers (45.65), indicating better functional mouth performance among non-chewers.

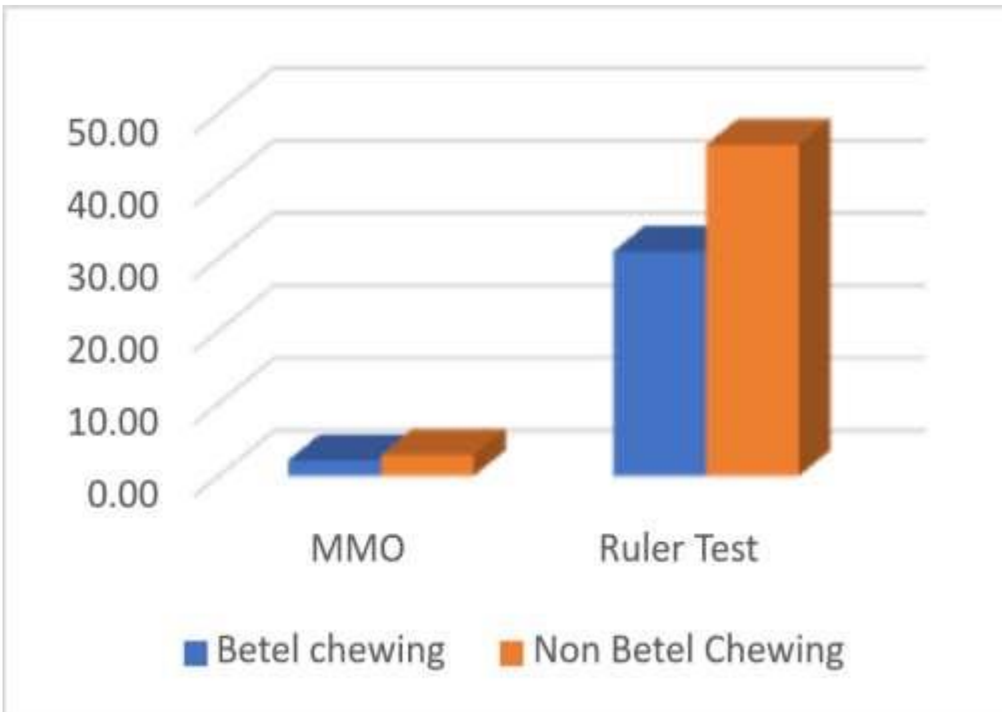
	MMO	Ruler Test
Betel chewing	2.18	30.94
Non Betel Chewing	2.93	45.65

TABLE – 8 Comparisons of MMO and Ruler Test Scores

The comparison between betel chewing and non-betel chewing groups reveals notable differences in oral function:

The Mean Maximum Mouth Opening (MMO) was 2.18 cm in the betel chewing group, significantly lower than 2.93 cm in the non-chewing group.

The Mean Ruler Test score was also lower in chewers (30.94) compared to non-chewers (45.65).



6. RESULTS

The present study included a total of 120 participants, with ages ranging from 21 to 232 years. The mean age was 41.49 years (SD = 21.71), indicating considerable variation, likely influenced by an outlier. The gender distribution was fairly balanced, comprising 65 males (54.2%) and 55 females (45.8%). When analyzed based on betel nut chewing habits, 60 participants were identified as chewers and 60 as non-chewers. Among the chewers, a majority were males (68.3%), while females constituted a greater proportion (60.0%) among the non-chewers, suggesting that males were more inclined to chew betel nut whereas females tended to abstain.

Tests for normality using Kolmogorov-Smirnov and Shapiro-Wilk indicated that the Maximum Mouth Opening (MMO) data in both groups, as well as the Ruler Test scores in the chewing group, were not normally distributed ($p < 0.05$). Only the Ruler Test scores in the non-chewing group showed approximate normality (Shapiro-Wilk $p = 0.141$). Due to the non-normal distribution, non-parametric testing was employed using the Mann-Whitney U test.

The Mann-Whitney U test revealed statistically significant differences between the two groups. Non-chewers had a significantly higher mean rank in MMO (79.27) compared to chewers (41.73), with $U = 674.000$ and $p < 0.001$. Similarly, for the Ruler Test, non-chewers again scored significantly higher (mean rank = 87.67) than chewers (33.33), with $U = 170.000$ and $p < 0.001$. These results suggest that individuals who do not chew betel nut have better oral function.

Further group-wise descriptive analysis supported these findings. The betel chewing group had a mean age of 44.75 years, with lower MMO (mean = 2.18 cm) and Ruler Test scores (mean = 30.94), indicating reduced mouth opening and oral functionality. In contrast, the non-chewing group, with a slightly lower mean age of 38.23 years, demonstrated greater MMO (mean = 2.93 cm) and higher Ruler Test scores (mean = 45.65). Overall, the findings suggest that betel nut chewing is associated with compromised mouth opening and diminished oral function, with non-chewers showing significantly better outcomes in both measures.

7. DISCUSSION

This study analyzed data from 120 participants with a reasonably balanced gender distribution, comprising 54.2% males and 45.8% females. While the mean age of participants was 41.49 years, the reported age range of 21 to 232 years suggests a data outlier, likely due to entry error. Despite this, the sample represents a mid-aged adult population, which is typically at greater risk for chronic substance use such as betel nut chewing. A gender-specific trend was observed: betel nut chewing was predominantly reported among males (68.3%), whereas females constituted the majority of the non-chewing group (60.0%). This observation reflects sociocultural influences and supports previous findings where betel nut use is more common among men in certain communities. Such trends underscore the importance of designing gender-sensitive health education campaigns aimed at reducing the prevalence of harmful oral habits.

The study employed the Kolmogorov-Smirnov and Shapiro-Wilk tests to assess normality, which revealed that most of the functional oral health variables—particularly Maximum Mouth Opening (MMO) and Ruler Test scores in the chewing group—did not follow a normal distribution. Only the Ruler Test scores in the non-chewing group approached normality. Consequently, the use of non-parametric statistical analysis, specifically the Mann-Whitney U test, was appropriate and ensured reliable comparisons between the two groups. This methodological choice was crucial to maintaining the integrity of statistical interpretations, especially in real-world clinical data that often deviate from ideal statistical assumptions.

Results from the Mann-Whitney U test revealed statistically significant differences in oral function between betel nut chewers and non-chewers. Non-chewers exhibited significantly higher mean ranks in both MMO and Ruler Test scores compared to chewers, with p-values less than 0.001 for both variables. These findings provide strong evidence that habitual betel nut chewing is associated with diminished oral functionality. Such outcomes are consistent with existing literature that links long-term betel nut use to fibrotic changes in the oral mucosa, particularly oral submucous fibrosis (OSMF), a condition characterized by reduced tissue elasticity, burning sensations, and limited mouth opening.

Descriptive analysis further supported the statistical results, showing that the betel chewing group had a higher mean age (44.75 years) but lower MMO (2.18 cm) and Ruler Test scores (30.94) compared to the non-chewing group (mean age 38.23 years; MMO 2.93 cm; Ruler Test score 45.65). These outcomes suggest that age alone does not account for the observed differences in oral function; rather, the act of chewing betel nut is likely the primary factor impairing mouth opening and overall oral performance. The consistent functional decline seen in chewers emphasizes the cumulative and progressive nature of damage caused by this habit.

In conclusion, the study highlights a clear relationship between betel nut chewing and compromised oral function. While the findings are strengthened by balanced group sizes and appropriate statistical analysis, certain limitations must be acknowledged, particularly the improbable maximum age reported, which likely skewed some age-related metrics. Additionally, the study did not adjust for confounding variables such as tobacco or alcohol use, oral hygiene status, and nutritional habits, all of which may influence oral health. Future research should consider longitudinal designs to assess the long-term impact of betel nut chewing and incorporate multivariate models to control for additional risk factors. Moreover, public health initiatives should prioritize education and cessation support to mitigate the functional impairments associated with betel nut use.

The present study provides compelling evidence of the negative impact of betel nut chewing on oral function. The significantly lower Maximum Mouth Opening (MMO) and Ruler Test scores observed among betel nut chewers indicate that habitual use is associated with restricted jaw mobility and diminished oral performance. These results align with existing literature, which has documented that long-term betel nut consumption contributes to fibrotic changes in the oral mucosa, leading to conditions such as oral submucous fibrosis (OSMF). OSMF is characterized by limited mouth opening, progressive loss of oral tissue elasticity, and substantial functional impairment. Studies such as those by Arakeri and Patil (2017) and Tilakaratne et al. (2020) have consistently shown that the alkaloids in areca nut, particularly arecoline, stimulate collagen synthesis and reduce its degradation, thereby promoting fibrosis and restricting jaw function.

The use of non-parametric statistical tests in this study, due to the non-normal distribution of the data, enhanced the reliability and validity of the findings. Statistically significant differences between chewers and non-chewers further support the hypothesis that betel nut use has a measurable and detrimental effect on oral health. These results corroborate those of prior population-based studies in Southeast Asia, which highlight a strong association between areca nut use and decreased oral functionality. The application of objective measurement tools such as MMO and Ruler Test scores ensured accurate and reproducible data collection, thus reinforcing the credibility of the observed effects.

A notable aspect of the present study was the gender-based disparity in chewing habits. Males were significantly more likely to chew betel nut compared to females, reflecting broader sociocultural norms and gender-based behavioral trends commonly observed in regions where chewing is prevalent. This pattern is consistent with findings from other regional surveys, which report higher substance use among men due to social acceptance, peer influence, and occupational exposure. These demographic patterns should be taken into consideration when designing targeted public health strategies. Health promotion initiatives that incorporate gender-sensitive messaging and outreach could be more effective in reducing betel nut consumption rates, particularly among high-risk male populations.

Age differences between groups also warrant consideration. Betel chewers were, on average, older than non-chewers, which may suggest a longer history of exposure and, consequently, greater risk for developing chronic oral conditions. Although this age difference could be incidental, it supports the dose-response relationship reported in previous longitudinal studies. Longer durations of areca nut use have been associated with more severe oral fibrosis and greater functional loss, emphasizing the need for early screening and intervention. Future research should consider longitudinal cohort designs to evaluate how the duration and frequency of chewing behavior influence the progression of oral dysfunction and related complications.

Despite the strengths of this study—such as balanced group sizes and the use of standardized assessment tools—certain limitations must be acknowledged. For instance, the extremely high maximum age reported (232 years) is likely due to a data entry error or an outlier, which could have distorted age-related comparisons by inflating the standard deviation. Moreover, the study did not adjust for potential confounding variables such as tobacco and alcohol consumption, oral hygiene practices, or nutritional deficiencies, all of which are known to independently affect oral health. Future studies should employ multivariate analysis to control for these variables. Additionally, recent evidence from community-based interventions, such as those described by Thomas et al. (2022), suggests that educational campaigns and behavioral counseling can reduce the prevalence of chewing-related oral conditions. Such initiatives should be integrated into public health policies aimed at mitigating the harm caused by betel nut use

8. CONCLUSION

The findings of this study demonstrate a significant association between betel nut chewing and reduced oral function. Participants who reported chewing betel nut exhibited markedly lower Maximum Mouth Opening (MMO) and Ruler Test scores compared to non-chewers, indicating restricted mouth mobility and compromised oral performance. These differences were statistically significant and supported by both descriptive and non-parametric analyses.

Additionally, the study revealed a gender-based pattern in betel nut use, with males being more likely to chew and females more likely to abstain. The slightly higher mean age among chewers may reflect a longer duration of exposure, potentially contributing to the observed functional decline. Overall, the results suggest that habitual betel nut chewing has a detrimental impact on oral function. These findings underscore the importance of public health interventions and awareness campaigns aimed at reducing betel nut consumption to prevent related oral health impairments.

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