



# Evaluation of Intelligence of Edentulous Patients and its Correlation with their Quality and Quantity of Saliva- Invivo Study

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(Received: 28 January 2026    Revised: 16 March 2026    Accepted: 09 April 2026)

## KEYWORDS

Intelligence quotient,  
Edentulous patients,  
Salivary pH, Amylase,  
Salivary viscosity,  
Catalyse

## ABSTRACT:

Saliva plays a crucial role in maintaining oral homeostasis and significantly influences prosthodontic outcomes, particularly in edentulous patients. This study aimed to evaluate the association between intelligence quotient (IQ) and the qualitative and quantitative properties of saliva. A total of 40 participants aged 16–84 years, including 25 partially edentulous and 15 completely edentulous individuals, were assessed. IQ was measured using the Wechsler Adult Intelligence Scale–IV (WAIS-IV), and Full-Scale Intelligence Quotient (FSIQ) scores were derived through standardized procedures. Unstimulated saliva samples were collected using the passive drool method and analyzed for parameters including pH, amylase, catalase, protein concentration, viscosity, and salivary quantity. Pearson correlation analysis was employed to determine the relationship between IQ and salivary characteristics. The results demonstrated weak but notable correlations between IQ and salivary parameters. Higher IQ levels were associated with increased salivary pH and amylase activity, along with reduced catalase levels, protein content, viscosity, and salivary quantity. Additionally, variations in salivary characteristics were found to influence oral function and prosthesis performance in edentulous individuals. These findings suggest a potential neurophysiological link between cognitive function and salivary regulation. Within the limitations of the study, the observed associations highlight the importance of considering salivary characteristics during prosthodontic treatment planning. Tailoring clinical approaches based on individual salivary profiles may enhance denture retention, stability, patient comfort, and overall treatment outcomes.

## 1. Introduction

Saliva is a complex biological fluid essential for maintaining oral health and functional balance within the oral cavity [1]. It provides lubrication, facilitates mastication, swallowing, and taste perception, and plays a vital role in regulating oral microflora. By maintaining tissue hydration and supporting enzymatic activity, saliva ensures oral comfort and efficient function. Any alteration in its quantity or quality can adversely affect oral health, leading to compromised mastication, speech difficulties, impaired swallowing, and reduced prosthesis retention. These concerns become particularly significant in completely edentulous patients, where optimal salivary flow, viscosity, and composition are crucial. During impression making and throughout denture fabrication, proper salivary control is essential to achieve accurate impressions, adequate retention, stability, and long-term patient comfort. Salivary composition varies considerably among individuals and serves as an important diagnostic indicator of both oral and systemic health. Salivation is

regulated through parasympathetic and sympathetic neural pathways controlled by specific brain nuclei. Since the brain governs several physiological and cognitive processes, age-related neurological changes may influence salivary secretion patterns. Aging affects systemic physiology, neuromuscular coordination, and nutritional status, thereby establishing a potential association between salivary function and cognitive ability. Declining salivary function may impair oral processing, alter taste and texture perception, and reduce dietary intake. Such alterations increase the risk of malnutrition [2], which may subsequently influence intelligence quotient (IQ) [3]. Because salivary secretion is under neural control, the interaction between aging, salivary physiology and cognitive performance warrants attention. Reduced salivary output and altered composition may therefore contribute not only to compromised oral function but also to broader cognitive implications. In this context, the present study evaluates the association between IQ and specific salivary parameters, including amylase activity, pH, viscosity,



catalase levels, and protein concentration [4]. These biochemical characteristics may reflect underlying neurophysiological processes related to cognitive performance. Previous studies have demonstrated that baseline cognitive function is significantly associated with subsequent edentulism, and that complete tooth loss may predict later cognitive decline in older adults [5]. Furthermore, edentulism and patterns of dental service utilization have been identified as independent predictors of cognitive impairment, with dental care potentially modifying this association [6]. Denture status, particularly the use of complete dentures in one or both arches, has also been linked to clinical cognitive impairment [7]. Severe tooth loss has been associated with lower cognitive performance even after adjusting for demographic and educational factors [8]. Functional denture quality and masticatory efficiency may further influence cognitive status through the mastication pathway [9], as mastication has been shown to stimulate neural activity and cerebral circulation. Additionally, masticatory stimulation affects salivary secretion volume and metabolite concentration patterns, suggesting that salivary metabolomic profiling may serve as a biomarker for oral functional status [10]. Emerging evidence indicates that qualitative salivary parameters may be stronger predictors of oral health outcomes than flow rate alone [11]. Following complete denture insertion, mechanical stimulation has been reported to increase salivary flow rate and pH while reducing viscosity and protein concentration, demonstrating the adaptive nature of salivary changes in edentulous patients [12]. Variations in salivary biochemical markers such as alpha-amylase and cortisol have been observed among different denture systems, although differences in pH were not statistically significant [13]. Moreover, denture retention correlates more strongly with surface wettability than with water sorption, underscoring the importance of surface characteristics in prosthesis stability [14]. Overall, these findings highlight the complex interplay between salivary physiology, edentulism, prosthodontic rehabilitation, and cognitive function, emphasizing the need for an integrated clinical approach that addresses both oral and systemic health outcomes.

## 2. Objectives

The objective of this in vivo study is to evaluate the association between intelligence quotient (IQ) and the qualitative and quantitative properties of saliva.

## 3. Methods

### INCLUSION CRITERIA:

1. Above 45 years old adults are taken.
2. Partially and completely edentulous individuals. (n=40) are included.

3. The adults with systemic diseases like diabetics, hypertension, epilepsy are included.

### EXCLUSION CRITERIA:

1. The adults less than 45 years old are not considered.
2. Patient with salivary gland dysfunction and tumors in the oral cavity were excluded.
3. The adults with tobacco use and smokers are excluded in the study.
4. The individuals with mental retardation and mental disability are not included.

### ARMAMENTARIUM REQUIRED:

1. Cryovials (Salimetrics Item No. 5004.01-06)
2. Saliva Collection Aid (Item No. 5016.04 or 5016.048)
3. Bar-coded labels (Item No. 5009.07)

The intelligent quotient of a patient is evaluated using the WAIS-IV (Wechsler adult intelligence scale). In WAIS-IV is used in patients with the age limit between 16 years and 84 years to calculate the full scale intelligence quotient (FSIQ) of an individual [15] [16]. The WAIS-IV subtests can be divided into two types namely, dichotomous and polytomous [17] subtests use a '0, 10' scoring system for all items and include Visual Puzzles, Figure Weights, Matrix Reasoning, and Picture Completion, assessing Perceptual Reasoning. Arithmetic measures Working Memory, Information assesses Verbal Comprehension, and Symbol Search and Coding reflect the Perceptual Speed factor. Polytomous subtests have more than two scoring options (e.g., 0, 1, 2) and include Block Design (assessing Perceptual Reasoning), Similarities, Vocabulary, and Comprehension (measuring Verbal Comprehension). Digit Span and Letter-Number Sequencing assess Working Memory, while Cancellation reflects the Perceptual Speed factor. When adapting the test, non-verbal subtests remained unchanged, but some items in verbal subtests (Similarities, Vocabulary, Arithmetic, Information, and Comprehension) were modified. Numbers used for Digit Span were also converted to Arabic equivalents. By having the reference of WAIS-IV Stimulus Book and based on the time limit the mark is allotted. The patient is asked to answer each question within 30 seconds of time. If the patient takes time more than 30 seconds to complete the question no marks are allotted. Then the scores of all questions are added up to get a Raw Score. By obtaining the raw score the scaled score is measured by using the Scaled Score Equivalent of Total Raw Scores. Each test of four will get a separate



scaled score. Then it is sum up to get a Full-Scale Intelligence Quotient (FSIQ) (Table 1). Then it is compared with the WAIS Intelligence Scale Remarks.

Initially, the patient's case history, including demographic information, past medical, and dental history is taken. Subsequently, clinical examination is done to assess the number of present and missing teeth. Upon reaching a final diagnosis, patient consent is obtained before proceeding with the WAIS test to assess their IQ. Out of 40 samples, 25 exhibited partial edentulism, including patients with single missing teeth, while 15 were completely edentulous. After obtaining consent from the patient to participate in this study, the above-described method is implemented in each participant. For the exploration of the relationship between IQ (intelligence quotient) and salivary properties such as quantitative and qualitative properties, saliva is collected from all the participants by following passive drool method. The patient is first asked to wash their mouth with normal water for 30 seconds. Then the saliva in mouth is made to pool under the tongue for 1 minutes. Then the patient is asked to spit the saliva into the saliva collecting tube with markings [18]. After collecting saliva from each participant, Triton X-100 was added to the collected saliva samples as a non-ionic detergent to facilitate cell lysis and ensure complete solubilization of proteins. This enables the release of intracellular enzymes and total protein content and centrifuge at 1000 rpm for 1 to 2 minutes (Figure 1) which is then stored in refrigerator, the sample is then transferred to the laboratory for analysis of qualitative properties of saliva such as amylase, catalase, ph, viscosity and protein concentration. The correlation is done by the Pearson correlation method [19] [20] (Figure2).

## 4. Results

Among the 40 patients evaluated (Table 2), the mean salivary amylase level was  $0.10 \pm 0.05$  and the mean Full-Scale Intelligence Quotient (FSIQ) was  $77 \pm 14$ . Pearson correlation analysis (Table 3) demonstrated a weak positive correlation between salivary amylase and FSIQ, indicating a slight increase in amylase levels with increasing FSIQ. The mean catalase level was  $0.33 \pm 0.12$ , and correlation analysis revealed a weak negative correlation between catalase and FSIQ, suggesting a decrease in catalase activity with higher FSIQ scores. The mean salivary pH was  $7.0 \pm 0.42$ , showing a weak positive correlation with FSIQ, indicating a tendency for salivary pH to increase with higher intelligence scores. The mean salivary protein concentration was  $0.43 \pm 0.11$ , and a weak negative correlation was observed between salivary protein and FSIQ, suggesting reduced protein levels with increasing FSIQ. Similarly, the quantity of saliva exhibited a weak negative correlation with FSIQ, indicating a decrease in salivary volume with higher FSIQ values. The mean salivary viscosity was 6.55

$\pm 0.74$ , and an inverse (weak negative) correlation was observed between viscosity and FSIQ, suggesting that salivary viscosity decreased as FSIQ increased. Overall, the correlations between salivary parameters and intelligence quotient were weak, indicating minimal linear associations (Figure 3).

## 5. Discussion

The significance of saliva becomes evident when considering the potential consequences of any alterations in its quantity or quality. In the case of completely or partially edentulous patients with compromised salivary flow, consistency, and composition, design and fitting of dental prostheses becomes more critical. Hence salivary characteristics meticulously considered in prosthodontic treatment planning. This helps in the creation of dentures to ensure the comfort, functionality, and overall well-being of the patient. The evaluation of intelligence in edentulous patients and its correlation with the quality and quantity of saliva reveals intriguing insights into the interplay between oral health and cognitive function. The cognitive assessments administered in this study provide a comprehensive understanding of the intelligence levels in edentulous individuals, shedding light on potential implications of edentulism on cognitive abilities.

When correlating pH of saliva with the intelligent quotient, the results revealed that there is a mild increase of the pH with increase of the intelligence quotient. Various studies have shown that acidity of saliva has significant effects on dental prostheses, particularly on their durability, mechanical properties, and corrosion resistance. Material degradation (Polymethyl methacrylate) due to salivary pH fluctuations, can adversely affect the properties of resin-based polymers used in dental prosthesis. This can lead to increased surface roughness, decreased micro-hardness, and increased release of residual monomers, making the prostheses more susceptible to degradation and fracture [21]. Corrosion is also observed in dental prostheses, particularly in metal components such as Co-Cr alloys which may be due to variations in salivary pH (especially in high acidic environments) which shows impact on their durability and stability.

Various studies on attachment retained implant-supported overdentures, revealed that attachments experienced decrease in retention under acidic environments due to corrosion, affecting attachment durability and retention, which can vary from person to person. Clinically, the choice of material for dental prosthesis fabrication should consider the material's response to different salivary pH conditions. In accordance to the study done by Madanagopal *et al.*, [22] materials like PEEK (Poly Ether Ether Ketone) have shown consistent performance regardless of pH variation, making



them suitable options for RPD (Removable Partial Denture) framework fabrications, especially for patients with conditions like GERD (Gastro-Esophageal Reflux Disease) or xerostomia. Amylase is biological fluid helps to begin the process of chemical digestion of food. Various review of literature, on comparing alpha amylase and salivary cortisol levels with conventional and BPS dentures, showed a statistically significant difference suggesting that BPS (Biofunctional Prosthetic System) dentures can provide better digestive properties and less stress distribution on the oral tissues than conventional dentures.

Study done by Ye-Ha Jung *et al.*, [23] in 2019 correlated the relation between stress and IQ and results revealed complex interaction between stress and intelligence (emotional and cognitive) which further depends on structure and function of brain. Liubov Petrakova *et al.*, [24] evaluated the correlation of Psychosocial stress with salivary amylase activity concluded that amylase levels increase with increases in acute stress. Our study when comparing the salivary amylase and intelligent quotient, revealed that salivary amylase increases with increase in intelligence quotient. Oral health and homeostasis are dependent upon the functions performed by the salivary film and most of these functions, including lubrication, barrier function and microbial interactions, are in turn dependent upon salivary proteins. Some salivary proteins appear to fulfil more than one function and some functions are performed by a number of different proteins. There are relatively great variations in amounts of different proteins present in saliva from different subjects. The results of this study revealed salivary protein decreases with increases in intelligent quotient.

In Prosthodontist perspective, various studies have shown that in patients with decreased salivary flow, the mucosal tissues are thin and fragile. In such condition, clinicians' knowledge on impression technique and impression materials plays an important role. Current study revealed that the important property of the saliva such as quantity tends to decrease with increase in the intelligence quotient. In such conditions, while recording preliminary or primary impressions, rigid impression materials such as impression compounds, Zinc oxide eugenol paste, and heavy body elastomers must be avoided. The mucocompressive technique is avoided as it compresses and peels the tissues. In such patients, mucostatic impression technique is preferred, and impression materials such as hydrocolloids are used preferably.

The next known characteristics of the saliva is the viscosity. The viscosity of saliva is one of the principal components of denture retention. A sufficient layer of saliva is essential for

complete denture retention. The contribution of physical forces to the retention of a denture is heavily dependent upon the presence of a continuous thin film of saliva between denture and mucosa, which wets both surfaces. When comparing the viscosity of saliva with the intelligent quotient of the patient, the current study results revealed that as intelligence quotient rises, the viscosity of the saliva decreases. In those cases, the denture base material sticks to mucous membrane of basal seat and other oral surfaces. Such adhesion is not very effective for retaining dentures and predisposes to mucosal abrasion and ulceration due to lack of salivary lubrication.

## 6. Conclusion:

The study indicates a mild yet significant correlation between changes in intelligence quotient and the qualitative and quantitative properties of saliva. The findings revealed a significant association between IQ and salivary properties, wherein an increase in IQ corresponded to elevated levels of amylase concentration and pH, alongside decreased levels of catalase, viscosity, protein content, and saliva quantity. This finding suggests that in clinical practice, treatment plans and impression procedures can be tailored to accommodate the unique properties of each patient's saliva, ultimately leading to improved treatment outcomes. However, limitation of this study being unequal distribution of participants between the two groups, further studies with increased sample size are required to confirm the reliability of intelligence quotient with salivary parameters.

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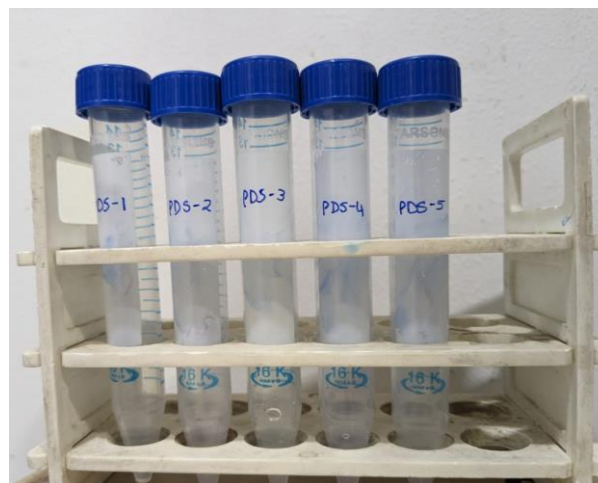


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**Figure 1: Centrifuge at 1000 rpm for 1 to 2 minutes****Table 1: FSIQ Score**

SCORE	INFERENCE
1 to 24	Profound mental disability
25 to 39	Severe mental disability
40 to 54	Moderate mental disability
55 to 69	Mild mental disability
70 to 84	Borderline mental disability
85 to 114	Average intelligence
115 to 129	Above average or bright
130 to 144	Moderately gifted
145 to 159	Highly gifted
160 to 179	Exceptionally gifted
180 and up	Profoundly gifted

**Figure 2: Bar coded test tube**

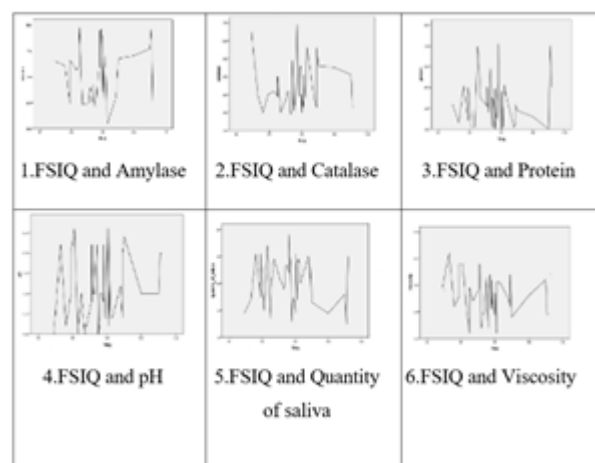


**Table 2: Descriptive statistics**

Parameters	Mean	Std. Deviation	N
FSIQ	77.08	14.446	40
Amylase	.10053	.050813	40
FSIQ	77.08	14.446	40
Catalase	.33650	.123080	40
FSIQ	77.08	14.446	40
pH	7.6000	.42547	40
FSIQ	77.08	14.446	40
Protein	.43002	.119965	40
FSIQ	77.08	14.446	40
Quantity of Saliva	.3068	.08754	40
FSIQ	77.08	14.446	40
Viscosity	6.55	0.747	40

			Viscosity
FSIQ	Pearson correlation	1	-0.224
	Sig. (2 tailed)		0.163
	N	40	40
Viscosity	Pearson correlation	-0.224	1
	Sig. (2 tailed)	0.163	
	N	40	40

**Table 3: Correlative statistics**



**Figure 3: Graph represent the quantitative and qualitative properties of saliva**

