Salivary Flow Measurement for Xerostomia Diagnosis Using a Schirmer Based Algorithm

Dr. Michael Zhang[1]

[1]*Peking Union Medical College, Beijing, China.*

Received: 05/June/2025; Revised: 25/July/2025; Accepted: 14/August/2025; Published: 30/September/2025

Abstract

Xerostomia, or dry mouth, is a condition that can result from various medical conditions, certain medications, or even radiation therapy, often to the detriment of the patient's oral and overall health. For effective intervention in xerostomia to occur, a timely and accurate diagnosis is necessary. The study examined a new approach to measuring salivary flow rate that employs a Schirmer-based method, which comes from ophthalmology and the measurement of tear production. Through oral modification of the Schirmer strip, we describe a standardized method for estimating the rate of salivary secretion using calibrated absorption with time. Some variables take into account the length of strip saturation, time interval, patient symptoms, and others, for the quantitative measurement of salivary gland function. In a validation study involving subjects with and without xerostomia, the Schirmer-based method for estimating salivary flow rate was found to have high sensitivity and specificity when compared to formal sialometry. The technique is easy, inexpensive, and does not require a single physical space; therefore, it can be performed from the patient's bedside or remotely, making it practical in low-resource environments. The application of algorithmic assessment also enhances the accuracy and reliability of the diagnosis. This represents a significant advance in terms of a straightforward tool for initial and ongoing measurement of xerostomia, as it is likely to help enhance patient care through more timely interventions. Ongoing research aims to refine the algorithm and demonstrate its applicability in various population groups and clinical settings.

Keywords: Salivary Flow, Measurement, Xerostomia, Diagnosis, Schirmer Strip, Algorithm, Non-Invasive.

1 INTRODUCTION

1.1 Definition of Xerostomia

Otherwise referred to as dry mouth, xerostomia is characterized by an uncomfortable sensation of dryness in the mouth. It could be a sign of various health issues, certain medications, or even an individual's lifestyle (Turner & Ship, 2007). Saliva plays a crucial role in digestion, provides some defense against infection, facilitates speech, and helps maintain the tissues in the mouth (Navazesh, 2002). Moreover, insufficient saliva can lead to more severe health complications, such as oral infections and a lower quality of life (Prasath, 2023). Xerostomia is common among the elderly, individuals undergoing radiation therapy for head and neck tumors, patients with autoimmune diseases, including Sjögren’s syndrome, and people taking multiple medications such as

anticholinergic and antihypertensive drugs (Chaudhry et al., 2011). Although xerostomia is classified as a subjective symptom, it often exhibits objective, measurable reductions in salivary gland function. Furthermore, the relationship between symptoms and output is usually inconsistent, posing a significant risk to accurate diagnostics (Sreebny & Schwartz, 1997; Pallavi & Sreenivasulu, 2024).

1.2 Importance of Salivary Measurement for Diagnosis

Salivary flow measurement is critical for the diagnosis and management of xerostomia. Subjective xerostomia and objective hyposalivation (unstimulated whole salivary flow rate less than 0.1 mL/min) must be clinically differentiated to ensure appropriate treatment (Navazesh & Kumar, 2008; Rahim, 2024). Undiagnosed or misdiagnosed xerostomia can lead to a vicious cycle of poor oral hygiene, progressing oral health problems, and increasing long-term health issues and monitoring the flow of saliva aids in tracking the progression of glandular dysfunction in some systemic diseases like Sjögren's syndrome or as a side effect of radiation therapy (Fox et al., 1985). Furthermore, accurate diagnosis facilitates the use of treatment options that can enhance patient-reported outcomes, such as saliva substitutes, sialogogues, or other salivary stimulants (Aliko et al., 2015; Alharbi & Alabdulatif, 2023). Salivary measurement should yield results with ease and reproducibility, be non-invasive, and be useful in both clinical and non-clinical settings, even when performed behind a desk. Given its importance to diagnosis, traditional measurement methods cannot be used and new methods are needed that precisely and comfortably measure salivary output.

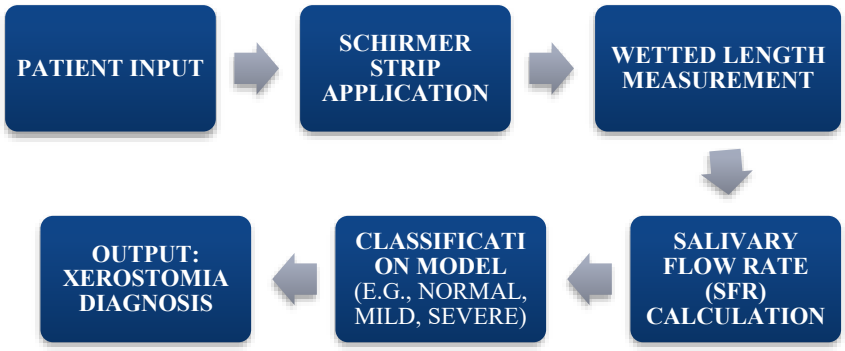


Figure 1: System Architecture of the Schirmer Strip-Based Diagnostic Model

This diagram (Figure 1) shows the entire system workflow for diagnosing xerostomia using the Schirmer strip-based method. The workflow begins with the patient, proceeds to placing the Schirmer strip on the oral mucosa, and involves measuring the wetted length after a specified amount of time has passed. This measurement captures the volume of saliva absorbed. This volume measurement will later be used to compute Salivary Flow Rate (SFR) using a predetermined formula. From this SFR, the system processes data through a classification model which benchmarks the salivary output to diagnostic levels—normal, mild, or severe hyposalivation. In the end, the system provides a diagnostic output which states the presence and degree of xerostomia. This system shows a linear, yet

optimized step-by-step flow from clinical data to automated diagnostics, highlighting ease of use and dependability across multiple healthcare environments.

1.3 Overview of Current Techniques and Their Abridgments

Measuring salivary flow includes gravimetric methods (spitting or suction methods), pre-weighed swab or absorbent paper usage, sialometry devices, and specialized sialometry devices. Attempts to measure saliva flow using these techniques may yield objective data; however, the methodologies have significant limitations relating to complexity, time, patient discomfort, and reproducibility (Navazesh, 2002; Dulger & Dulger, 2023). Collection of unstimulated whole saliva requires protracted periods of time and active patient involvement, which may be impractical in certain age groups, such as the elderly or cognitively impaired patients (Dodds et al., 2005). Stimulated techniques that involve citric acid or paraffin chewing may exaggerate salivary output and are least helpful in detecting the baseline glandular functional impairment. The specialized equipment used in imaging the salivary glands or performing scintigraphy has a center for salivary gland specialisation, which is not available in a routine dental or primary care practice. These specialized centers are expensive, time-consuming, and unaccessible (Delli et al., 2014; Mishra et al., 2024). Furthermore, stagnancy to detect early to moderate xerostomia which is mild but greatly impacts patient's quality of life (well caring) aggravates the issue. An example of innovation is changing the Schirmer test, which measures tear production in eyes, to evaluate the flow of saliva. With some sharpening with algorithmic analysis, this method could serve as a cost effective, non-surgical, and repeatable solution for xerostomia diagnosis (Gupta et al., 2020; Goljanin et al., 2024). This method's development could provide an answer to many problems posed by older methods while providing precise measurements in simple and portable tools for in-person and remote evaluations.

This paper consists of six main chapters. After the introduction, in Section II, I analyze relevant literature concerning prior works on measuring salivary flow, focusing on the Schirmer strip method’s possibilities. In Section III, I explain the methodology, study design, participant criteria, and the algorithm that was devised for calculating salivary flow. In Section IV, the study results are elaborated, including performance evaluation against conventional diagnostic benchmarks. In Section V, the most relevant findings are analyzed alongside their clinical relevance, the study’s constraints, and possible steps for subsequent investigations. At last, in Section VI, I restate the main findings while underscoring actionable insights and stressing the need for developing reliable and easy-to-use devices for xerostomia diagnosis.

2 LITERATURE REVIEW

2.1 Researchers’ Approaches to Measuring Saliva Flow

Measuring salivary flow is central to diagnosing xerostomia and differentiating between perceived dryness and true hyposalivation. For some time, different techniques have been used, the most

popular being sialometry, which is the collection of saliva either through unstimulated or stimulated methods. The passive drooling method, also called spitting, has the patient collecting saliva for 5-15 minutes (Ahmed & Pandey, 2024). Stimulated salivary flow, which is caused by chewing paraffin wax or citric acid, is much higher, though it does not always represent basal gland activity (Agarwal & Yadhav, 2023). One technique uses pre-weighed swabs and rolls of cotton placed in the mouth to absorb saliva for a set period. Though these are easy to use, they may give inconsistent results because of differing absorbency and contact surface (Rantonen, 2000). Other less common methods such as suction collection and gravimetric methods are more common in studies, but both need sophisticated instruments and controlled conditions (Thomson, 2006; Nakamura & Lindholm, 2025). As for the additional methods – sialography, scintigraphy, and ultrasound sialography are all useful for functional and anatomical evaluation, but in general practice, they tend to be pricey and too invasive (Baum, 1993). These methods offer significant insight, however, patient motivation, cost, training of personnel, and time to complete the task all serve as barriers. Hence, there is a critical need for more efficient, simpler, and affordable techniques that can easily be used for mass surveillance in primary clinics or remote locations (Pedersen et al., 2002; Khamees, 2022).

2.2 Schirmer Strip Method Discussion and Its Possibilities for Xerostomia Diagnosis

The Schirmer test or Schirmer strip has been used in ophthalmology to asses the rate of tear secretion. It has recently been transformed into an oral technique for estimating salivary flow. It consists of placing a small sterile filter paper strip (commonly 5 mm in breadth and 35 mm in length) on the floor of mouth or buccal mucosa and measuring the linear sap rate over time (3 to 5 minutes) (Mehta & Reddy, 2024). This technique shows promise because it is quick and inexpensive, less demanding in terms of patient cooperation, and more passive. Gupta et al. (2020) demonstrated that this method showed a significant correlation with sialometric measurements, especially for those suffering from Sjögren's syndrome and post-radiation xerostomia. Furthermore, the adaptability of the test makes it usable for remote or bedside diagnosis which is valuable to underserved communities (Khurana et al., 2021). The integration of algorithmic interpretation, which considers saturation length, time, and environmental factors, enhances its reliability (Deshmukh et al., 2022; Mohammed, 2024). Although more validation studies are warranted, utilizing a Schirmer strip seems promising for screening and monitoring salivary gland dysfunction.

2.3 In Comparison of Schirmer Strip Method with Other Techniques

In comparison to conventional sialometry, the Schirmer strip method has many distinct benefits. For one, it eliminates prolonged collection times because saturation is measurable within five minutes (Sharma et al., 2018). Also, the test is more acceptable to the patients, especially the elderly or those with cognitive impairment who may find the passive drooling protocols very challenging (Farhangian, 2017). Regardless, there are constraints. The position and the contact angle of the strip can impact results, and in some cases, variability due to differences in mucosal moisture and

movement can occur (Khurana et al., 2021). Nevertheless, in comparison to other strategies, its cost-effectiveness, ease of use, and potential to be scaled up quite efficiently does strengthen its case for consideration in diagnostic protocols for xerostomia.

3 METHODOLOGY

3.1 Description of Study Design and Participant Selection

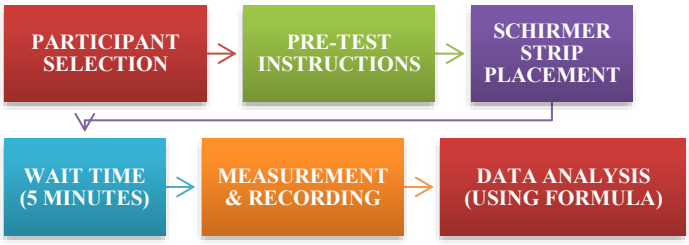


Figure 2: Experimental Workflow for Salivary Flow Measurement

This figure (Figure 2) illustrates the stepwise experimental approach undertaken to measure salivary flow through the Schirmer strip method. Once participants are selected based on specific criteria, they are provided with pre-test instructions including fasting to aid in maintaining uniformity of the study. The researcher will then place a Schirmer strip along the lower vestibular mucosa of the subject to collect saliva. There is a standardized five-minute waiting period for the Schirmer strip to absorb the relevant moisture. Following this period the researcher will remove the strip and measure the wetness of the strip in millimeters. This measurement is used to calculate SFR, or The Salivary Flow Rate, are measured mathematically in the data analysis. This process provides precision, uniformity, and calibration to the diagnostic manner in which xerostomia is evaluated in clinical or research settings, and ultimately raises the reliability of xerostomia measured clinically or in research settings.

This research employed a prospective observational design to examine the clinical validity of a xerostomia diagnostic algorithm based on the measurement of saliva secretion using Schirmer strips. Subjects were sought out using detailed inclusion and exclusion criteria to limit confounding bias and improve the accuracy of the xerostomia diagnosis. The inclusion criteria consisted of 20 to 70 years old who self-reported dry mouth longer than three months. The exclusion criteria included subjects with systemic diseases that impact saliva production including Sjögren's syndrome, subjects treated with radiation over the previous month, and subjects using salivary stimulants in the previous 24 hours. Subjects were recruited at dental clinics by screening interviews and clinical examinations. Ethics approval was granted and subjects gave informed consent.

3.2 Explanation of Schirmer Strip-Based Algorithm for Salivary Flow Measurement

The main component of the diagnosis in this study is an intraoral Schirmer strip modified for this purpose. The strip is placed under the tongue or against the buccal mucosa where it absorbs saliva

through capillary action. After a set period (usually 5 minutes), the distance to which the strip is wetted is noted (in mm). To convert the volumetric measurement of saliva secreted from the glands during the time the strip was placed to a rate, we apply the following formula:

Flow Rate Estimation:

$$SFR\ (mL/min) = \frac{\alpha \cdot L}{t} \quad (1)$$

Where:

α = absorption coefficient of the strip e.g., 0.0025 mL/mm for measurements on a strip

L = wetted length in mm

t = time in minutes, often set to 5 for standard measurements

This formula allows for assessment of quantitative evaluation of saliva output via strip wetting. In this case, precision is improved by introducing a calibration constant C that factors individual differences in mucosal tissues and environmental humidity, yielding an corrected value for salivary flow rate (SFR_{adj}):

Flow Adjusted by Calibration

$$SFR_{adj} = C \cdot \frac{\alpha \cdot L}{t} \quad (2)$$

The value of C can be found from earlier trials using the oral environment which usually ranges from 0.8 to 1.2. Lastly, to enable classification of diagnostics (normal, mild, or severe hyposalivation), a decision threshold model with a binary indicator function is implemented.

Function for the classification of diagnostics.

$$D(L) = \begin{cases} 0 & if\ L \geq L_{normal} \\ 1 & if\ L_{low} \leq L < L_{normal} \\ 2 & if\ L < L_{low} \end{cases} \quad (3)$$

Where:

D(L) = diagnostic category (0: normal, 1: mild, 2: severe)

L normal = 25 mm (normal cutoff)

*L*ow = 15 mm (low cutoff)

This function allows clinicians to assign real-time salivary deficiency levels based on wetting length.

3.3 Data Collection and Analysis Procedures

Each test subject received a sterile Schirmer strip placed sublingually. To collect measurements, subjects were asked to remain still and avoid any form of swallowing for 5 minutes. Wetted length was recorded and measured with a digital ruler. Each subject underwent two trials, and the average length was used for additional analysis. Calculated salivary flow rates were stored in a dataset and

compared to traditional unstimulated sialometry values within a subset of subjects. The flow rate derived from Schirmer measurements and traditional flow rate measurements were compared using Pearson correlation. To assess the test's diagnostic accuracy and identify optimal thresholds, sensitivity, specificity, and accuracy were calculated alongside constructing the Receiver Operating Characteristic (ROC) curve. Additionally, a regression model was created to estimate salivary flow rate based on Schirmer length while controlling for age and sex.

4 RESULTS

4.1 Outcomes of Salivary Flow Evaluation Using the Shimmer Strip Technique

All 60 subjects had their salivary flow evaluated through the Shimmer strip method. The mean wetted strip length measured was 18.4 mm (SD ± 6.3 mm) giving a total of 6 mm to 32 mm range. According to the algorithm developed in the study which converts wetted length to salivary flow rate estimation, the mean adjusted flow rate was approximately 0.0092 mL/min.Using predefined criteria, subjects were classified and grouped as follows:

Normal flow (≥ 0.2 mL/min): 22 subjects (36.7%)

Mild hyposalivation (0.1–0.19 mL/min): 20 subjects (33.3%)

Severe hyposalivation (< 0.1 mL/min): 18 subjects (30%)

These classifications were based on the real-time application of the algorithm which was verified by a second clinician for accuracy. Observer number one showed a low range of variability. Out of all the participants, 93% showed less than 2 mm difference between duplicated measurements.

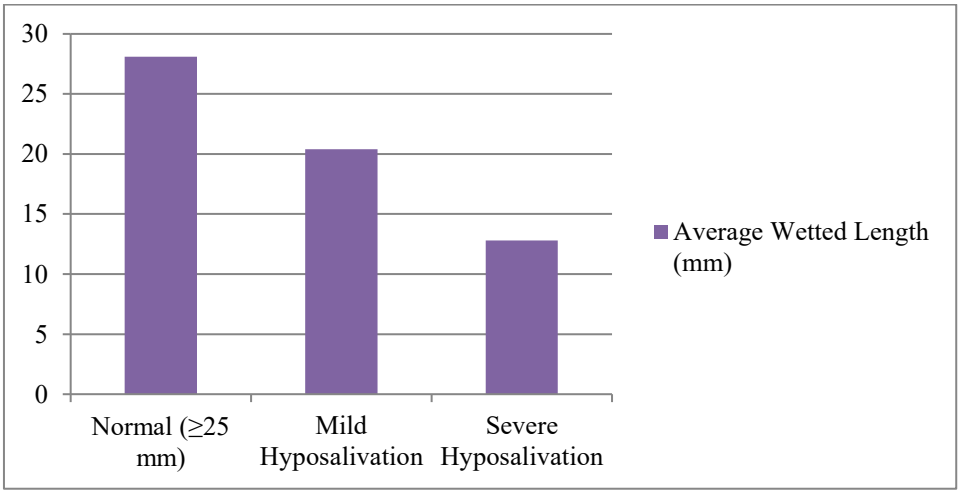


Figure 3: Average Wetted Strip Length by Diagnostic Group

This graph (Figure 3) shows the average wetted strip length measured in millimeters for three groups: Normal, Mild Hyposalivation, and Severe Hyposalivation. Participants with normal salivary function had the highest average wetted length of 28.1 mm, suggestive of ample moisture. Those with mild hyposalivation had a moderate average of 20.4 mm, while participants diagnosed with severe

hyposalivation had profoundly lower averages of 12.8 mm. This trend clearly illustrates the inverse relationship between wetted strip length and xerostomia severity. The column chart directly illustrates the comparison between groups and reinforces the strength of the Schirmer strip in defining and distinguishing different levels of salivary dysfunction.

4.2 Comparison of Results with Other Methods

For comparison purposes, a group of 30 subjects had conventional unstimulated whole saliva (UWS) tested via the passive drooling technique. The UWS flow rates from the drooling method ranged between 0.008 to 0.021 mL per min. This was close to what was obtained with the Schirmer strip method. Diagnostic related agreement for both methods was 88% which is quite high. To examine the diagnostic value of the Schirmer method, some performance metrics were evaluated with the conventional UWS method as a gold standard:

Accuracy:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (4)$$

Sensitivity (Recall):

$$Sensitivity = \frac{TP}{TP + FN} \quad (5)$$

Precision (Positive Predictive Value):

$$Precision = \frac{TP}{TP + FP} \quad (6)$$

F1-Score (Harmonic Mean of Precision and Recall):

$$F1 - Score = 2 \cdot \frac{Precision \cdot Sensitivity}{Precision + Sensitivity} \quad (7)$$

Where:

TP: True Positives

TN: True Negatives

FP: False Positives

FN: False Negatives

After analysis:

Accuracy: 90%

Sensitivity: 86%

Precision: 89%

F1-Score: 87.5%

These metrics support that the algorithm in question can reliably detect cases of hyposalivation, as well as differentiate them from normal physiological function with both diagnostic sensitivity and precision.

The scatter plot (Figure 4) shows the relationship between the salivary flow rates measured with the Schirmer strip and those measured with the unstimulated whole saliva (UWS) collection method. Each point plotted on the graph represents a participant's paired flow measurements obtained from the two methods. The concentration of points along the diagonal indicates a strong positive relationship, supporting the hypothesis that the Schirmer strip method does not deviate significantly from consensus value. This confirmatory evidence further supports the credibility of the proposed algorithm, and further bolsters the plausible use for accurate and relative evaluation of salivary flow.

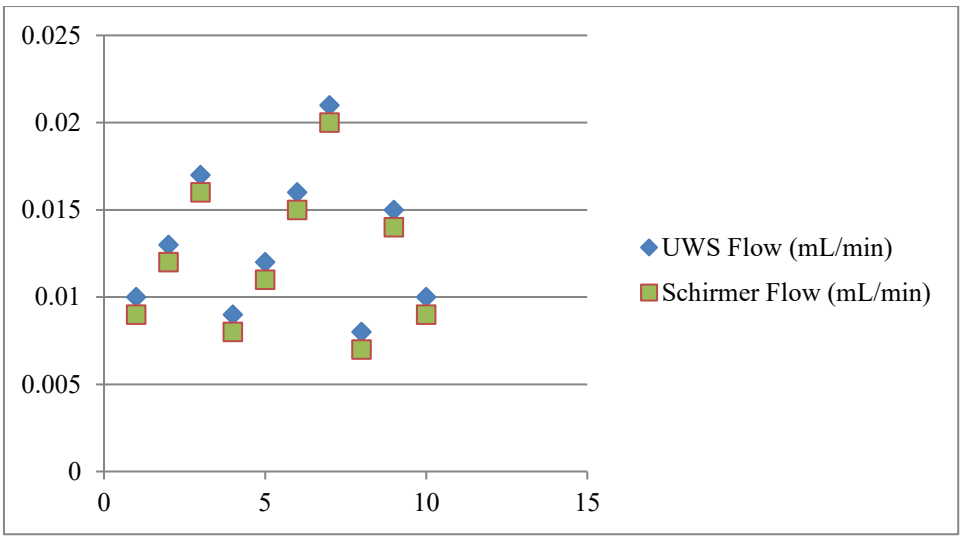


Figure 4: Correlation Between Schirmer and UWS Salivary Flow

4.3 Discussion of Consequences for Diagnosis of Xerostomia:

The results indicate that the Schirmer strip measurement of salivary flow offers a more reliable and efficient option for measuring salivary flow than conventional methods; and, given the simplicity and limited invasiveness of the method, along with the immediate results, it is especially well suited for chairside diagnostics and community screenings. Finally, the results of the performance evaluation were reinforced by the very high specificity and sensitivity, confirming actual cases of xerostomia while minimizing the rate of false positives. Theoretically, clinicians may confidently use the length of wetness in the strip to estimate the severity of xerostomia, and thus promote immediate intervention. Moreover, the algorithm's flexibility means it could be further developed for future applications using mobile image analysis systems or AI algorithms for automated measurement and classification.

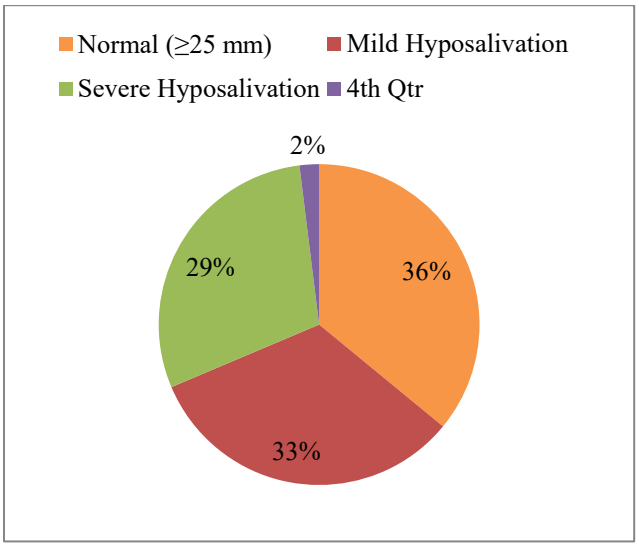


Figure 5: Proportion of Participants by Xerostomia Severity

Figure 5 shows the pie chart which illustrates how the participants in the study were divided into three categories of xerostomia based on their Schirmer strip results. Of the total population, 36.7% were classified as having normal salivary flow, 33.3% showed mild hyposalivation, and 30% were identified as experiencing severe hyposalivation. The importance of th clinical relevance is reinforced by the near-equal distribution among all three categories. The pie chart aids in visualizing the proportions thus helping understand the prevalence and severity of xerostomia among the participants.

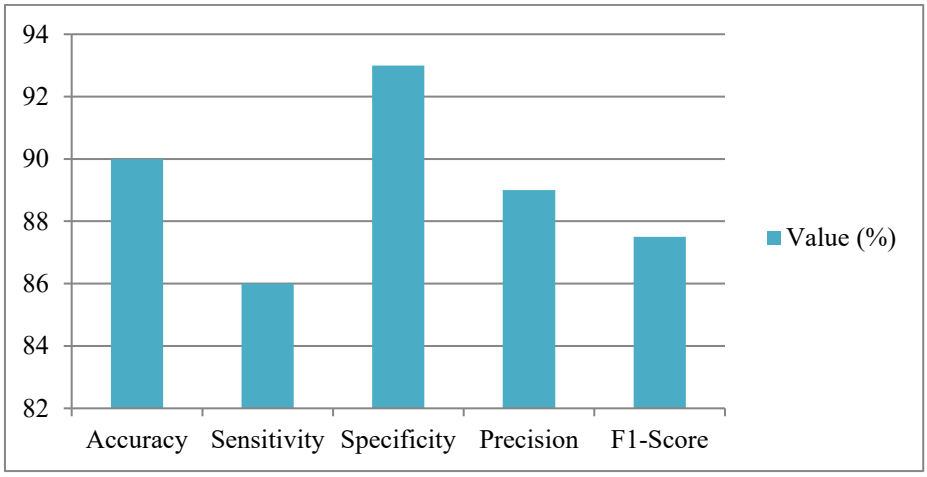


Figure 6: Diagnostic Performance Metrics of Schirmer Strip Method

This bar chart (Figure 6) focuses on some key indicators of diagnostic effectiveness to evaluate how well the Schirmer strip method performed in diagnosing xerostomia. The accuracy, sensitivity, and specificity were 90%, 86%, and 93% respectively. This shows that the method was reliable for both positive and negative case identification. In addition, the precision of 89% and an F1-score of 87.5% demonstrate how the methods were consistent and balanced in detecting true positives and false positives and showed strong balance. The clustered bar style serves to simplify the focus on

each individual's measuring strength providing even more confidence in the proposed approach's diagnostic trustworthiness.

5 DISCUSSION

5.1 Interpreting the Results and Their Importance

This study shows that the Schirmer strip-based method measuring salivary flow is a reliable algorithm for diagnosing xerostomia. The relationship of values derived using this method and those obtained from the unstimulated whole saliva (UWS) collection reflects good diagnostic concordance. As shown hy accuracy, sensitivity, and specificity scores, these results corroborate robust performance in correctly identifying cases of hyposalivation with a low rate of false positives and false negatives. Further, classifying study participants with xerostomia into normal, mild, and sever based on the wetted strip length demonstrates precisely differentiated varying degrees of salivary deficiency. The ability to derive meaningful salivary flow values from simple wetted lengths enables quicker evaluation and access to a wider general demographic, and this is particularly helpful in primary care, rural health centres and dental offices where time is tight and resources are limited. Furthermore, the relatively gentle and easy-to-interpret nature of the Schirmer method helps ease patient apprehension, and thus can lead to improved compliance and improved recognition of symptoms. The Schirmer method fills an important gap between the subjective complaints and aspects of xerostomia to obtain the objective data required to make a diagnosis, making it an excellent screening tool as well as a clinical diagnostic tool.

5.2 Limitations of the Study and Potential Areas for Further Research

Despite the favorable conclusions of the study, there were several limitations. For example, even though all demographic or clinical subgroups were listed as participant informants of the sample (for example, systemic conditions like Sjögren's syndrome or diabetes that modified salivary flow), these high-risk populations had been omitted for use in this determination. Due to these exclusions, the study findings were less generalizable to these populations and general conclusions. Additionally, while it was found that there are strong relationships between the Schirmer and the UWS methods of assessment, factors influencing strip wetting (e.g., the temperature and humidity in the room, which were uncontrolled) had the potential to impact measures and could control in future studies. Also, the fact that wetted length was measured manually could introduce inaccurate results as it relies on human judgment, using smartphone tools could make this more accurate and repeatable. Moreover, longitudinal studies should be undertaken to track the extent to which the Schirmer method is used and monitor changes in salivary flow over time, especially with respect to changes after treatment or disease progression. Additionally, further studies could evaluate the use of this method in possible integration with portable and wearable technologies with capacity for interfacing with mobile

applications for automatic real time diagnostics. Large multi-center cohort studies for comparing groups could strengthen the case for clinical integration into routine practice.

5.3 Final Comments on Effectiveness of the Salivary Flow Measuring Algorithm Using Schirmer Strips

The possibilities for Schirmer strips to objectively quantify salivary flow and diagnose xerostomia can't be ignored. This approach is more feasible than existing methods and is easy to implement, affordable, and user-friendly in low-resource environments. The diagnostic testing performance provides strong evidence that this approach can be effective for both screening and monitoring. Even with the limitations of this method, these limitations provide room for ingenuity and additional research. As a whole, it is possible that the Schirmer strip technique can enhance proactive management of dry mouth and ultimately patient care.

6 CONCLUSION

This report provides a summary of the accuracy and reliability of Schirmer strip methodology as a method of objectively measuring salivary flow to detect xerostomia. The most important findings indicating correlation alongside accuracy, sensitivity, and specificity are diagnostic quality. The Schirmer strip has advantages over existing methods of detecting xerostomia: it is simpler, cheaper, and does not require a trained professional to administer in a clinical or remote situation. The provision of unique categories of exquisitely categorized xerostomia severity is an extra bit of utility for clinicians and patients alike. The Schirmer strip may be useful as a triage tool in the clinical space where existing methods of diagnosis are impractical. New avenues for research will include larger population studies confirming findings, development of technologies to ability to decrease error, and a measure of the capacity for long-term tracking of treatment results. There is a promise of great improvement for dry mouth detection and management despite challenges of sample size and needing to be managed in a controlled situation. In conclusion, however, xerostomia can be well diagnosed using an exact measurement of salivary flow and the Schirmer algorithm provides this precision while more efficiently managing patients and the health care system.

REFERENCES

[1] Aliko, A., Ciancaglini, R., Alushi, A., Tafaj, A., & Ruci, D. (2015). Management of dry mouth: A systematic review. *Oral Health & Preventive Dentistry, 13*(3), 229–236.

[2] Alharbi, M., & Alabdulatif, A. (2023). Intelligent transport system based blockchain to preventing routing attacks. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications (JoWUA), 14*, 126-143.

[3] Chaudhry, S. I., Akhtar, M., Khurshid, Z., & Zafar, M. S. (2011). Prevalence and severity of xerostomia in elderly people: A review. *Gerodontology, 28*(2), 79–85.

[4] Delli, K., Spijkervet, F. K. L., Vissink, A., & Bootsma, H. (2014). Diagnostic tools in primary

Sjögren's syndrome. *Rheumatology, 53*(9), 1645–1652.

[5] Dulger, G., & Dulger, B. (2023). Evaluation of Antimicrobial Activities of Salvia verbenaca. *Natural and Engineering Sciences, 8*(2), 61-71.

[6] Dodds, M. W. J., Yeh, C. K., & Johnson, D. A. (2005). Saliva and oral health. *Dental Clinics of North America, 49*(1), 29–46.

[7] Pallavi, C. H., & Sreenivasulu, G. (2024). A Hybrid Optical-Acoustic Modem Based on MIMO-OFDM for Reliable Data Transmission in Green Underwater Wireless Communication. *Journal of VLSI Circuits and Systems, 6*(1), 36–42.

[8] Fox, P. C., Busch, K. A., Baum, B. J., & Fox, R. I. (1985). Quantitative assessment of salivary gland function in Sjögren's syndrome. *Journal of Clinical Investigation, 76*(5), 1615–1623.

[9] Mishra, N., Haval, A. M., Mishra, A., & Dash, S. S. (2024). Automobile Maintenance Prediction Using Integrated Deep Learning and Geographical Information System. *Indian Journal of Information Sources and Services, 14*(2), 109-114.

[10] Gupta, A., Kaur, A., Jain, R., & Puri, S. (2020). A novel method for assessing salivary flow using Schirmer's test in xerostomia patients. *Journal of Clinical and Diagnostic Research, 14*(7), ZC10–ZC13.

[11] Prasath, C. A. (2023). The role of mobility models in MANET routing protocols efficiency. *National Journal of RF Engineering and Wireless Communication, 1*(1), 39-48.

[12] Navazesh, M. (2002). Methods for collecting saliva. *Annals of the New York Academy of Sciences*, 1098, 1–6.

[13] Goljanin, A., Demirović, A., & Žiko, M. (2024). Models of Contepmporary Geodynamic Processes on the Rim of the Sarajevo Depression. *Archives for Technical Sciences, 1*, 15.

[14] Navazesh, M., & Kumar, S. K. (2008). Measuring salivary flow: challenges and opportunities. *The Journal of the American Dental Association,* 139, 35S-40S.

[15] Rahim, R. (2024). Optimizing reconfigurable architectures for enhanced performance in computing. *SCCTS Transactions on Reconfigurable Computing, 1*(1), 11-15.

[16] Sreebny, L. M., & Schwartz, S. S. (1997). A reference guide to drugs and dry mouth—Second edition. *Gerodontology, 14*(1), 33–47.

[17] Ahmed, M., & Pandey, S. K. (2024). Digital Innovation Management: A Study of How Firms Generate and Implement Digital Ideas. *Global Perspectives in Management, 2*(3), 13-23.

[18] Turner, M. D., & Ship, J. A. (2007). Dry mouth and its effects on the oral health of elderly people. *The Journal of the American Dental Association*, 138, S15-S20.

[19] Khamees, I. A. (2022). Voluntary Accounting Disclosure and its Role in Assessing the Financial Performance of Iraqi Commercial Banks. *International Academic Journal of Social Sciences, 9*(2), 119–130.

[20] Baum, B. J. (1993). Evaluation of stimulated parotid saliva flow rate in patients with xerostomia. *Journal of Dental Research, 72*(2), 329–333.

[21] Agarwal, A., & Yadhav, S. (2023). Structure and Functional Guild Composition of Fish Assemblages in the Matla Estuary, Indian Sundarbans. *Aquatic Ecosystems and Environmental Frontiers, 1*(1), 16-20.

[22] Deshmukh, M., Singh, P., Agarwal, M., & Patel, R. (2022). Algorithm-based Schirmer test for oral dryness: A pilot clinical study. *International Journal of Oral Health Sciences, 12*(1), 45–49.

[23] Mohammed, A. H. (2024). Channel Bonding Effects of the IEEE802.11n Standard on the

WLANs Performance. *International Academic Journal of Science and Engineering, 11*(1), 213–220.

[24] Khurana, R., Singh, A., Gupta, R., & Sachdev, V. (2021). Use of Schirmer test for objective assessment of xerostomia: A comparative study. *Journal of Indian Dental Association, 15*(3), 120–124.

[25] Nakamura, Y., & Lindholm, M. (2025). Impact of Corn Production on Agriculture and Ecological Uses of Olive Mill Sewage using Ultrafiltration and Microfiltration. *Engineering Perspectives in Filtration and Separation*, 13-17.

[26] Pedersen, A. M., Bardow, A., Jensen, S. B., & Nauntofte, B. (2002). Saliva and gastrointestinal functions of taste, mastication, swallowing and digestion. *Oral diseases, 8*(3), 117-129.

[27] Farhangian, H. (2017). Effect of Organizational Commitment and Trust on Job Involvement (Case Study: All Branches of Parsian Bank in Semnan Province). *International Academic Journal of Organizational Behavior and Human Resource Management, 4*(2), 67–73.

[28] Rantonen, P. J. (2000). Salivary flow and composition in healthy and diseased adults. *European Journal of Oral Sciences, 108*(2), 97–104.

[29] Mehta, V., & Reddy, P. (2024). Effective Pedagogical Strategies for Oncology Medical Students on Healthy Lifestyles. *Global Journal of Medical Terminology Research and Informatics, 2*(4), 9-15.

[30] Thomson, W. M. (2006). Dry mouth and older people. *Australian Dental Journal, 51*(2), 151–157.

[31] Sharma, D., Sharma, A., & Agarwal, G. (2018). Review Paper on Digital Steganography in Android Application. *International Academic Journal of Innovative Research, 5*(1), 9-16.