

The Correlations between Systemic Problems, Age, and Gender to the Severity of Periodontal  
Disease

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## **Acknowledgements**

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## **Abstract**

Periodontal disease is a serious inflammation of the gums that can cause pockets of infection around the roots and crowns of teeth, loss of bone, damage to gum tissue which will lead to tooth loss, if not treated. It has been previously shown that there are correlations between certain attributes, such as age and gender, to the presence of periodontal disease (Greene, 1963). But more importantly, there have been a growing number of recent studies associating rising numbers of people who suffer from periodontal disease to prevalent systemic problems such as cancer, cardiovascular disease, and preterm birth (Meyer et al., 2008). In addition, there is research made on correlations between systemic problems, such as type 2 diabetes, and periodontal disease, but such studies focus only on the prevalence of periodontal disease (Sandberg et al., 2000). This study attempted to come upon correlations between the severity of periodontal disease to age, gender, and systemic problems by comparing the probing pocket depths and bleeding on probing between patients. Due to the many variables affected by periodontal disease, a patient scoring system was developed in order to be able to compare patients with a single variable. Then, the scores were analyzed to find significant data by means of ANOVA and t-tests. Thus far, the research has shown minimal significant data. It is assumed that this is due to a small sample size. If correlations are found, doctors and dentists will be able to have a more probable cause for one's periodontal disease or systemic problems. This would provide information to be used for prophylactic purposes and will either support or oppose the movement to turn dental practices into a place to screen for diseases.

## **Introduction**

The purpose of this investigation was to determine correlations between systemic problems, age and gender to the severity of periodontal disease. Systemic problems are any problems that affect the systemic health of a person. Examples of systemic problems are diabetes, cancer, and high blood pressure.

The expectation is that the oral health has improved because of improvements in the medical field (Zitzmann et al., 2008). One example of oral health improvement is that between 1994 and 2004, severe periodontal disease has decreased among seniors in America by 10% (Dye et al., 2007). This is because of increased exposure to the protective factors such as fluoride (Petersen, 2008). Finding correlations between periodontal disease and systemic problems would be beneficial as this information may be utilized for prophylactic treatments in the future. In addition, many diseases such as type 2 diabetes have been associated with the presence of periodontal disease (Sandberg et al., 2000). Currently, there have been correlations found between periodontal disease to attributes such as age and gender; much of this information is outdated by almost 50 years. This research attempted to make these correlations more current and also compare periodontal disease with systemic problems. As a result, the uses of the information would be more valuable. This information gathered by this research may be used for improving some patients' general and oral health in the future.

According to research conducted in the past, there have been correlations shown between oral health, certain attributes such as Body Mass Index, and certain systemic problems such as type 2 Diabetes (Greene, 1963). In many places it has been proven that Body Mass Index impacts the oral health of older people. It was proven in studies that people with more than 20 original teeth are more likely to have a normal Body Mass Index (Sheiham et al., 2002;

Marcenes et al., 2003). It has also been shown that that periodontal disease rates increase by age. One of the most apparent oral diseases impacted by age is periodontal disease. As age increase the percent of adults with periodontal disease also increases. In various experiment it was supported that it was the different lifestyles of different ethnicities that impact oral health. These studies demonstrate the impact of the attributes of the ethnicities on oral health. Attributes of different lifestyles and ethnicities include diet and wealth. It was proven that the rate of periodontal disease in men is almost double of women (Walls and Steele, 2004). Andersen and Davidson (1997) support that ethnicity impacts oral health.

There has also been past research on changes of oral health through time. There has been a study in Switzerland showing changes in oral health there over a ten year period. The study demonstrated improvements in oral health such as an increased proportion of subjects with all retained natural teeth. There was also an increase in the mean number of teeth existing, on average, by 1.3 (Zitzmann et al., 2008). According to the WHO Global Oral Health Programme, states that the rapidly changing oral disease patterns root from changing lifestyles, which include diets full of sugar, increased use of tobacco, and increased consumption of alcohol (Petersen, 2003). This is supported by a research which demonstrated that volatile sulfur compounds, which are found in cigarettes, result in pocket depths twice as large as normal (Miyazaki et al., 1995). In another 10-year study, it was proven that the periodontal health conditions improved among a group of initial smokers. This improvement of health was because of the quitting by smokers. After they ceased smoking, signs of oral healthiness appeared such as a cease of gingival bleeding (Bergstrom et al., 2000). These studies proved that there is a possibility oral health does alter after a short period of time due to constant changes in lifestyle.

Many diseases, such as diabetes and some heart diseases have been traced back to oral health. According to data, diabetic patients show greater need to periodontal treatment (Sandberg et al., 2000). This is most likely because diabetic patients suffered from xerostomia, or drymouth, at a much higher degree than a non-diabetic (Moore et al., 2001). Coronary heart disease has also been proved to be impacted by oral health. Montebugnoli et al. (2004) shared through their study that there is a link between poor oral health and Coronary Heart Disease. The study also provides evidence that inflammatory and haemostatic factor may also possibly play a role with this association. These analyses provide evidence about the link between oral health and systemic diseases.

In order to carry out this study, data will be received from a local dentist. This data would include the pocket depths of people with periodontal disease and other systemic problems such as heart disease. After this data is obtained, it would be analyzed and preferable correlations would be found. The objective of this experiment is to come upon correlations between systemic problems and these pocket depths. It is hypothesized that pocket depths are impacted by certain attributes resulting in more severe periodontal disease.

## Methodology – Data Collection

First, de-identified, un-analyzed medical history and perio-maintenance chart of patients that suffer from periodontal disease were collected from a local dentist. Furthermore, de-identified, un-analyzed

Health Information			
Date of Last Dental Visit: <u>10/25/2011</u>		Reason for this visit: _____	
Have you ever had any of the following? Please check those that apply:			
<input type="checkbox"/> AIDS	<input type="checkbox"/> Excessive Bleeding	<input type="checkbox"/> Liver Disease	<input type="checkbox"/> Stroke
<input type="checkbox"/> Allergies _____	<input type="checkbox"/> Fainting	<input type="checkbox"/> Mental Disorders	<input type="checkbox"/> Tuberculosis
<input type="checkbox"/> Anemia _____	<input type="checkbox"/> Glaucoma	<input type="checkbox"/> Nervous Disorders	<input type="checkbox"/> Tumors
<input type="checkbox"/> Arthritis	<input type="checkbox"/> Growths	<input type="checkbox"/> Pacemaker	<input type="checkbox"/> Ulcers
<input type="checkbox"/> Artificial Joints	<input type="checkbox"/> Hay Fever	<input type="checkbox"/> Pregnancy	<input type="checkbox"/> Venereal Disease
<input type="checkbox"/> Asthma	<input type="checkbox"/> Head Injuries	Due date: _____	<input type="checkbox"/> Codeine Allergy
<input type="checkbox"/> Blood Disease	<input type="checkbox"/> Heart Disease	<input type="checkbox"/> Radiation Treatment	<input type="checkbox"/> Penicillin Allergy
<input type="checkbox"/> Cancer	<input type="checkbox"/> Heart Murmur	<input type="checkbox"/> Respiratory Problems	OTHER: _____
<input type="checkbox"/> Diabetes	<input type="checkbox"/> Hepatitis	<input type="checkbox"/> Rheumatic Fever	<input type="checkbox"/> _____
<input type="checkbox"/> Dizziness	<input type="checkbox"/> High Blood Pressure	<input type="checkbox"/> Rheumatism	<input type="checkbox"/> _____
<input type="checkbox"/> Epilepsy	<input type="checkbox"/> Jaundice	<input type="checkbox"/> Sinus Problems	<input type="checkbox"/> _____
	<input type="checkbox"/> Kidney Disease	<input type="checkbox"/> Stomach Problems	
• Have you ever had any complications following dental treatment? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, please explain: _____			
• Have you been admitted to a hospital or needed emergency care during the past two years? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, please explain: _____			
• Are you now under the care of a physician? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, please explain: _____			
• Name of Physician: _____		Phone: _____	
• Do you have any health problems that need further clarification? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, please explain: _____			

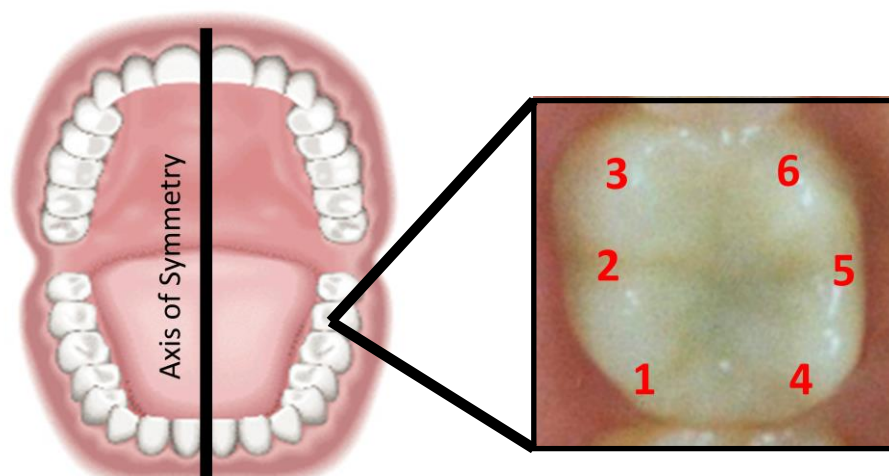
**Figure 1a** – De-identified medical history of a patient. This certain patient has no investigated systemic problems. – Courtesy of Dr. Helfner

TOOTH NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Maxillary	DCM	DCM	DCM	DCM	DCM	DCM	DCM	DCM	MCD	MCD	MCD	MCD	MCD	MCD	MCD	MCD
Probing Depth	Facial 3 3 6	Facial 6 3 7	Facial 7 4 8	Facial 5 4 4	Facial 4 3 3	Facial 3 2 3	Facial 3 2 3	Facial 3 2 3	Facial 3 2 3	Facial 3 2 3	Facial 3 2 3	Facial 3 2 4	Facial 4 3 4	Facial 4 3 5	Facial 5 3 5	Facial 5 3 4
Bleeding/Suppuration	Lingual 4 3 5	Lingual 5 3 5	Lingual 5 3 5	Lingual 4 3 5	Lingual 4 3 4	Lingual 3 2 3	Lingual 3 2 3	Lingual 3 2 3	Lingual 3 2 3	Lingual 3 2 3	Lingual 3 2 3	Lingual 3 2 3	Lingual 4 3 6	Lingual 4 3 6	Lingual 5 3 6	Lingual 5 3 4
Gingival Margin	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial
Clinical Attachment Level	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual
Microgingival Junction	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial
Plaque/Mobility/Bone Loss	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual
Furcation Grade	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal
Mandibular Tooth Codes	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual
MANDIBULAR TOOTH NUMBER	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Maxillary	DCM	DCM	DCM	DCM	DCM	DCM	DCM	DCM	MCD	MCD	MCD	MCD	MCD	MCD	MCD	MCD
Probing Depth	Facial 4 3 5	Facial 5 3 5	Facial 5 3 5	Facial 3 2 3	Facial 3 2 3	Facial 3 2 3	Facial 3 2 3	Facial -	Facial -	Facial 3 2 3	Facial 3 2 3	Facial 4 3 4	Facial 4 3 4	Facial 5 3 5	Facial 5 3 5	Facial 5 3 4
Bleeding/Suppuration	Lingual 5 3 6	Lingual 6 3 6	Lingual 6 3 6	Lingual 5 3 4	Lingual 3 2 3	Lingual 3 2 3	Lingual 3 2 3	Lingual -	Lingual -	Lingual 3 2 3	Lingual 3 2 3	Lingual 4 3 5	Lingual 4 3 5	Lingual 5 3 5	Lingual 5 3 5	Lingual 5 3 4
Gingival Margin	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial
Clinical Attachment Level	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual
Microgingival Junction	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial	Facial
Plaque/Mobility/Bone Loss	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual
Furcation Grade	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal	Buccal
Mandibular Tooth Codes	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual	Lingual

**Figure 1b** – De-identified perio maintenance chart of a patient. (Same patient as Fig. X) – Courtesy of Dr. Helfner

medical histories were separated among groups of systemic problems, age, and gender. The data was digitized by copying the de-identified, un-analyzed data into Microsoft Excel so that it may be analyzed. For each patient, the age, gender, and types of systemic problems

were recorded so that they would be able to be organized into different groups for different analyses. In addition, probing depths and bleeding were recorded for each of the six sections of the tooth. The six sections of the tooth include a facial side (to the side of the cheek) and a lingual side (to the side of the tongue) which are each further separated into a mesial section (closest to line of symmetry of the mouth), a distal section (closest to back of the mouth), and a central section (between the distal and mesial).



**Figure 2** – The six zones of the tooth and defined on Tbl. 1

**Table 1** – Names of each zone

1	Mesial Lingual
2	Central Lingual
3	Distal Lingual
4	Mesial Facial
5	Central Facial
6	Distal Facial

## Methodology – Data analysis

After the medical history and perio maintenance chart of every patient was digitized into Microsoft Excel, a patient score was formed in order to quantitatively measure the severity of the patients' periodontal disease. Previously formed methods such as PSR (Periodontal Screening and Recording) and OHI (Oral Hygiene Index) have been considered by use, but such methods were too vague and did not separate the patients effectively. And so, a patient score was formed in order to overcome this dilemma.

The patient scoring system was devised in a way to take into account traits affected by periodontal disease such as probing pocket depth and probing on bleeding. For the patient scoring system, the probing pocket depths were multiplied by the number of pockets with the corresponding probing pocket depth. This was done because use as the probing pocket depth increases, the severity of periodontal disease increases as well. The third molars were ignored for this investigation because it would have skewed the results due to other factors such as common acid decay that contribute to the high pocket depths within the third molars (Petersen 2008). All of these products were then added to obtain a number that is referred to as the “raw score.” The raw score is multiplied by  $1 + (\% \text{ of bleeding})$  because bleeding in a high pocket depth area is much worse than bleeding in a low pocket depth area (Bergström et al., 2000). This final number is referred to as the “patient score” and portrays the severity of the periodontal disease of a patient. It is important to note that a higher score means more severe periodontal disease.

Pocket Depth (mm)	1	2	3	4	5	6	7	8	9	10	Bleed (%)
Amount	0	10	51	70	26	4	0	0	0	0	0.28
Raw Score	0	20	153	280	130	24	0	0	0	0	1.28

**Table 2a** – Example of raw patient score formation.



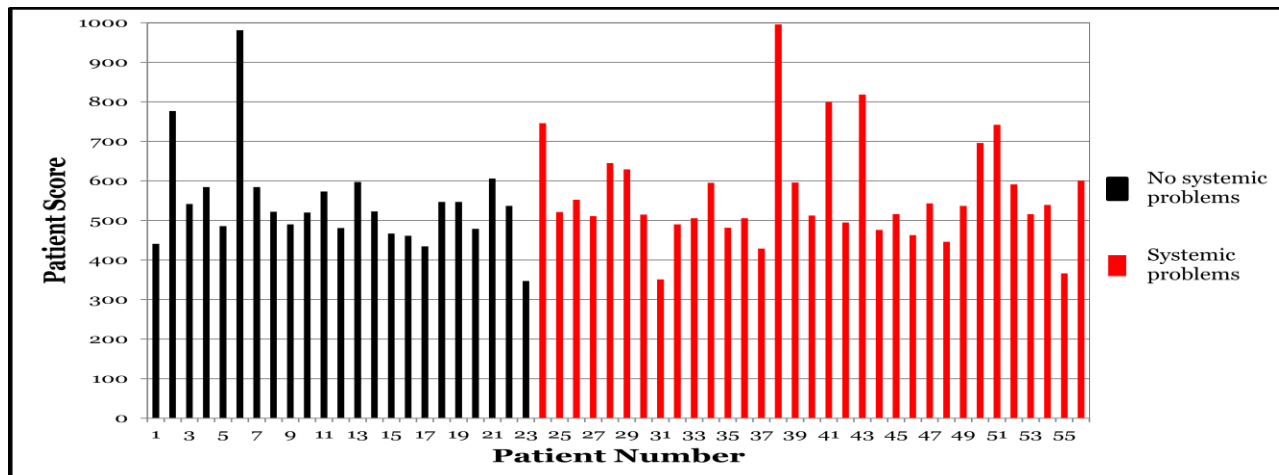
**Table 2b** – Example of final patient score formation.

Total Raw Pocket Score	Bleeding Score	Patient Score
607	1.28	776.96

Furthermore, student T-tests and ANOVA (analysis of variance) tests were used in order to determine if results were statistically significant. The general null hypothesis used for this investigation stated that there is no statistical difference among the selected attributes for the patient score. The general alternative hypothesis used for this investigation stated that there is a statistical difference among the selected attributes for the patient score. These tests determine if results are statistically significant by calculating a probability value (P-value). If the P-value is less than .05, this means that the probability of selecting the alternative hypothesis when the null hypothesis should be supported is very low. This indicates that there is a statistical significant difference among the groups. A student T-test was used if there were two variables that needed to be compared. An ANOVA test was used if there were more than two variables than needed to be compared.

## Results and Discussions

To analyze the overall impact of systemic problems on the severity of periodontal disease, all the patients, regardless of age and gender, were studied together (Fig3).

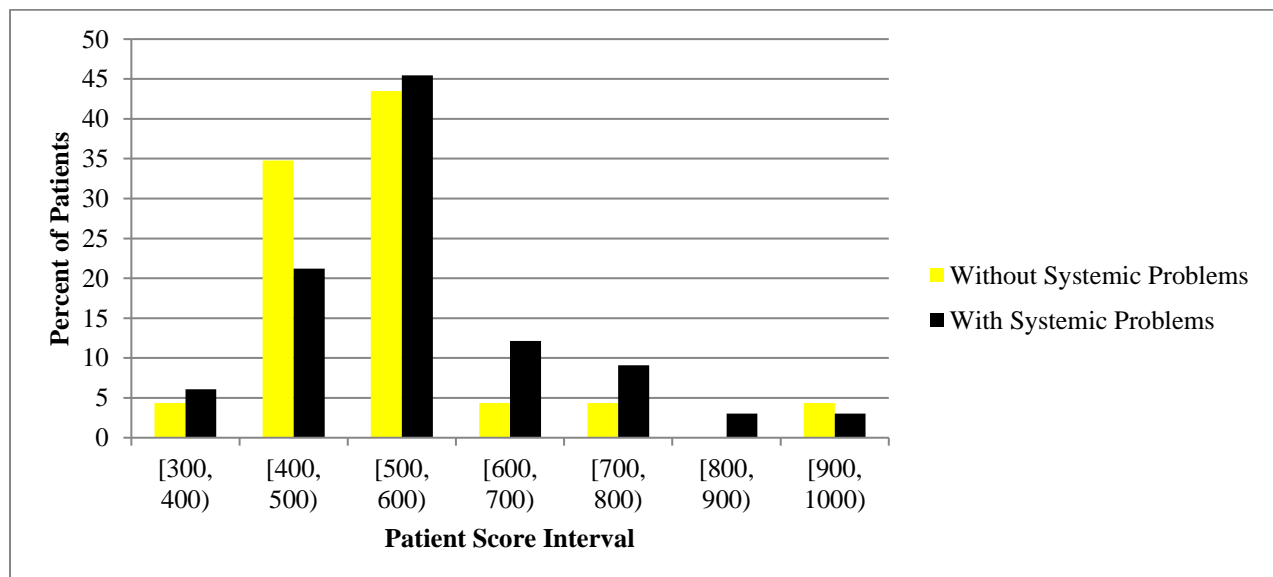


**Figure 3** – Patient scores of all analyzed patients.

In figure 3, patients 1 through 23 (shown in black) did not have any systemic problems other than periodontal disease whereas patients 24-56 (shown in red) did have other systemic problems. In order to find the overall impact of the systemic problems, the frequency of each interval of a hundred was recorded (Table 3). No interval below 300 was recorded because none of the studied patients had a patient score below 300.

**Table 3** – Frequency and percentage of patient scores in ranges with intervals of a hundred.

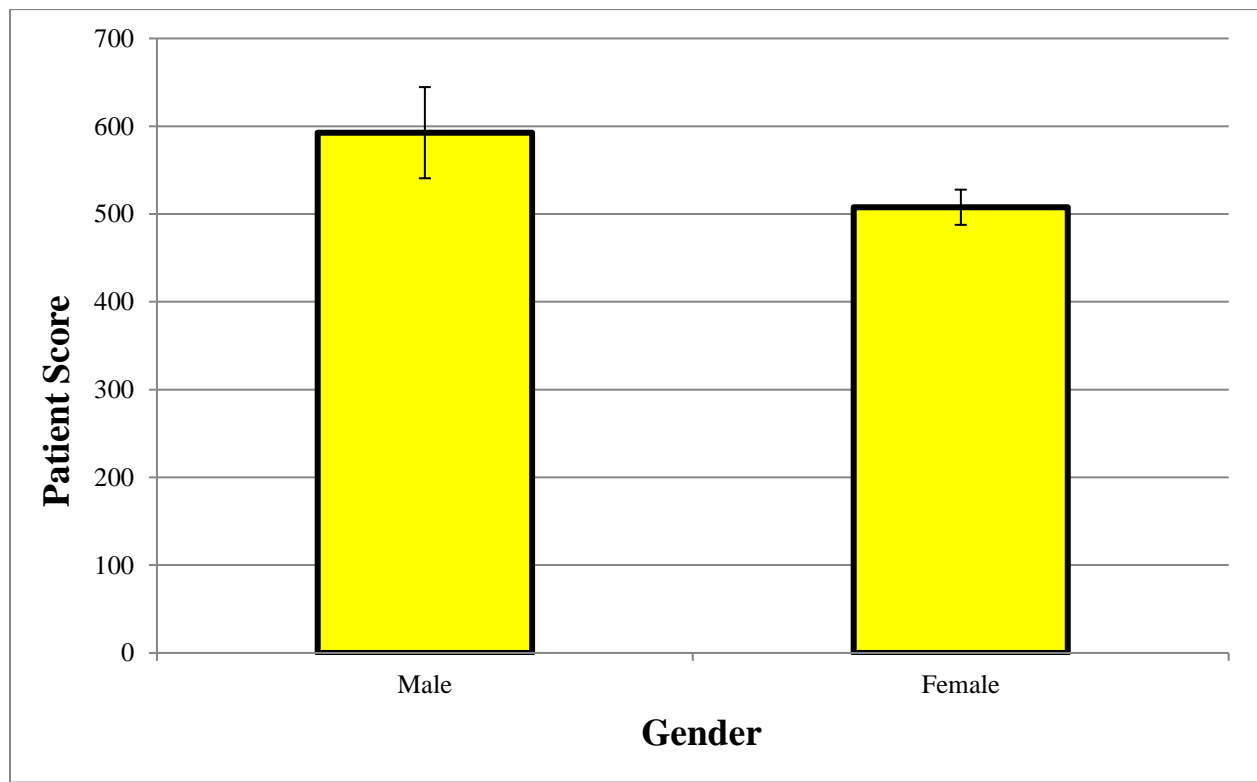
Patient Score Range	Without Systemic Problems		With Systemic Problems	
	Frequency	Percentage (%)	Frequency	Percentage (%)
[300, 400)	1	4.35	2	6.06
[400, 500)	8	34.78	7	21.21
[500, 600)	10	43.48	15	45.45
[600, 700)	1	4.35	4	12.12
[700, 800)	1	4.35	3	9.09
[800, 900)	0	0.00	1	3.03
[900, 1000)	1	4.35	1	3.03



**Figure 4** – Percentage of patients within a respective group who fall within an interval.

The first column (yellow) in figure 4 represents the percent of patients within a group without systemic problems. The other column (black) represents the percent of patients within a group with systemic problems. As shown in figure 4, both groups had a similar percentage of patients who fell within a range of [500, 600) in terms of patient score. But, there were more of a percentage of patients without systemic problems that had a patient score of less than 500, whereas there were more of a percentage of patients with systemic problems who had a patient score of more than 600. Generally, patients with systemic problems have a higher patient score.

In the research, there were comparisons made between males and females within the control group, who are patients with periodontal disease but without any other systemic problems (Figure 5). Similar research had been done by Greene (1963), but in that study, the patients did not have periodontal disease. In addition, this study observes the severity of periodontal disease within the genders in contrast to the overall oral health, as done by Greene (1963).

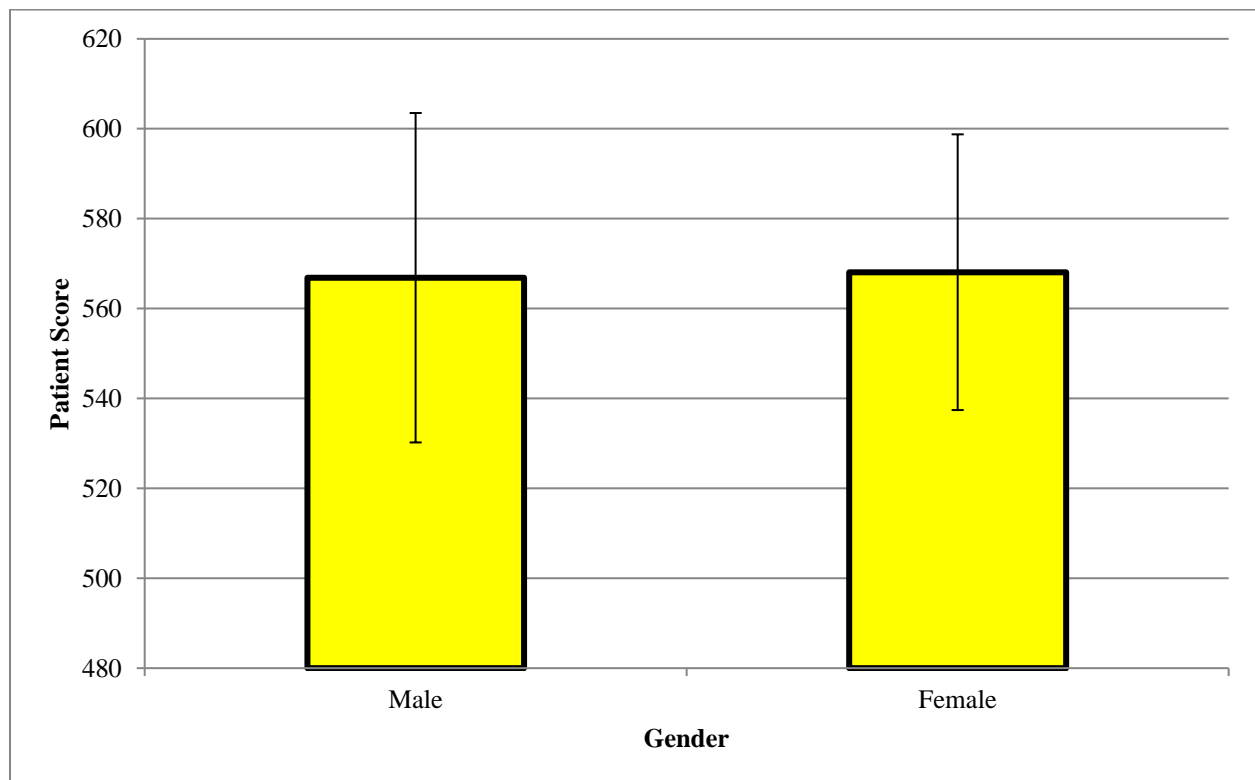


**Figure 5** –Comparison of patient scores between gender within control group  
(Error bars = standard error)

As shown in figure 5, it was calculated that males have an average patient score of 100 more than females. But it is important to note that the p-value for the t-test was 0.108812, meaning that the alternate hypothesis must be rejected. Also, the error bars are overlapping, meaning that the data is inconclusive.

Even though the data has no significance, past studies suggest that males have more periodontal disease possibly because of lifestyle choices (Walls and Steele, 2004). Such lifestyle choices include women paying more attention to oral health and being more reluctant to visit the dentist more often. It is believed that the reason for insignificant data was a non-sufficient amount of patients and a small sample size.

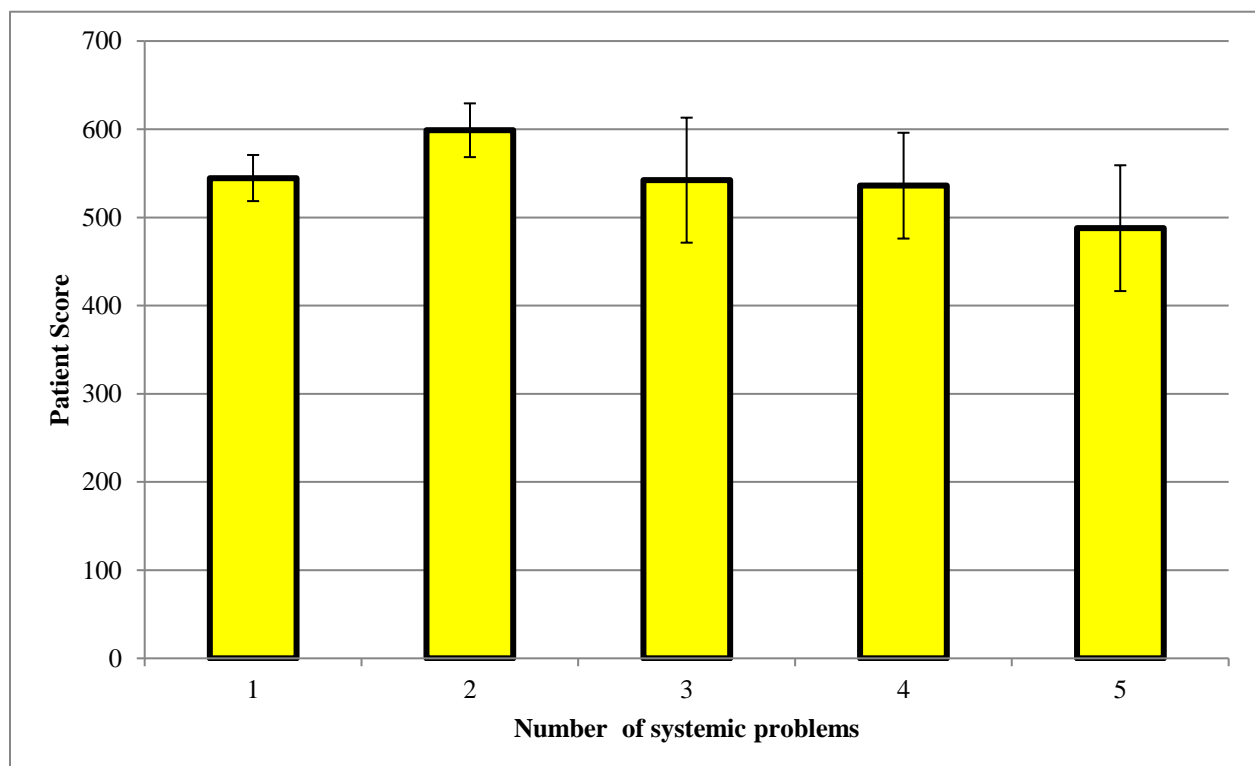
In addition, a comparison of patient scores between genders of people with any systemic problem was made (Figure 6).



**Figure 6** – Comparison of patient scores between genders of people with any systemic problem  
(Error bars = standard error)

This time, when the severity of periodontal disease was compared between males and females with systemic problems, the average patient score of the males was equal to the average patient score of the females, rather than being higher. Also, the p-value of the t-test was very high: 0.979517. This means that the alternate hypothesis is rejected and it can be concluded that males and females with systemic problems have the same average oral health. When compared to the previous set of data (figure 5), males had a higher average patient score and more severe periodontal disease when other systemic problems were not present. It can then be possible to infer that systemic problems may overcome the impact of lifestyle differences between males and females on the severity of periodontal disease. It is not safe to make a conclusion because the first set was insignificant and inconclusive.

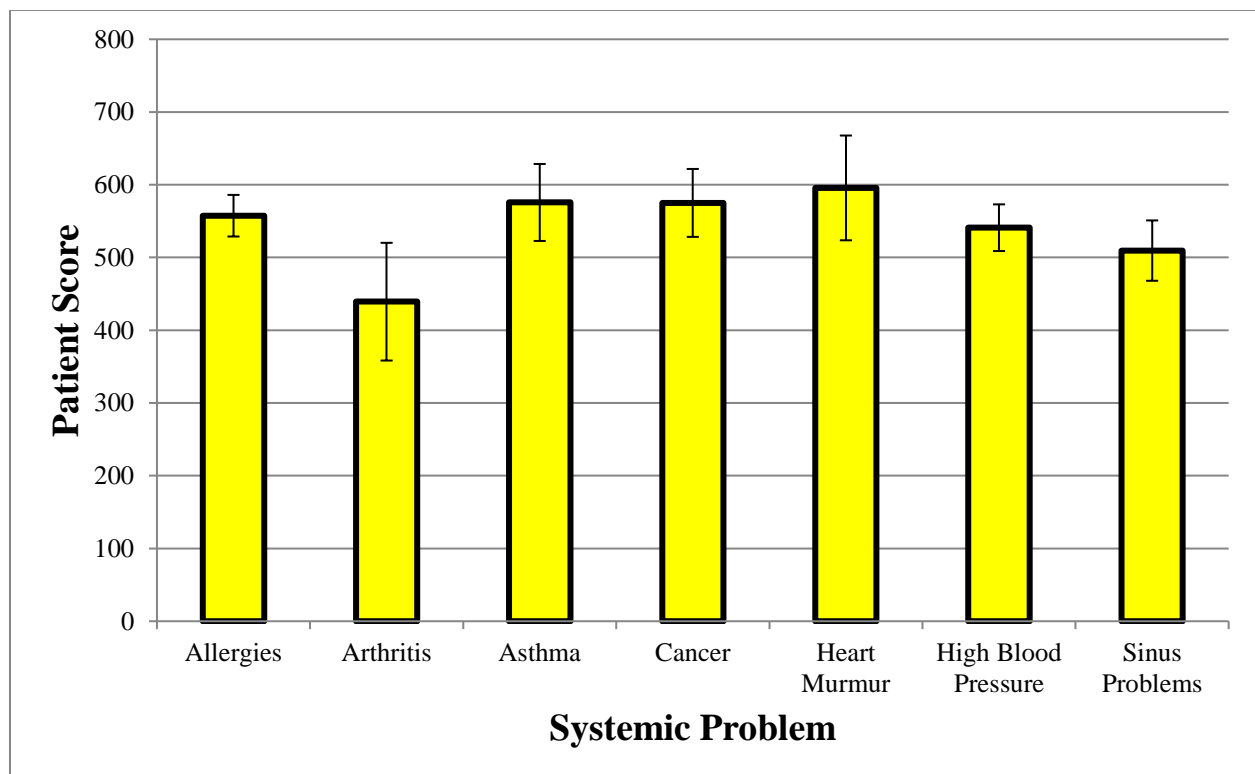
Subsequently, the impact of the number of systemic problems on periodontal disease was analyzed (figure 7). In this figure, the mean patient score of patients with different amounts of systemic problems were compared.



**Figure 6** – Comparison of amount of systemic problems other than periodontal disease  
(Error bars = standard error)

It was previously hypothesized that the more systemic problems one has, the more severe the periodontal disease because as shown in previous studies, systemic problems are correlated with a poor immune system which is unable to ward off periodontal causing bacteria in the mouth (Sandberg et al., 2000). It was unexpected that patients with 5 systemic problems would have the lowest mean patient score and patients with 2 systemic problems have the highest. Nevertheless, the data was insignificant due to a high p-value of 0.44553 derived from an ANOVA test. Also, most of the error bars are overlapping, meaning that the data is also inconclusive. Again, this is thought to be due to the small sample size.

Finally, one more set of data was analyzed: different types of systemic problems to the severity of periodontal disease (figure 7).



**Figure 7** – Comparison of all systemic problems  
(Error bars = standard error)

In this figure, the mean patient score of patients with different types of systemic problems were compared. The p-value of the ANOVA was 0.73052, which is very high and means that the data is again insignificant. The alternate hypothesis must be rejected and no valid conclusion could be made.

### **Limitations and Improvements**

There are some limitations in this investigation. One limitation is the validity of the data collected. The medical history of a patient may contain false information regarding the age and medical history. This may have happened accidentally due to human error in filling out the medical history or purposely in order to hide certain information. To overcome this limitation, a completely anonymous medical history chart could be given to patients before a perio maintenance. This would eliminate a patient's desire to hide his or her medical history.

Another limitation in this investigation was the small sample size of patients collected. To overcome this limitation, additional de-identified unanalyzed medical history and perio maintenance charts could be collected from various dental practices or dental clinics in order to possible gain significant and more conclusive results.

Furthermore, another limitation faced in this investigation was the accuracy of the patient scoring systemic devised in order to measure the severity of periodontal disease. In order to test the accuracy of the patient scoring system, a study could be conducted that compares severe periodontal disease to mild periodontal disease using the patient scoring system to conclude if the patient score shows this comparison.

### **Future Research**

This study leads to many areas of future research. With this study, the investigation can come upon correlations of age, gender, or systemic problems has and the depth of a pocket or the

percentage of bleeding on probing in the mouth in order to attain a better picture of aspects of periodontal disease being affected by these characteristics.

Furthermore, there are many dental practices and dental clinics all over the United States, and even in other parts of the world where there is information regarding probing pocket depth, bleeding on probing, age, gender, and systemic problems for patients that suffers from periodontal disease. These records can be used to expand the database of dental health information so that they are more accessible to others and can be used when analyzing correlations between periodontal disease and other characteristics in a specific area of the world.



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