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Periodontal Disease an Overlooked Chapter in Public Health: A Statistical Analysis

Arpan Sheth [α], Ritul Patel [σ] & Shivam Patel [ρ]

Abstract- This study aims to find that there is any association between Periodontal diseases with factors like diabetes, depression, blood pressure, age, gender, alcohol, smoking, education level, and obesity. For this study data were taken from National Health and Nutrition Examination Survey (NHANES). From this data various variables are taken and test in SAS 9.4 software for analysis. This study is done on a 3737 sample in which 734 people reported having gum/periodontal disease. Logistic regression analysis was performed with variables. We found a significant association between diabetes, depression, age, smoking, and obesity to have periodontal disease.

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I. Introduction

Gum diseases are considered a periodontal problem. Periodontal problems are highly prevalent up to 90% of the population are having a mild to an extreme state of disease. In the initial stage, the disease starts with gingivitis, without causing any issue towards the underlying bone. If this reversible situation does not intervene with mechanical instrumentation plaque on teeth will mineralize and become calcified. [1]

As this plaque-filled calcified structure will retain in the gingival sulcus, GCF mixed with bacteria will amplify inflammatory response from periodontium leading to loss of structure.

This calcified structure will retain in the sulcus of the gingiva. In this gingival sulcus, a GCF (Gingival Crevicular Fluid) has a plasma protein, anti-microbial properties with antibodies. This calculus contains microorganisms that process with this fluid and antibodies as a result there is a loss of gingiva to the specific structure.[2]

Many factors contribute to this increased inflammatory process, which results in mild, moderate to extreme loss of connective tissue and bone loss, which we can acknowledge as periodontal tissue loss in periodontitis.

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Now certain factors will aggravate this process of gingival loss. This gingival loss will result in tooth mobility and periodontal loss which is known as periodontitis. Periodontitis results from the loss in the connective tissues and bone support.[1]

Usually, the initial stage of periodontal disease is overlooked by most of the population. As the disease progresses, symptoms become more noticeable, ranging from swollen or puffy gingiva, bleeding, halitosis, dull ache, and mobility of teeth. Which patient usually reports to dentist or dental hygienist.[3]

For this study, we went through a database and categorized patients with different factors associated with periodontal disease.

II. Background

a) Age

Beck et el did a study in North Carolina in 5 different counties consists of a population over age 65 with significant bone loss and more mean pocket depth.[4]

Aljehajni et el found out that increasing age has a strong relationship with the rapid progression of periodontal disease. They found out while 25-year-old showing 0.07mm loss whereas in the 70-year-old bone loss was 0.28mm.[5]

b) Depression

Several studies were done on depression and stress with the relation of having gum diseases. According to one study done on the 45 patients whom dentists referred. They measure salivary cortisol asked several questions on chronic stress, demographic questions, overall health, and depression. In this study, they found that depression and stress are associated with the destruction of periodontium. So, as a preventive measure, we control such factors to reduce periodontal disease.[6]

Another study was done on the 160 subjects in which a logistic regression model was run with the age, depression, hopelessness, psychiatric symptoms variables and they did not find any evidence of association of this variable to the periodontal diseases.[7]

c) Gender

There are several studies have been done on the relation between sex and having gingival disease. In those studies, they have found that males have a higher number of periodontal destruction than females.

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Although other factors may control sex, there might be some interference.[5]

One randomized study consists of 1710 participants between the age group 45 and 75 to find the relation of periodontal disease to cardiovascular diseases in the difference of gender. According to this study's findings tooth loss and periodontitis are related to atherosclerosis in men but not in women.[8]

d) Education level

Education level has a reciprocal relationship with periodontal disease, which means that higher education people have lesser periodontal disease. According to one study done on 948 patients were selected and they provide their lifestyle, education, and socioeconomic status were recorded. They found a significant decrease in periodontitis with the increase in education levels and income.[9] This is a regional study that cannot conclude an international level with other factors that may vary.

e) Blood pressure

According to the American College of Cardiology, one study was done on the 11,750 U.S adults who went in for dental exams and did health survey to find blood pressure and disease association and found that patients with gum disease impact high blood pressure. They also found that more severe gum disease, treatment was more likely to fail in high blood pressure candidate. Therefore, taking care of teeth and gums is essential to control blood pressure.[10]

f) Diabetes

One case-control study was done on 212 individuals to find an association between diabetes and periodontitis. It was a case-control study. At a 95% confidence level, they found significant results in diabetes patients having periodontitis. The study concludes that having Type 2 diabetes mellitus have a higher chance of having periodontitis. [11]

g) Alcohol

One cross-sectional study was done on the 1371 subjects for finding an association between alcohol intake and periodontal disease in which less than 5 drink, 5 to 10 drink, and above 10 drinks are taken in that logistic regression study, and they found that there is a moderate relationship between alcohol consumption and periodontal disease. They found that more alcoholic people have more periodontal loss is seen in that group.[12]

h) Smoking

According to this article review, all the cross-sectional and longitudinal studies have suggested the increased risk of getting the periodontal disease with smoking. This article suggests that smoking impacts the vasculature, humoral immune system, and inflammatory system, leading to a reduction in cytokines and adhesion molecule network.[13]

i) Obesity

According to this article, they found an association between body fat and periodontal disease measures was found in younger adults but not found any association in middle-aged and older adults. In this study, they conclude that having a controlled weight is associated with the decrease prevalence of disease, but obesity is the risk factor for periodontal disease in young adults. [14]

III. Methods

For this study, our dependent variable which is the outcome is predicted as to whether our respondents think they have any gingival disease. For this outcome, our predictors are found from a different literature review from PubMed and other scholarly articles that stated that they find any relation between gum disease and any predictor. For this research, we got data from NHANES (National Health and Nutrition Examination Survey) questionnaires in 2015-2016 which is the latest available data found for this study. This data is provided by the Center for Disease Control and Prevention (CDC) to the public. This data was collected by phone interview and by examination of the individual. There was a total of 9971 respondents. For this research questionnaire study, 3737 respondents who gave all the responses to our research questions are included. Missing responses refused are excluded from our study.

Number of Observations Read	9971
Number of Observations Used	3737

For getting a clear picture and explanation several categorical variables are coded in this research. For dependent variable is the question about whether respondents think they have gum disease? Which is coded No as '0' and yes as '1' while '7' as refused is recoded as '.' As missing value as '9' (Do not know) recoded as '.' As a result of this recording, we got our responses in which 864 people said yes in that response which is shown below

Response Profile

Ordered Value	ohq835_rec	Total Frequency
1	0	3003
2	1	734

An independent variable is recoded as above recoding. This research having various independent variables like a person's age in years this variable is not

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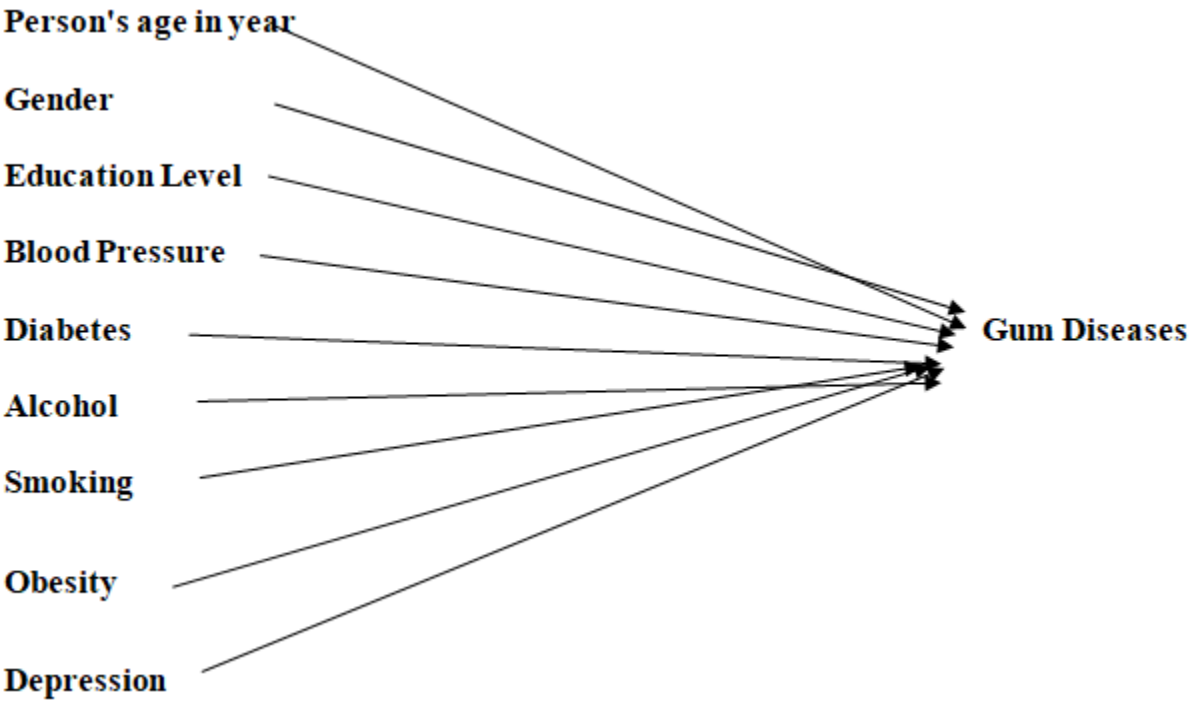
recoded. Gender is recoded in which male is recoded as '0' and female is recoded as '1'. For depression no response is recoded as '0' depression several days is recoded as '1', depression for more than half days is recoded as '2', and depression nearly every day is recoded as '3' every other response like refuse or do not know are recoded as missing in this study. The education level is divided into 2 groups. Less than 12th-grade educations are recoded as 0 and more significant than high school graduates are recoded as 1 and refuse and do not know responses are recoded as missing. Blood pressure with higher values respond with 'yes' are coded as 1 and 'no' as 0 else recoded as missing. Diabetes is recoded as yes response as 1 and no response as 0 else responses are coded as '.' mean missing. Smoking who had smoked more than 100 cigarettes is recoded as 1 as yes and 0 as no response is coded as missing. For calculating obesity in this analysis underweight is coded as 1, normal is recoded as 2, and overweight is recoded as 3 other values are coded as missing.

From the above variables for this research project logistic regression was done on the SAS 9.4 software was used for this analysis. Using this software multiple independent variables can quickly check and see the impact of that variable on another variable outcome. Also, ignore the variable which cannot show impact or correlation with the outcome or another variable.

For doing this logistic regression analysis certain categorical variables are given as reference groups. For gender male is taken as the reference group, for depression no response is taken as the reference group, for education level below high school level education is taken as the reference group, Blood pressure who respond No is taken as the reference group, Diabetes who respond No is taken as the reference group, for smoking, who responded smoked less than 100 are taken as references, for obesity those who are in normal categories are taken as references.



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Analysis of Maximum Likelihood Estimates

Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-1.5520	0.2141	52.5498	<.0001
Person age in Year		1	-0.0101	0.00316	10.2387	0.0014
Depressed several days	1	1	0.5020	0.1057	22.5661	<.0001
Depressed more than half day	2	1	0.4964	0.1980	6.2851	0.0122
Depressed nearly every day	3	1	0.6952	0.2034	11.6786	0.0006
Gender	1	1	-0.0191	0.0914	0.0437	0.8344
Education Level	1	1	-0.0475	0.0981	0.2350	0.6278
Blood Pressure	1	1	0.1536	0.0931	2.7212	0.0990
Diabetes	1	1	0.3875	0.1082	12.8382	0.0003
Alcohol		1	0.0708	0.1029	0.4732	0.4915
Smoking	1	1	0.5079	0.0914	30.8507	<.0001
Underweight	1	1	0.5220	0.1797	8.4392	0.0037
Overweight	3	1	0.2146	0.0919	5.4532	0.0195

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
Person age in a year	0.990	0.984	0.996
Depression several days 1 vs 0	1.652	1.343	2.032
Depression more than half days 2 vs 0	1.643	1.114	2.422
Depression nearly every day 3 vs 0	2.004	1.345	2.986
Gender 1 vs 0	0.981	0.820	1.173
Education 1 vs 0	0.954	0.787	1.156
Blood pressure 1 vs 0	1.166	0.972	1.400
Diabetes 1 vs 0	1.473	1.192	1.821
Alcohol	1.073	0.877	1.313
Smoking 1 vs 0	1.662	1.389	1.988
Underweight 1 vs 2	1.685	1.185	2.397
Overweight 3 vs 2	1.239	1.035	1.484

IV. Findings and Interpretation from the Model

By running this logistic regression model some significant result findings suggest the relation of that factors on the outcome while controlling the other variable. Here from the result, a person's year in age is showing a significant relationship. Another variable is blood pressure, depression, diabetes, smoking, and obesity (both underweight and overweight) showing a significant relationship while controlling the other variables. While looking at the model and significance we can say that every increase in one year of age will have a 0.02% decreased risk of getting gum diseases, which can collaborate as person age increases that person will try to take better care of his overall health

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and oral health per se. For depression and selected reference groups, we can interpret that depression for several days has 65% more likely to get gum diseases than those who do not have depression. Same as depression for more than half days and depression for all the days have 64% and 2 times more likely to get gum disease than those who do not have depression. For gender and education, the study shows the inconclusive result. For blood pressure, we cannot predict likely due to not getting any significant result. For diabetes, we can say that those who reported diabetes as positive are 43% more likely to get gum disease than those reported as negative. For alcohol, we are not getting any significant results. For Smoking, we can say that those who are smoking have 83.6% more likely to get gum disease than those who reported a negative response to smoking. For the weight category, we can say that those reported as underweight have 58.2% more likely to get gum disease than those who reported as normal weight. We can say that overweight has 23.9% more likely to get gum disease than those who are at a normal weight.

V. Discussion

For this statistical study, we ran a model fit test that came at -2 likelihood, suggesting that this model scenario is not fit with big sample size, which attributes mainly to a common understanding varies among population. However, that does not take out the possibility of correlation with various factors and periodontitis. When we checked Variance inflation factor (VIF) and tolerance level, which shows factors with >0.7 tolerance level with VIF nearly 1 indicating no multicollinearity, the study has an appropriate sample size to derive a conclusion.

This study has found some significant association with predisposing factors whereas no relevant information is found as suggested in literature otherwise. For example, the literature suggests male is at higher risk of getting the disease. However, this study contradicts its result which can be contributed to lesser care towards oral health leading to lesser education/ awareness made them answer in survey otherwise about having gum disease. On the other hand, a study shows more likeliness to have gum disease, which can contribute to more awareness and more education made them answer more carefully about having gum disease, which made that factor more susceptible to gum disease.

With multicollinearity model with blood pressure and alcohol together not showing significant relation but without one other they show very significant statistical correlation with each other and disease.

There are some other variables which we have included in this study variables like hormonal differences, genetics, pregnancy, a socio-economic status which are showing association with gum diseases but due to survey design for this specific study so we cannot access those variables. However, this study includes most common predictors for gum disease.

VI. Conclusion

There are many reasons for getting gum/periodontal disease after assessing different factors for disease, this study found many significant connections and conclusions with those involving variables concerning periodontal disease. In this research, we found a relationship between obesity, a person's age in a year, smoking, diabetes. Another variable might be having an impact on the periodontal disease, study can have errors which lead to some impact on the result. However, we are sure to say with data studied that we can somewhat control periodontal disease if we control our predisposing variable/ condition. As fellow author, Dr. Ritul Patel says often to his patients “Dentistry is not expensive, your neglect is”.

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