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*Virginia Commonwealth University*

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School of Dentistry  
Virginia Commonwealth University

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PREVALENCE OF PULPAL AND/OR PERIRADICULAR DISEASE IN THE VCU  
SCHOOL OF DENTISTRY SCREENING PATIENT POPULATION has been approved  
by his or her committee as satisfactory completion of the thesis or dissertation requirement  
for the degree of Master of Science

---

B.Ellen Byrne, D.D.S., Ph.D., Assistant Dean of Academic Affairs, School of Dentistry

---

B.Ellen Byrne, D.D.S., Ph.D., Assistant Dean of Academic Affairs, School of Dentistry

---

Russell E Bogacki, D.D.S., M.S., Dept. of General Practice, School of Dentistry

---

James R. Lance, D.D.S., Dept of Endodontics, School of Dentistry

---

Frederick R. Liewehr, D.D.S., M.S., Chair, Dept. of Endodontics, School of Dentistry

---

Laurie Carter, D.D.S., Ph.D., Director of Advanced Dental Education

---

Dr. F. Douglas Boudinot, Dean of the School of Graduate Studies

April 29, 2005

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PREVALENCE OF PULPAL AND/OR PERIRADICULAR DISEASE IN THE VCU

SCHOOL OF DENTISTRY SCREENING PATIENT POPULATION

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

by

ELLEN RIVES OERTEL, D.D.S.  
B.S., James Madison University, 1984  
D.D.S., Medical College of Virginia, 1992

Director: B. ELLEN BYRNE, D.D.S., PH D  
ASSISTANT DEAN OF ACADEMIC AFFAIRS, SCHOOL OF DENTISTRY

Virginia Commonwealth University  
Richmond, Virginia  
May, 2005

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## Abstract

### PREVALENCE OF PULPAL AND/OR PERIRADICULAR DISEASE IN THE VCU SCHOOL OF DENTISTRY SCREENING PATIENT POPULATION

By ELLEN RIVES OERTEL, D.D.S., M.S.

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

Virginia Commonwealth University, 2005

Major Director: B. Ellen Byrne, D.D.S., Ph D  
Assistant Dean of Academic Affairs, School of Dentistry

The purpose of this study was to determine the prevalence and demographic predictors of pulpal and/or periradicular disease in an urban population. A total of 210 subjects were recruited from a population of patients that were screened for acceptance to the dental school clinics. The diagnosis of pulpal and/or periradicular disease was made using the following data: radiographic interpretation, patient's history of previous pain and chief complaint, and objective pulpal testing. Objective pulpal testing included percussion, palpation, electric pulp test, and cold. The unit of observation was the individual, not the tooth. The overall prevalence of endodontic disease among the study sample of the



screening patient population was 39.52%. Controlling for gender, patients in the 30-39 age group were 3.05 times more likely to have pulpal disease than patients in the 18-29 age group (OR=3.05, 95%CI 1.04-8.9). Controlling for age, men were 1.82 times more likely to have pulpal disease than women (OR=1.82, 95%CI 1.01-3.26). Non-white patients were 2.69 times more likely to have pulpal disease than white patients (OR=2.69, 95%CI 1.51-4.81). Patients who earned less than \$25,000 were 2.06 times more likely to have pulpal disease compared to those who earned more than \$25,000 (OR=2.06, 95% CI 1.15-3.69). Overall, this data provides valuable information for identifying vulnerable populations and addressing the policy goals of the U.S. Surgeon General.

## CHAPTER 1 INTRODUCTION

The majority of studies on the prevalence of pulpal and/or periradicular disease have been performed outside of the United States. Most of these studies were based on radiographic findings of periapical pathosis. Goldman and Pearson's study in 1972, showed that reading radiographs is a subjective interpretation and that interexaminer agreement is only 47%<sup>1</sup>. Very few studies have been done on the prevalence of periapical disease in a United States population<sup>3,4,5,6,7</sup>. In 1995, a study was performed at the University of Connecticut that examined the quality and prevalence of endodontic treatment<sup>2</sup>. The study focused on the quality of endodontic treatment and treated the tooth as the unit of observation, making it difficult to predict the level of disease at the population level.

A study on an urban Danish population by Kirkevang et al<sup>3</sup> radiographically examined 614 patients. There were 15,984 teeth examined, 538 (3.4%) had apical periodontitis and 773 (4.8%) had been endodontically treated. Of the endodontically treated teeth, 404 (52.2%) had apical periodontitis. The results of this study are difficult to apply to the general population, because all of the data were collected from a hospital that handles dental emergencies and the diagnosis was based on radiographic findings.

The US Department of Health and Human Services Surgeon General Report on Oral Disease states that there are profound disparities in oral health status in some population groups. The magnitude of differences in oral health status among population groups classified by gender, income, age, and race/ethnicity is striking.<sup>9</sup> This study is the first to our knowledge to determine the prevalence of pulpal and/or periradicular disease among these population groups.

The purpose of this study was to determine the prevalence of pulpal and/or periradicular disease in the Virginia Commonwealth University (VCU) School of Dentistry patient population, a population that closely matches the general population in the City of Richmond. The unit of observation was the individual, not the tooth. The prevalence of pulpal and/or periradicular disease was the percentage of patients with disease not the percentage of teeth with disease. The diagnosis of pulpal and/or periradicular disease was made using the following data: radiographic interpretation, patient's history of previous pain and chief complaint, and pulpal testing. Pulpal testing included percussion, palpation, EPT, and cold. The secondary goal was to examine the predictive value of gender, age, race, income and smoking on the presence of pulpal and/or periradicular disease.

## CHAPTER 2 MATERIALS AND METHODS

A survey tool was designed to gather information from respondents on their demographics, their tooth pain experiences during the past 6 months, and their treatment experiences for tooth pain throughout their lifetime. The survey is presented in Table 1. The demographic questions were modeled after similar questions found in the Brief Risk Factor Surveillance Survey (BRFSS), which were developed by the Centers for Disease Control ([www.cdc.gov/brfss/](http://www.cdc.gov/brfss/))

Potential patients of the dental school predoctoral clinic must go through a screening visit to determine if their care can appropriately be met by third and fourth year dental students, or if they should be referred to clinicians with more experience and training. Study subjects were recruited from this population of patients. Patients were compensated \$50.00 for participation. If the patient was in pain, they were given the option of root canal therapy or extraction and appointed for treatment.

A total of 210 study subjects were recruited, regardless of whether they were accepted into the predoctoral clinic or not. Individuals under 18 years old and patients who were mentally impaired were excluded. Because the sample population consisted of the patients who were coming to the dental school seeking dental treatment, it represented only

the type of individual that would seek dental care in a dental school located in a dense urban area. This was a limitation of our study, because it raised barriers to extrapolating the findings to the general population. Patients who consented to participate were given the survey presented in Table 1. They were given as much time as needed to answer the survey questions. To avoid bias, they did not receive assistance with interpreting the questions, but they did receive assistance if they could not read the survey. After completion of the survey, the surveys were reviewed to ensure completeness, and then the study subjects were sent for clinical examination in an area separate from where the survey was administered. Clinical examiners were blinded to the study subject's responses to the survey.

Residents in the graduate endodontic program performed all of the clinical examinations. The primary goal of the clinical examination was to determine whether or not the patient had pulpal and/or periradicular disease. The clinical examiners were calibrated to perform the examination before the study started, and received reviews repeatedly throughout the study. After each day of clinical examinations, meetings were held to discuss difficulties and ensure consistency with examination techniques. During these meetings, clinical examination data were reviewed to ensure completeness and accuracy. The clinical examination data form is presented in Table 2.

When the study subjects presented for clinical examination, the examiner looked for suspicious teeth by reviewing the panoramic radiograph taken at screening, asking general

questions as to past and present tooth pain, and by percussion testing all teeth. Suspicious teeth were defined as teeth that had one or more of the following:

- evidence of periapical pathology or deep caries on the panoramic radiograph;
- current pain or a history of pain;
- pain on percussion.

Suspicious teeth were then examined more carefully to determine a clinical diagnosis.

Information was collected on all suspicious teeth to establish as accurate a clinical diagnosis as possible. When possible and appropriate, the following tests were performed: electric pulp testing, palpation, percussion, and thermal testing. Periapical radiographs were taken of all suspicious teeth to check for previous root canal therapy and evidence of widened periapical periodontal ligaments or periapical radiolucencies. Suspicious teeth were examined for cracks or fractures, and the surrounding tissues were examined for sinus tracts and swelling. Based on all of these signs and symptoms, a clinical diagnosis was assigned to each suspicious tooth. Each suspicious tooth received a pulpal diagnosis and a periapical diagnosis.

The pulpal diagnosis was normal, reversible pulpitis, irreversible pulpitis, or necrotic. The periapical diagnosis was normal, chronic apical periodontitis, acute apical periodontitis, acute apical abscess, or suppurative apical periodontitis. (see Table 3). To ensure accuracy, the first 48 patients were examined by two independent examiners. It was

found that examiners agreed 88% of the time resulting in a  $\kappa$  of 0.74. Using the scale described by Landis and Koch this is considered to be substantial agreement. A score ranging from 0.81 to 1.00 is considered almost perfect.<sup>11</sup> Inconsistencies were evaluated and resolved in study meetings. This process produced a standardized and consistent clinical examination for pulpal and/or periradicular disease.

Table 1. Survey Questions

<b>Patient Name:</b>		<b>Date:</b>	
Do you have any natural teeth? y / n <b>If you answered no to this question, stop and notify the study doctor.</b>			
<b>Section:</b>	<b>Question</b>	<b>Please write or circle your answer.</b>	
<b>Demographics</b>	What is your age?		
	Are you male or female?	male / female	
	Is your annual household income from all sources:	1. less than \$10,000 2. \$10,000 to less than \$15,000 3. \$15,000 to less than \$20,000 4. \$20,000 to less than \$25,000 5. \$25,000 to less than \$35,000 6. \$35,000 to less than \$50,000 7. \$50,000 to less than \$75,000 8. \$75,000 or more 9. Don't know / not sure 10. Refuse	
	What is your race? Would you say:  (Please circle all that apply.)	1. White 2. Black 3. Asian, Pacific Islander 4. American Indian 5. Other - specify _____ 6. Don't know / not sure 7. Refused	
<b>Prevalence</b>	In the past 6 months, have you had a toothache that kept you awake at night?	y / n	
	In the past 6 months, have you had to take analgesics (pain killers) for a toothache?	y / n	
	In the past 6 months, have you had a facial swelling that was caused by a tooth?	y / n	
	In the past 6 months, have you injured any of your teeth?	y / n	
	In the past 6 months, have you broken a tooth?	y / n	
	In the past 6 months, have you noticed any of your teeth turning darker than the teeth around them?	y / n	
	In the past 6 months, have you noticed a bump, pimple, or boil on your gums?	y / n	
	In the past 6 months, have you noticed that if you eat or drink something hot or cold, you get a toothache that lasts for a few minutes?	y / n	
	In the past 6 months, have you had repeated sharp pain in the same area while chewing?	y / n	
	In the past 6 months, have you visited an emergency room or emergency center for treatment of a toothache or facial swelling related to a tooth?	y / n	
	<b>Treatment Experience</b>	Have you ever been told that you needed a root canal?	y / n
		If yes, what did you do about it?	had a root canal/ had the tooth extracted/ did nothing
Have you ever had a bump, pimple, or boil on your gums?		y / n	
If yes, what did you do about it?		had a root canal/ had the tooth extracted/ did nothing	
Have you ever been told you needed to have surgery on a tooth that has had a root canal?		y / n	
If yes, what did you do about it?		had a root canal/ had the tooth extracted/ did nothing	



Table 2. Clinical Evaluation Form

<b>Patient Name:</b>		<b>Patient Number:</b>			
<b>Examiner:</b>					
	<b>Tooth Number</b>				
	#	#	#	#	#
<b>Test</b>					
EPT					
Palpation					
Percussion					
Cold					
Warm					
Sinus Tract					
Pain					
Previous RCT					
Periapical Radiolucency					
Swelling Associated					
Crack or Fracture					
<b>Diagnosis</b>					
<b>Standardization Information:</b>					
EPT	1 - 80				* Missing Values – leave blank or write reason
Palpation	0 - no	1 - yes			
Percussion	0 - no	1 - yes			
Thermal Stimulus	0 - none	1 - short	2 - continuous		
Sinus Tract	0 - no	1 - yes			
Pain	0 - none	1 - spontaneous	2 - diffuse	3 - localized	
Previous RCT	0 - no	1 - yes			
Periapical Radiolucency	0 - normal	1 - thickened PDL	2 - apical radiolucency		
Swelling	0 - no	1 - yes			
Crack or Fracture	0 - no	1 - yes			

**Table 3. Diagnostic Categories**

Tissue	Diagnosis	Recommended Treatment
Pulpal	normal or reversible pulpitis	none
	irreversible pulpitis	extraction or root canal therapy
	necrosis	extraction or root canal therapy
Periapical	normal	none
	acute apical periodontitis	extraction, root canal therapy, or surgical therapy
	chronic apical periodontitis	extraction, root canal therapy, or surgical therapy
	acute apical abscess	extraction, root canal therapy, or surgical therapy
	suppurative apical periodontitis	extraction, root canal therapy, or surgical therapy

### CHAPTER 3 DATA ANALYSIS

Prevalence was determined and presented by simple descriptive statistics. The prevalence was also stratified using logical levels of analysis such as gender, age, race, income and smoking. Data on gender, age, race, income and smoking was gathered from the survey forms. Data on the presence of pulpal and/or periradicular disease was collected from the clinical examination. Logistic regression was used for this part of the analysis. The explained variable was the presence of pulpal and/or periradicular disease. The explanatory variables were gender, age, race, income and smoking.

## CHAPTER 4 RESULTS

The number of people examined in this study with pulpal and/or periradicular disease was 83 out of the 210. The prevalence of endodontic disease among the VCU School of Dentistry patient population was 39.52%. A breakdown of the basic demographics of this population is presented in Table 4.

There were 81 patients in the <\$25,000 income bracket, 40 of 81 (49%) had pulpal and/or periradicular disease. Of the patients in the >\$25,000 income bracket, 37 of 115 (32%) had a need for root canal therapy. Patients who earned <\$25,000 were 2.06 times more likely to have pulpal disease compared to those who made more than \$25,000 (OR=2.06, 95%CI 1.15-3.69).

There were 133 participants who were white, 41 had pulpal and/or periradicular disease (31%). Seventy seven participants were non-white, 42 had pulpal and/or periradicular disease (55%). Race was found to be a predictor of pulpal and/or periradicular disease. Non-white patients were 2.69 times more likely to have pulpal disease than white patients (OR=2.69, 95%CI 1.51-4.81).

Patients under the age of 40 who had pulpal and/or periradicular disease were 25 of 66 (37.88%). Of the participants over the age of 40, 40.28% had pulpal disease. Controlling for gender, patients in the 30-39 age group were 3.05 times more likely to have

pulpal and/or periradicular disease than patients in the 18-29 age group (OR=3.05, 95% CI 1.04-8.9).

A total of 133 females participated in the survey, 46 of them had pulpal and/or periradicular disease (33%). There were 77 males who participated in the survey, 37 of them had pulpal and/or periradicular disease (48%). Controlling for age, men were 1.82 times more likely to have pulpal disease than women. (OR= 1.82, 95% CI 1.01-3.26).

There were 44 smokers who participated and 146 nonsmokers in the survey. Of the smokers, 23 had pulpal and/or periradicular disease (52%). Of the nonsmokers, 92 of them had pulpal and/or periradicular disease (63%) Smoking was not found to be a predictor of disease.

**Table 4 Basic Demographics**

<b>Income</b>	<b>&lt;25,000</b>	<b>&gt;25,000</b>	<b>Refused</b>
	<b>81</b>	<b>115</b>	<b>14</b>
<b>Race</b>	<b>White</b>	<b>Non-white</b>	
	<b>133</b>	<b>77</b>	
<b>Age</b>	<b>&lt;40</b>	<b>&gt;40</b>	
	<b>66</b>	<b>144</b>	
<b>Gender</b>	<b>Male</b>	<b>Female</b>	
	<b>77</b>	<b>133</b>	
<b>Smoking</b>	<b>Yes</b>	<b>No</b>	<b>Refused</b>
	<b>44</b>	<b>146</b>	<b>20</b>

## CHAPTER 5 DISCUSSION

Most studies done on prevalence of pulpal and/or periradicular disease were done on radiographs and chart reviews and not with clinical examinations. These studies based their statistics on the tooth as the unit of measurement, making it difficult to determine the prevalence of pulpal and/or periradicular disease on the population level. The shortcoming of these studies is that they determined the presence of pulpal and/or periradicular disease on the basis of radiographic findings. Different observers may not agree with what they see on a radiograph<sup>1</sup>. Pulpal and/or periapical disease is not evident radiographically until a sufficient amount of bone loss has occurred, therefore pulpal and/or periradicular disease can be present without radiographic evidence<sup>10</sup>. Very few published studies have been done on a United States population. Our study used clinical examinations as well as radiographs to determine the presence of pulpal and/or periradicular disease.

In a longitudinal cohort study done by Boykin et. al.<sup>8</sup> in 2003, they found that 13% (88 of 873 adults) had some type of endodontic treatment performed on at least one tooth during a 48 month follow-up period. We found that pulpal and/or periradicular disease is present in 39.52% of the dental school screening patient population. The difference in these results may indicate that the pulpal and/or periradicular disease that was diagnosed in this study was asymptomatic and that the patients may not seek treatment for this disease until it becomes symptomatic. Also, some of the patients in the Boykin study with pulpal

and/or periradicular disease may have had their teeth extracted, which would explain the lower percentage of endodontic treatment.

Patients under the age of 40 who had pulpal and/or periradicular disease were 25 of 66 (37.88%). Data presented in Table 5. This was higher than Eriksen et al.<sup>5</sup> who found 14% of 35 year olds in Norway had apical periodontitis. Of the participants over the age of 40, 40.28% had pulpal disease. This was also higher than Erikson & Bjertness<sup>4</sup> previous study, which found apical periodontitis in 30% of 50 year olds in Norway in 1995. The Eriksen et al study was based on radiographic findings. The present study made a diagnosis of pulpal and/or periradicular disease based on clinical and radiographic findings. The marked differences in prevalence of disease between our study and the Eriksen study indicates the weakness associated with diagnosing pulpal and/or periradicular disease using radiographs alone. Controlling for gender in our study, patients in the 30-39 age group were 3.05 times more likely to have pulpal and/or periradicular disease than patients in the 18-19 age group. This was statistically significant with a p-value equal to 0.042.

We hypothesized that patients in a lower household income bracket would have a higher prevalence of pulpal and/or periradicular disease. We found that patients in the <\$25,000 income bracket were 2.06 times more likely to have pulpal and/or periradicular disease. The Surgeon General Report stated that employed adults in the U.S. lose more than 164 million hours of work each year due to dental disease and dental visits<sup>9</sup>. Patients

in this income bracket can ill afford to miss hours of work. Those with incomes at or above the poverty level are twice as likely to report a dental visit in the past 12 months than those who are below the poverty level<sup>9</sup>. The burden of oral disease is disproportionately borne by individuals with low socioeconomic status<sup>9</sup>. This is the first study to our knowledge, to demonstrate an increase in pulpal and/or periradicular disease in individuals with low socioeconomic status.

Race was found to be a predictor of pulpal and/or periradicular disease. Nonwhites were 2.69 times more likely to have pulpal and/or periradicular disease in this study, with a p-value equal to 0.0007. This confirms the statement made by the Surgeon General that despite improvements in oral health status, in some population groups as classified by sex, income, age and race the magnitude of the differences in oral health is striking<sup>9</sup>. To our knowledge, this is the first study to demonstrate a higher prevalence of pulpal and/or periradicular disease in the nonwhite population.

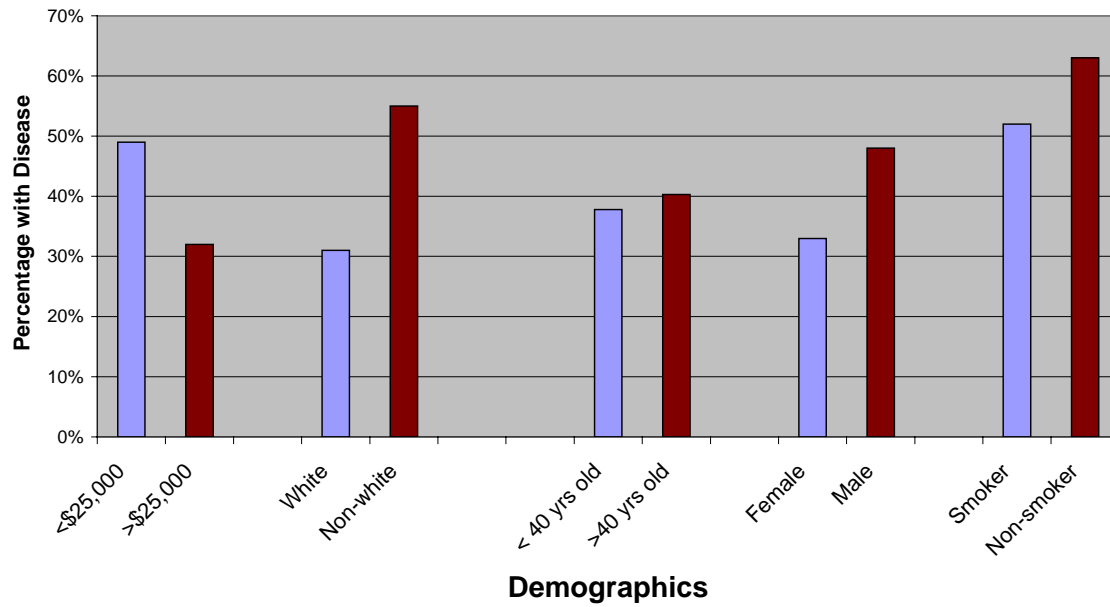
Gender was found to be a positive predictor of disease. Controlling for age, men were 1.82 times more likely to have pulpal and/or periradicular disease. This demonstrates that there is a difference in oral health status in population groups classified by sex.

There were 44 smokers who participated in the survey. Of the smokers, 23 had pulpal and/or periradicular disease (52%). There were 146 nonsmokers, 92 of them had



pulpal and/or periradicular disease (63%). Smoking was not found to be a predictor of pulp and/or periradicular disease.

Table 5



## CHAPTER 6 CONCLUSION

This study was of patients who sought treatment at the VCU School of Dentistry, who were 18 years of age or older and who had at least one tooth . The data analysis focused on whether or not the patient had pulpal and/or periradicular disease based on radiographic and clinical examination, and which socioeconomic factors could predict the presence of pulpal disease. The Surgeon General Report on Oral Health by the US Department of Health and Human Services, reports that not all Americans are achieving the same degree of oral health. Many of us still experience needless pain and suffering, complications that devastate overall health and well being, and financial and social costs that diminish quality of life<sup>9</sup>.

Overall, we found a prevalence of pulpal and/or periradicular disease of 39.52% in our patient population. We found that nonwhite, middle aged men with an annual income below \$25,000 were at the highest risk for pulpal and/or periradicular disease. Public health efforts should be directed to serve this population of Americans.

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Literature Cited

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VITA

Ellen Rives Oertel, D.D.S., M.S. was born Jan. 8, 1962 in Richmond, Virginia. She received her B.S. from James Madison University in 1984 and her D.D.S. from the Medical College of Virginia in 1992. She did her endodontic residency at the Virginia Commonwealth University from 2003-2005.