12-1983

An Etiological and Epidemiological Study of Dental Caries in Children Residing in East Tennessee

Deborah Marie Mc Grath
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Deborah Marie Mc Grath entitled "An Etiological and Epidemiological Study of Dental Caries in Children Residing in East Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Benita J. Howell, Major Professor

We have read this thesis and recommend its acceptance:

Michael H. Logan, Mary A. Bass

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a thesis written by Deborah Marie Mc Grath entitled "An Etiological and Epidemiological Study of Dental Caries in Children Residing in East Tennessee." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Benita J. Howell
Benita Howell, Major Professor

Michael H. Logan

Mary L. Bass

Accepted for the Council:

Carl Minkel
The Graduate School

AN ETIOLOGICAL AND EPIDEMIOLOGICAL STUDY OF DENTAL CARIES IN CHILDREN RESIDING IN EAST TENNESSEE

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Deborah Marie Mc Grath

December 1983

ACKNOWLEDGMENTS

I would like to express a note of thanks to my thesis advisor, Dr. Benita Howell, for her guidance throughout my graduate studies. Her assistance with the writing and organization of this thesis was greatly appreciated. Special thanks are extended to Dr. Michael Logan for introducing me to the field of medical anthropology and suggesting that stress be pursued as an etiological variable in this study. I am also thankful for his editorial comments on the many drafts of this thesis. A sincere note of appreciation is extended to Dr. Mary Ann Bass for her suggestions regarding the nutritional aspects of this study.

I am grateful to Drs. Blanton and Dunford for allowing me to gather data from their dental offices and to the many parents and children who participated in this study. A special thank you is extended to Betsy Baily who spent many hours decoding childrens' dental records. Her cheerful attitude made the data gathering process enjoyable.

A note of thanks is extended to Henry Case for his assistance with the identification of caries in the skeletal material.

I wish to express sincere gratitude to William Sanders who offered continuous support throughout the various phases of this research. He provided help with the statistical analysis and patiently listened as I expressed ideas. But most importantly, he offered encouraging words and an open heart when these were greatly needed.

And finally, I wish to extend deepest thanks and gratitude to my parents, Frank and Eileen Mc Grath, for their unfailing love over the years. This thesis is dedicated to them.

ABSTRACT

The present study examines caries variability in children, between the ages of 2 and 17, residing in the eastern portion of Tennessee. The purpose was to identify factors which are associated with dental health status in children.

Biographic data on 99 children and their parents were obtained through the use of a questionnaire which was distributed in the offices of two pedodontists with practices in Knoxville. Dental health status was measured by the number of decayed, missing, and filled (DMF) teeth supplied by each child's dental records. The Statistical Package for the Social Sciences (Nie et al. 1975) was used to analyze the data.

The data demonstrated a great variability in the number of DMF teeth among children. Few of the variables derived from the questionnaire were significantly associated with dental health, but children with a history of stress related health disorders, such as allergies and asthma, had a higher rate of dental decay than their non-stressed counterparts. In addition, the data revealed that popular opinions on the cause and prevention of dental decay differed from the professional viewpoint. These findings led the researcher to pursue stress as a possible etiological factor in dental caries and to further examine folk orientations toward dental health.

A questionnaire was sent through mail to the homes of 60 parents who agreed to be contacted by the researcher for further information. This questionnaire elicited information regarding the presence or

absence of stress indicators in children. In addition, informants were asked to respond to statements reflecting curative, preventive, internal, and/or external orientations toward dental health.

A T-Test demonstrated that children with a high number of DMF teeth had a higher number of stress indicators than children with a low DMF score. No significant differences were found between parents of high and low DMF children with regard to any of the four orientations (curative, preventive, internal, and/or external) toward dental health. Collectively, the sample favored curative and internal orientations toward dental health.

The relationship between stress and caries was further explored in a sample of children from an Arikara Indian skeletal population. Caries rates were compared between a stressed population from the post-contact Leavenworth site and a non-stressed population from the pre-contact Mobridge 1 site. No significant differences were found between sites with regard to the frequency of caries.

The major finding of this research is that the etiology of dental caries is complex and can not be explained with reference to any single variable. Stress may be an etiological factor involved in human dental caries. More research on stress as well as other psycho-social variables and their relation to dental health is needed.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

CHAPTER I

INTRODUCTION

The etiology of dental caries has been studied extensively by researchers in various professions, including, of course, dentistry as well as nutrition, biology, and epidemiology. Although it is widely recognized that the cause of this disease is multifactorial, most studies have examined caries in relation to a single factor, such as diet. Dietary factors, most notably sugar, have been underscored as primary etiological variables because most research has been devoted to examining the carious effects of carbohydrates (Newbrun 1979). Some researchers have recently acknowledged, however, that differential decay rates can not always be explained with reference to diet (Retief 1981, Richardson 1982, Schamscula 1981). Other factors implicated in the carious process include oral hygiene habits, stress, impaired salivary functioning, and variables related to socio-economic status. But the role of all these factors in caries etiology is in need of clarification.

Dental caries present an extremely complex problem and a promising area of study for medical anthropologists. Research in medical anthropology is characterized by "a holistic view of health and disease" (Foster 1974:7), where disease etiology is viewed as the result of a "multiplicity of interacting factors" (Logan and Hunt 1978:xiii). Caries researchers in other disciplines, such as those named above, have contributed valuable knowledge concerning

dental caries, but a synthesis is needed where caries etiology is viewed as the result of a synergistic relationship among a wide range of variables. Thus, diet may be a cause of dental decay, but not the only factor involved in the growth of this disease.

In addition, medical anthropology developed out of the "growing awareness of culture's role in health" (Logan and Hunt 1978:xiii). The etiology of diseases such as malaria, kuru, obesity, and hypertension has been more clearly understood with reference to the concept of culture. Epidemiologic studies demonstrate that dental caries may be the most prevalent disease in the modern world (Heloe and Haugejordan 1981). Yet no attempt has been made to examine the cultural conditions (other than diet) which may contribute to the growth of this disease.

The present study examined caries variability in children residing in East Tennessee. Dental caries have been identified as a health problem for children in Tennessee (East Tennessee Health Improvement Council 1978), where East Tennessee children exhibit some of the highest frequencies of decayed, missing, and filled teeth for the state (Tennessee Department of Public Health 1979).

The approach used in this study was exploratory and holistic, where a multiplicity of factors and their relation to caries variability were examined. Information pertaining to both children and parents was obtained because parents are largely responsible for the dental well being of their children (Jenny 1974a). Variables chosen for investigation included diet, dental behavior, and general health status of children as well as the dental attitudes, behavior,

knowledge, and socio-economic status of their parents. These data were gathered through the use of questionnaires. Dental health status was the dependent variable and was measured by the number of decayed, missing, and filled teeth for each child. Ten research hypotheses were formulated, relating questionnaire variables and dental health status of children. The data were statistically analyzed through the Statistical Package for the Social Sciences (Nie et al. 1975).

The etiology of dental caries is complex and in need of clarification. The problem with many studies is that they attempt to explain caries etiology with reference to a single variable. The significance of this study lies in the exploratory, holistic nature of its research design, where a multiplicity of factors were examined, thus allowing the researcher to identify which test variables have a significant association with dental health. These variables provide a promising area for future research on dental caries.

CHAPTER II

LITERATURE REVIEW

I. INTRODUCTION

The purpose of the following review is to present a summary of the research on dental caries. This review will provide a framework to evaluate and discuss the results of the present study.

The problem of dental caries is outlined and definitions of the disease are presented. A discussion of etiology and epidemiology follows. With regard to the latter, the effects of acculturation on the dental health of traditional peoples is emphasized. The behavioral and psycho-social significance of dental caries is explored, where an ecological model for explaining caries variability is reviewed. Research on stress and dental caries is considered as well.

According to many researchers (Colella 1968, Rowe 1976, Newbrun 1979, Leus 1981), caries is the most prevalent form of dental disease and may be the most common disease afflicting man today. Dental decay is a significant problem worldwide. Virtually all adults and 90% of children in the United States, Europe, and most of Latin America have dental caries (Leus 1981). On average, every adult in the United States has 12 decayed, missing, or filled teeth. There are one billion unfilled cavities in the mouths of Americans (Richmond 1978:11, Newbrun 1979:1). In addition, approximately 56 million teeth are extracted annually and 20% of the American population is edentulous (Richmond 1978:11). Newbrun (1979:1) informs us that "the cost of

treating decayed teeth in the United States exceeds $2 billion annually and to completely repair the nationwide damage due to caries would cost an additional $8 billion."

Traditionally, dental caries have been viewed as a disease of modern industrialized nations, but some researchers suggest that underdeveloped countries are experiencing a higher rate of dental decay as they become acculturated into a Western world (Oranje 1935, Fisher 1968, Donnelly et al. 1977, Heloe and Haugejordan 1981). The World Health Organization (WHO) has identified dental caries as a major health problem for underdeveloped countries, such as those in Latin America and Africa, and has made plans to mitigate the occurrence of dental disease the world over (Barmes 1981).

Teeth should not be viewed as "inert pegs" in the mouth and cavities should not be regarded as simply "holes in the teeth" (Colella 1968, Newbrun 1979) because teeth are living tissues. Dental health is a vital aspect of an individual's total health and well being. According to WHO researchers, serious problems such as periostitis of the jaw, and abcess or cellulitis of the dento-facial region, can result from severe decay in a single tooth (Leus 1981).

Left untreated, decay in the deciduous dentition can lead to enamel defects such as hypoplasias or malocclusion in the permanent teeth (Newbrun 1979, Leus 1981). Organisms which harbor themselves in the cavities of decayed teeth can cause a diversity of ailments, for example, tonsillitis, ginginvitis, sinusitis, colds, and allergies. Dental caries can cause pain and discomfort, as well as "social

difficulties in communicating with others, ranging from reluctance to smile and speech deformities to halistosis. Decayed teeth left in the mouth over a long period of time can be important contributory causes of a wide range of diseases" (Leus 1981:10).

II. DEFINITION OF DENTAL CARIES

Researchers appear to be in agreement as to the nosological classification of dental caries. Most definitions have in common the notion of a decalcification or softening of the enamel. According to WHO researchers, dental caries is a "localized, post-eruptive pathological process of external origin involving softening of the hard tissues and proceeding to the formation of a cavity" (WHO 1971, Leus 1981). Newbrun (1979:1071) tells us that dental decay is a "pathological process of localized destruction of tooth tissues by microorganisms and usually takes 18 $\pm$ 6 months to develop." Similarly, Schamschula (1981:26) writes that dental decay is a gradual "dissolution of highly mineralized tooth structure by acids which are produced by plaque flora formed by dietary carbohydrates, especially sugar and sugar containing sweets."

Based on location, it is possible to distinguish three major types of caries. Pit or fissure caries are the most common caries type, and as the name indicates, they develop in the pits or grooves found in teeth which trap food. Interproximal or smooth surface caries occur in the enamel between teeth.

Young children are particularly vulnerable to decay for several reasons. They do not have the manual dexterity necessary to properly

brush their teeth. In addition, young children are highly active and growing and may consume snack foods other than their three meals per day (Newbrun 1979:1070). Dental caries is often regarded as a disease of youth, the greatest intensity of experience occurring between the ages of 15 and 25. After age 25 the caries rate declines as the more suseptible tooth surfaces have already been decayed (Dunning 1962).

Root and dentinal caries are less prevalent forms of dental decay and generally occur in older individuals whose gums have receded, exposing the root or where enamel is destroyed, exposing the dentine (Colby 1971, Newbrun 1979).

III. ETIOLOGY

Much of the research in the area of dental caries has focused on the etiological aspects of the disease. Most workers agree that dental decay is a result of environmental factors. The etiology of dental caries is multi-factoral and may be attributed to the presence of at least three factors: (1) appropriate bacteria in the oral cavity (Streptococcus mutans); (2) an available carbohydrate substrate; (3) a salivary environment suitable for the growth and maintenance of the cariogenic bacteria (WHO 1971, White 1977).

The carious process may be described as follows:

> The tooth's enamel is slowly dissolved by acid formed by microorganisms of dental plaque. When people have neglected their oral hygiene and have eaten sweet products, after a few hours or days a thick layer of dental plaque forms in the fissures on the surfaces of teeth near the gums. Certain strains of microorganisms then begin to transform sugar into acid.

> The acid can cause a partial dissolution of the tooth's enamel; a white patch with loss of natural polish may appear in a particular area. This stage may or may not develop further and it can be prevented from developing if the tooth's surface is cleaned of plaque, if the person stops eating sweets or if flouride solution is applied (Leus 1981:12).

Not all foodstuffs are equally cariogenic or caries producing. Studies have shown that high carbohydrate diets, consisting of sugar and refined flours, are conducive to dental decay whereas complex carbohydrates, including corn, rice, and whole wheat, are implicated less often in the carious process as they necessitate more action in the oral cavity in order to break them down (Newbrun 1979, Bibby 1981). Highly refined carbohydrates appear to be heavily involved in the etiology of dental decay, but they are not all equally destructive. Factors such as the frequency with which they are eaten, physical texture, and the length of time they adhere to the teeth will influence the cariogenicity of a given carbohydrate.

The most well known and well studied carbohydrate linked to the cause of dental decay is sucrose or common table sugar (Finn and Glass 1975, Newbrun 1979, 1982). The Vipeholm dental caries study was one of the earliest investigations into the effects of dietary sugar on teeth. Approximately 500 adults residing in a mental institution in Sweden were chosen for study over a five year period. The subjects were divided into seven groups where three groups ate carbohydrates such as chocolate, caramel, and toffee in varying amounts between meals. The oral hygiene of the inmates was also observed. Four major conclusions were drawn from this study:

1. Sugar consumption can increase caries activity.
2. The risk of sugar increasing caries activity is greatest if consumed between meals and in a sticky form such as toffee.
3. Caries experience appears to be related to the physical properties of sugar and the frequency of intake rather than total sugar consumed.
4. Oral hygiene measures such as toothbrushing appear to reduce the incidence of caries if performed regularly. (Finn and Glass 1979).

The results of the Vipeholm study have been confirmed by other research conducted on school and wartime populations. With regard to the latter, it was found that in countries where sugar was in short supply during both World Wars, the incidence of caries decreased accordingly (Finn and Glass 1975, Newbrun 1979).

Carbohydrates other than sugar can cause dental decay if left in the mouth over a long period of time. Bibby (1981) has rated the cariogenicity of various foods based on the amount of carbohydrate found in the food, the physical texture of the food (sticky versus non-sticky), and the quantity of salivary acid produced by the food. Other researchers have worked out similar ratings (Dunning 1962). Caldwell (1970) has pointed out that certain foods are retained on the hard dental tissues (teeth), whereas other foods adhere to the soft dental tissues (gums). For example, cola has a high soft tissue retention, ice cream has a high hard tissue retention, and milk chocolate has a fairly even hard tissue/soft tissue retention.

Many researchers have noted that saliva plays an important role in the cause and prevention of dental caries (Bibby 1935, Burstone 1946, Hyams 1948, Dunning 1962, White 1977). According to Bibby (1935) the effects of saliva on the hard dental tissues are threefold:

> Saliva may serve as a cleansing agent which prevents food from accumulating. . . . Saliva may neutralize acids as fast as they are formed. . . . Saliva may prevent the growth of certain bacteria types . . . (while) favoring the growth of particular bacteria species thus tending to establish a fixed flora in the mouth which may or may not be potentially acid producing.

The quantity and acidity of saliva vary from individual to individual and the reasons for this are not clear. But it is clear that an adequate quantity of saliva and a balanced salivary composition can aid in the prevention of dental decay.

Many studies have suggested that regular oral hygiene measures may help prevent dental decay (Tucker et al. 1976, Bellini et al. 1981), but other researchers report no significant association between oral hygiene practices and dental caries (Cleaton-Jones et al. 1979). Some researchers believe that poor oral hygiene results in periodontal disease and not dental decay (Ripa, Barenie and Leske 1977). Bellini et al. (1981) suggests that professional plaque removal may be more effective in the prevention of dental caries than self performed oral hygiene measures such as toothbrushing.

IV. EPIDEMIOLOGY

Dental caries have often been thought of as a disease of civilization or the modern world, where diets are high in refined carbohydrates and sugars. According to Turner (1979), the incidence of dental caries increases along a continuum of socio-cultural evolution. Therefore, hunter and gatherers have a low rate of dental decay whereas agricultural peoples have a much higher rate of dental caries. The high

rate of decay for agricultural peoples is explained with reference to a high carbohydrate diet with a heavy reliance on a starchy food source such as maize (Leigh 1925, Turner 1979).

As traditional peoples become acculturated the prevalance of dental caries increases dramatically. This has frequently been attributed to the abandonment of traditional diets and an increased consumption of Western foodstuffs (Oranje 1935, Fisher 1968, Curzon and Curzon 1979, Barmes 1977, Heloe and Haugejordan 1981).

This trend is readily apparent among peoples residing in Tristan da Cunha, an island located in the Atlantic Ocean midway between the South African and Argentinian coasts (Fisher 1968a). The islanders had very little contact with the outside world prior to 1940 when a naval base was stationed there and 1950 when a crawfishing industry was set up on the island. Prior to 1940 the diet consisted largely of fish and potatoes; sea bird eggs, pumpkin, mutton, berries, and apples were consumed less often. As Fisher (1968:452) points out, "such a diet was essentially simple and monotonous but devoid of cariogenic elements."

Since 1940 drastic changes in the diet have occurred. Fish is still eaten, but bread made from white flour has replaced the potato as the staple carbohydrate. In addition, various imported foodstuffs are purchased and consumed such as flour, sugar, evaporated milk, canned meat, biscuits, chocolates and sweets, beverages, canned fruit and preserves, canned vegetables, rice, dried fruit, alcohol and wine (Fisher 1968:452). Tea is a popular beverage and is usually

prepared with a large amount of sugar. "Chocolate is very popular and some teenagers eat 12 to 14 two ounce bars per week." Interestingly, "the only caries free child under 5 years was one with an aversion to sweet things" (Fisher 1968:452).

The prevalence of dental caries in Tristan da Cunha has increased dramatically in accordance with the changes in diet which have taken place. For example, prior to 1940 the average number of carious teeth per individual between 13 and 29 years of age was less than one. In 1962 the number increased to approximately 10 (Fisher 1968:448). In an attempt to directly relate diet to caries incidence the author compared sugar and sugary foods consumed in grams per individual per day before and after 1940 and found, for example, that sugar consumption rose from 1.8 grams to 150 grams, jam from .2 to 20 grams, and chocolate and other sweets consumed negligibly before 1940 increased to 50 grams per day after 1940 (Fisher 1968:453).

Although changes in diet play a role in the increased incidence of caries among traditional peoples undergoing rapid cultural change, recent research suggests that other factors may be involved in the growth of the disease. Schamschula (1981) has proposed that the high incidence of caries among the acculturated Australian Aborigines residing in New South Wales can be understood with reference to social conditions resulting from forced cultural change rather than diet alone. Before the Aborigines became acculturated their oral health status was superior to that of their Caucasian counterparts, but over the last few decades the dental health of Aborigines has deteriorated and is poorer than that of whites. The author tells us that

> Aboriginal children aged between 6 and 8 years had 90% more decayed tooth surfaces than Caucasians. Within one to two years, three or four permanent first molar teeth had become carious and the severity and destructiveness of the carious lesions were nearly 120% greater than those of Caucasian children of a similar age living in the same areas (Schamschula 1981:27).

The disparity between the dental health of Aborigines and Caucasians cannot be explained solely in terms of consumption of refined carbohydrates and sugars as the workers found little or no difference in this aspect of the diet for the two groups. Rather, differential dental health status can be explained in terms of a nexus of psycho-social and economic factors. Agricultural and industrial development forced the Aborigines out of their traditional homelands into infertile regions of Australia. Experiencing great difficulty in adapting to a foreign lifestyle and largely incapable of maintaining a traditional way of life, the Aborigines have experienced widespread deprivation. "Under these circumstances," Schamschula (1981:29) writes, "their living conditions are appalling, hygiene is poor and disease is rampant. It is not difficult to understand that awareness of the need for oral hygiene and for oral health care is minimal and rates a very low priority." This leads to a low utilization of dental services except in cases of extreme need, while other cases are left untreated.

Aboriginal children experience a higher rate and degree of malnutrition in comparison to Caucasian children living in the same areas. Nutritional stress can lower an individual's resistance to disease and if experienced during a period of tooth development, structural deformities, known as enamel hypoplasia can result, which

render the tooth weaker and more susceptible to decay. Schamschula found that Aboriginal children who were malnourished, as measured by height and weight, had more hypoplastic teeth than other children. In addition, hypoplastic teeth exhibited a 50% higher frequency of caries than structurally normal teeth. A similar association between malnutrition, enamel hypoplasia, and a higher incidence of caries has been found among children in Guatemala (Infante and Gillespie 1977).

Among the Indians of the Mexican Cordillera, the Peruvian Andes, and the Amazon Headwaters, Neumann and Di Salvo (1958:13) write that the "diets encountered were high in carbohydrates, low in protein and fat. The inhabitants of the area eat few of the foods considered essential in a balanced nutrition." However, the caries rate for these groups as well as most traditional peoples was extremely low. The virtual absence of caries among traditional peoples is usually attributed to a diet based on the consumption of complex carbohydrates, such as taro or corn. It is complex carbohydrates, however, which are implicated in the high caries rate among prehistoric agricultural groups (Leigh 1925, Turner 1979). Rosebury and Waugh (1939:872) discuss the problem of diet and dental caries:

> The characteristically high protein, high fat, low carbohydrate diet of the Eskimo, composed almost entirely of meat and fish, seem to have little in common with the diets of tropical races in which abundant fruit and vegetables yield a relatively high carbohydrate content; yet both groups have little caries. Taro and sweet potatoes were held responsible for the sound teeth of the Hawaiians by Jones and her co-workers, but abundance of the same foods at Pitcairn, according to Sprawson was associated with rampant decay.

As dental caries is a multi-factorial disease, perhaps something other than diet can explain the high rates of dental decay in pre-historic agricultural peoples and traditional peoples undergoing acculturation. Stress may be involved in the high rates of caries for these two human groups as they may experience possible emotional, disease, or nutritional stress.

According to Heloe and Haugejordan (1981), dental caries are on the rise in developing countries, and are declining in prevalence in industrialized nations. The former trend may be attributed to a change in diet, as discussed by Fisher (1968), and the social ramifications of the acculturation process as discussed by Schamschula (1981). The latter trend is largely a result of water flouridation and flouride prevention programs in the United States, Scandinavia, and England.

The relationship between caries and race is not clear. Some researchers have found that Chinese and Negro populations have lower caries rates than whites (Dunning 1962, Heloe and Haugejordan 1981), whereas other workers note no difference in caries rates between the various racial groups (Heifetz, Horowitz and Kate 1976). The Ten State Nutrition Study reported that blacks experience fewer caries than their white counterparts (Rowe et al. 1976). With regard to sex, females may experience a slightly higher rate of dental decay than males, but most researchers would agree that the difference is so slight as to be insignificant (Dunning 1962, Heloe and Haugejordan 1981).

No clear relationship between caries rates and socio-economic status has been determined or agreed upon by researchers. Some workers have found that individuals of higher socio-economic classes experience a higher degree of dental decay than those individuals occupying lower levels (Rowe et al. 1976, De La Rosa 1978). Rowe suggests that this may be due to a higher food intake and sucrose consumption. Other researchers have reported a higher rate of dental decay in lower socio-economic levels as compared to higher ones (Beck and Drake 1975, Heifetz et al. 1976). Beck and Drake (1975:224) propose that this could be due to "a combination of crowding, inadequate oral hygiene and poor nutrition." Still other researchers have found no statistically significant relationship between rates of dental decay and socio-economic factors (Weddell and Klein 1981).

V. BEHAVIORAL AND PSYCHO-SOCIAL SIGNIFICANCE OF DENTAL CARIES

Dental caries are a result of both biological and psycho-social factors. Much of the research in the area of psychology and dentistry has dealt with the fear and anxiety individuals may experience in response to treatment (Phipps and Marcuse 1972, Roskin and Rabiner 1979). Some researchers have conducted surveys to assess the attitudes, knowledge, and habits an individual may possess with regard to dental health. Beal and Dickson (1975) examined attitudes and behavior in various ethnic groups and found that positive attitudes may not always translate into matching behaviors. For example, Asians appeared

to have the best attitude with regard to conservation of teeth yet they rarely visited a dentist. Consequently they had a large number of decayed teeth left untreated.

Bulman (1968) surveyed people from two communities in England with regard to perceived dental health status and found that informants tended to be more optimistic about their dental health than did dentists. Only 15% of the individuals who considered their health to be good or very good were supported by the judgments of their dentists.

Hazelwood (1977) has studied the dental habits of Tennesseans and reported that 43% of her informants visited the dentist at least once a year, while 13% had never been to a dentist. Both of these figures compare well to the national average. Frequency of dental visits was related to household income. Children of parents whose income was less than $10,000 annually visited the dentist an average of .7 times per year, whereas children of parents whose income was higher than $10,000 visited the dentist an average of 1.8 times per year.

Kegeles (1977) defines preventive dental behavior as consisting of regular dental visits, regular toothbrushing, professional plaque removal, and consumption of low cariogenic diets. According to Kegeles, nationwide surveys demonstrate that 46% of the American population visit the dentist at least once a year and 50-70% report brushing their teeth at least once a day.

Jenny (1975) interviewed parents of third grade children and found that parents of lower socio-economic classes possessed less

knowledge in the area of dental health than did those of higher socio-economic levels. Parents of the former group agreed more often to statements such as "there is no point in filling baby teeth since permanent teeth will replace them," "no matter how well you take care of your teeth eventually you will lose them any way," and "some people are born with good teeth and others are not--and there is not much you can do about it." Children of parents in this group experienced a higher incidence of caries than did children of more well off parents. Chapman et al. (1971) reported similar findings in his survey of dental knowledge among pregnant women of lower socio-economic classes.

Results from studies examining the relationship between reported dietary habits and caries experience are inconclusive. Schroder (1981) interviewed parents with regard to dietary habits of their children and found a positive correlation between high sucrose consumption and a high rate of dental decay. Other researchers (Retief 1981) have found little correlation between diet and caries. Tijmstra (1981) attributes this latter finding to the fact that informants may respond to questionnaires in a "socially desirable way" rather than in an accurate manner regarding their diet.

One of the more systematic developments in the study of behavioral dentistry employs an ecological model to explain variability in caries experience (Jenny 1974a, Jenny et al. 1974b). Rather than surveying one element, such as diet or oral hygiene, Jenny and her co-workers investigated a multiplicity of factors which can be reduced to three elements: the individual, family, and community.

Individual factors include age, sex, and general health status of the child. Family factors include dental knowledge, attitudes and behaviors of parents, orientation to dental visits, socio-economic status, types of foods provided at meals, and model behavior for oral hygiene practices. Community factors refer to the idea that food preferences and eating practices are socially learned through advertising, television, and home making magazines "which picture the ideal homemaker as one who keeps the cookie jar filled. Sociability and hospitality are associated with the sharing of food, often cariogenic in nature" (Jenny 1974a:1152). In addition,

> mass media advertising plays a major role in the public's education in oral hygiene. Commercial messages advertising dentifrices fail to mention plaque removal as a goal or brushing and flossing techniques even though toothbrushing as usually practiced is an inefficient procedure and does not achieve its avowed purpose of removing destructive agents from the caries suseptible areas on the teeth (Jenny 1974a:1153).

The community factor also includes the relationship between a dentist and his patient and the amount of dental health education a patient receives from the dental personnel.

Jenny et al. (1974b) applied this model in a study of 838 white third grade children and their parents residing in a community in Minnesota. The authors selected diet, oral hygiene, and dental treatment as factors for study and found that these three factors accounted for 20% of the variability in caries. Dental treatment alone accounted for most of the variability and included such things as length of time since child's last dental visit and reason for child's last dental visit.

Jenny (1974a:1150) stresses the importance of the family in determining the dental health of children:

> When maintenance of oral health is socially defined as a private or personal health problem the initiation of most preventive and corrective actions for the benefit of oral health falls upon the family. The family can provide a positive setting for oral health by its dental knowledge, attitudes, behaviors and orientation to dental visits. When parents are unable--because of physical, intellectual, emotional, social or economic factors--to provide an optimum dental environment for their children families themselves become a barrier to the provision of conditions which foster oral well being.

VI. STRESS AND DENTAL CARIES

Dentists and psychiatrists have described the effects of a variety of emotional states on the workings of the salivary glands. Burstone (1946:865-6) tells us that "the quantity of saliva is an important factor in caries suseptibility and immunity" and that "the emotion of fear may result in a sympathetic domination (of the nervous system) during which salivary flow is inhibited because of vaso-constriction." This condition of inhibited salivary flow is known as xerostomia. Manic depressives (Dunning 1951, Strongin and Hinsie 1949) and alcoholics aged between 30 and 40 (Dunning 1951) have been reported to suffer from xerostomia. Burstone (1946:867) reports a case study of a woman suffering from anxiety neurosis concomittant with xerostomia, "especially during states of panicky depression." Psychotic schizophrenics undergoing periods of tense anxiety also exhibit xerostomia.

It has been thought that emotional stress lowers the pH of the saliva, thus creating a more acidic oral environment conducive to

dental decay. Some researchers have found no differences between the salivary pH of stressed and non-stressed individuals (Phipps and Marcuse 1971), whereas others have noted a temporary rise in pH while under emotional stress (Burstone 1946). It has been noted, however, that manic depressives have a more acidic saliva than individuals in the normal population (Burstone 1946).

Unfortunately, many of the researchers cited above failed to assess dental health in individuals suffering from xerostomia or an altered pH balance of the saliva. Dunning (1951), however, has reported that alcoholic and manic depressives, as discussed above, have a significantly higher incidence of dental decay than their normal counterparts. In a study of naval recruits, Manhold (1979) found that those reporting medical complaints had a higher rate of dental decay than otherwise healthy recruits. The same author (1979) measuring stress through the Berneuter Personality Inventory found that individuals with neurotic tendencies had a significantly larger number of decayed, missing, and filled teeth than those who did not.

The most convincing argument for stress as an etiological factor in dental caries comes from the work of Sutton (1962:254):

> Attention was attracted when within a four day period, acute caries were observed in six patients, more than 40 years of age. Five of them, judging from their remarks, had recently been through a period of severe worry and the sixth complained of severe overwork. None of the subjects disclosed any major changes in the dietary patterns or in their oral hygiene procedures.

The author conducted a follow up study on 661 patients in order to test his clinical impression that stress exerts an influence on

dental decay. One hundred and sixty-nine subjects had acute dental caries, 96% of which "admitted having recently undergone severe mental stress" (Sutton 1962:254). The causes of the stress were as follows: severe illness of a spouse, child, parent or other relative, worry regarding own health, severe business or financial worries, unsatisfactory employment, and overworking.

It can be concluded that stress does appear to influence the rate of dental decay by interfering with the proper functioning of the salivary glands and their secretion, thus creating an oral environment more suseptible to decay of tooth structures.

As discussed previously, prehistoric agricultural populations and traditional peoples undergoing acculturation are two examples of human groups with a high incidence of dental caries. These groups present examples of peoples experiencing possible emotional, nutritional, and disease stresses. Perhaps these stresses create an oral environment which renders carbohydrates more cariogenic.

VII. CONCLUSION

A review of the literature reveals that there has been vast research on various aspects of dental caries. But there is no conclusive study which can definitively pinpoint one factor or factors which alone explain the cause of dental decay. Dental caries present an extremely complex problem and although most researchers recognize that caries etiology is multi-factorial, few studies have approached the problem in this manner.

Epidemiological studies demonstrate that the patterning of dental caries is quite clear. The prevalence of the disease increases with socio-cultural evolution, where prehistoric agricultural populations, traditional peoples undergoing acculturation, and members of the Western world have experienced its greatest effects. The reason for this patterning, however, is not clear and a monocausal explanation implicating diet has been emphasized in many studies. Some researchers, however, are beginning to question the role of diet. Additional research on prehistoric agricultural populations, traditional peoples undergoing acculturation, and modern societies may clarify the role of diet in dental health.

There is a paucity of literature devoted to the behavioral and psycho-social aspects of dental caries, but the importance of these factors should not be ignored. The ecological model presented by Jenny (1974a, 1974b) is important both methodologically and theoretically, where a multi-factorial approach is suggested, and caries etiology is explored behaviorally as well as biologically.

The fact remains that dental caries is a disease of the modern world, affecting those who are part of it or absorbed into it, but few researchers have examined the social environment, other than diet as a possible factor in caries etiology. When considering that many diseases of the modern world are associated with a stressful lifestyle, perhaps the role of stress in dental caries needs to be re-examined and more research in this area is needed.

CHAPTER III

PROBLEM AND METHODS

I. STATEMENT OF THE PROBLEM

There is a wealth of information on the etiology of dental caries but, although many variables have been associated with dental decay, researchers have not been able to clearly determine the cause or causes of this disease. A complex etiology underlies variability in the patterning of dental caries, yet most researchers have examined differential dental health status in relation to a single independent variable, such as diet. Jenny and her co-workers (1974b) investigated caries variability in children with reference to diet, oral hygiene, and dental treatment, but more research is needed where differential decay rates are examined in relation to a wide range of factors.

A holistic, anthropological approach was used in this study where a multiplicity of factors and their relation to caries variability were explored. These variables included diet, stress, socio-economic status, dental knowledge, behavior, and attitudes (See Figure 1). These were chosen for investigation because their importance in the etiology of dental caries has been suggested by other caries researchers. However, the nature of the relation between these factors named above and caries variability is controversial and in need of clarification. For example, some researchers have reported that individuals occupying lower socio-economic ranges have a significantly higher rate of dental decay than their more affluent and more educated counterparts. But

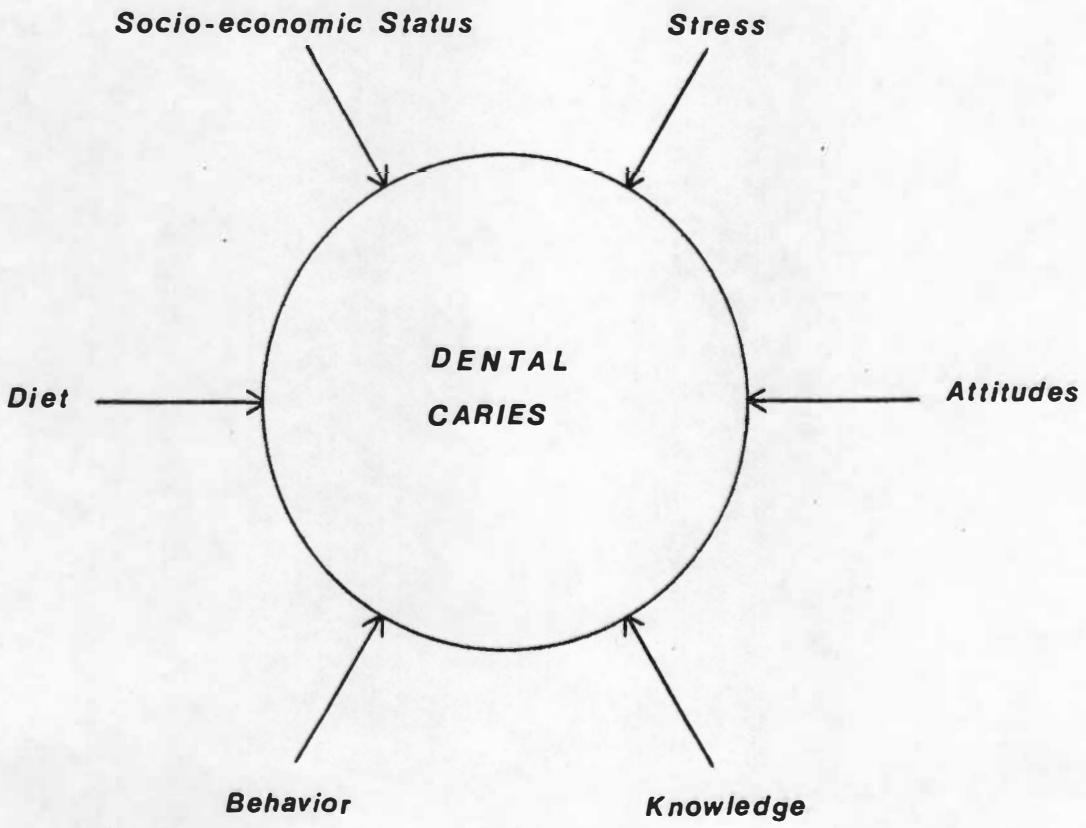

FIGURE 1. Caries etiology.

other studies have demonstrated strong correlations between high socio-economic status and high rates of dental decay. And yet other researchers have reported no association between socio-economic variables and caries variability. Diet is another controversial etiological variable. Many studies have shown that frequent consumption of cariogenic foods is strongly related with dental caries, while other researchers have found no association between diet and rates of dental decay.

Stress received wide attention in caries research during the 1940s and 1950s but in recent years this variable has received only minimal attention. Krasner (1978:491) attributes this to the fact that "the term psychosomatic medicine lost a lot of professional and public favor and took on a prejorative meaning."

The present study examined caries variability in children residing in East Tennessee. Children were chosen for investigation because dental caries present a particular problem for the young. Susceptible tooth surfaces come under attack during this time and many children consume cariogenic foodstuffs in order to meet their high caloric requirements.

For most individuals the maintenance of dental health is a personal matter, but for children the responsibility for dental care falls upon the family. Therefore, a broad range of variables, pertaining to both parents and their children were explored. Information was obtained on children's diet, dental behavior, and general health status. Data was also obtained on socio-economic status and dental knowledge, attitudes, and behavior of parents.

East Tennessee was chosen as the setting for this study because dental caries have been identified as a problem of major proportions for children residing in this area (East Tennessee Health Improvement Council 1979). In addition, East Tennessee, as part of Appalachia, exhibits certain subcultural traits such as pronounced religiosity, which may exert an influence on attitudes toward dental health care.

The role of stress, diet, socio-economic status, and other variables in dental caries needs to be clarified. The purpose of this study was to determine which of these variables are associated with dental health in the sample of children studied. In doing so, the present research has identified several factors that deserve increased research attention.

II. METHODS

Introduction

The present research was divided into two parts. The first of these was a preliminary study designed to identify variables which have a significant association with dental health status. The second part of research involved a further investigation of the relation between caries and stress and popular opinions on the cause and prevention of decay.

This chapter briefly describes the demographic characteristics of the sample and the setting for the study. Dental health status is defined and the procedures involved in the data gathering process

are outlined. The general questionnaire used in Part 1 is described, and the specific hypotheses to be tested are stated.

Setting and Sample

The present study was conducted in Knoxville, Tennessee which is included in the East Tennessee dental health region (Tennessee Department of Public Health 1979). Dental caries have been identified as a health problem of "major proportions" for children in Tennessee (East Tennessee Health Improvement Council 1978), where East Tennessee exhibits a slightly higher rate of dental decay than that reported for the state. In 1979 the average number of decayed, missing, and filled (DMF) teeth for children aged 5 to 19 in Tennessee was 2.8, whereas East Tennessee children exhibited an average of 2.9 DMF teeth.

Six pedodontists with practices in Knoxville were contacted for assistance regarding this research. Two expressed interest in this study and agreed to have the researcher gather data from their offices.

The sample consisted of 99 children and their parents (80 mothers, 13 fathers, 6 guardians or other relatives who live in household). Sixty-nine of the parents reported themselves and their children as Caucasian, 8 as Black, 4 as Oriental, and 18 unidentified with regard to race. The religious affiliation of most of the parents was Baptist and sectarian (60) although 26 reported themselves as some other form of Protestant, 3 as Jewish, 2 as Catholic, and 6 as some other form of religion not specified.

Eighteen informants reported household incomes below $15,000, whereas 11 reported earnings above $50,000. The annual income for 69 of the households ranged from $15,000 to $49,999. Compared to household incomes for Knox County, Tennessee (U.S. Bureau of Census 1980), 56 of the households were in the upper 25% and 71 families were in the upper 50%.

Ninety-two percent of the children's fathers and 97% of the children's mothers received at least a high school education. These percentages are much higher than those reported for Knox County (U.S. Bureau of the Census 1980) where 64.4% of the adult population received a high school education. Thirty percent of the children's fathers and 24% of the children's mothers received college educations. These percentages are slightly higher than those reported for Knox County (U.S. Bureau of the census 1980) where 19% of the adult population completed four or more years of college education.

Twenty-four of the children's fathers are employed in support and service occupations, 23 hold administrative, executive, or managerial positions, and 16 report factory or mechanic work. Forty of the children's mothers are unemployed or housewives, and 23 reported support and service occupations. These figures are similar to those reported for Knox County (U.S. Bureau of the Census 1980) with the exception that support and service occupations are under represented in the sample.

The mean number of DMF teeth for all children aged 6 and above in the sample was 7.16 and is higher than that of similarly aged school

children in Tennessee (Tennessee Department of Public Health 1979). This disparity may be partially attributed to the incorporation of deciduous and permanent teeth into the tabulations of DMF scores for 6 and 7 year old children in the sample. In addition, a pedodontist as a dental specialist receives patients with more dental problems than a regular dentist. The dental personnel in both offices related accounts where children were referred to their offices because of special problems. The dental personnel also informed the researcher that teeth with deep fissures are sometimes filled even though a carious lesion may not have developed. It is not likely, however, that the practice of filling non-carious teeth would significantly raise the DMF score for any child in the sample because only teeth which are highly suseptible to decay are filled.

Definitions of Variables

Dental health status was the dependent variable and was measured by the number of decayed, missing, and filled (DMF) teeth for each child. The DMF score is the most common measurement used by researchers to assess dental health status (Dunning 1962). Following rules laid out by Dunning (1962), no tooth was listed more than once in the count and no teeth were recorded as missing unless extracted due to decay. Therefore, teeth extracted for orthodontic purposes, or those lost accidentally were not included in the tabulations.

DMF data were initially recorded in interval form but were recategorized into two ordinal categories, high and low DMF, for the goal was to identify biographic traits and their association with

good and poor dental health, and not the precise numbers of caries. In addition, a chi-square test was used to identify associations among variables, a task most appropriately accomplished through four celled cross tabulations.

DMF scores were corrected for age by dividing children into five age groups and calculating mean DMF scores for each group. Ages were grouped according to the degree of exfoliation of deciduous and eruption of permanent teeth. DMF scores above the mean were considered to be high whereas scores below the mean were rated as low. A high DMF score reflects a poor dental health status, whereas a low DMF score reflects a high dental health status.

Traditionally, the DMF score includes only deciduous or permanent teeth--never both. However, for 6 and 7 year old children, a DMF score calculated solely on the basis of deciduous or permanent teeth would not accurately reflect dental health status. Therefore decayed, missing, and filled teeth in the deciduous and permanent dentitions were included in the count for this age group.

Attitudes, knowledge, behavior (including information relating to oral hygiene habits and dental visits), dietary, and demographic characteristics were the major independent variables. Data concerning these variables were collected through the use of a questionnaire.

Data Collection

The measuring device for the independent variable was a 12 page questionnaire designed to obtain information concerning parents and their children. A questionnaire was chosen as the primary research

tool so that the data could be easily quantified and compared to the work of other researchers. In addition, the researcher wanted to test specific hypotheses, the evaluations of which were greatly facilitated through numerical analysis.

The data were gathered over a five week period in the offices of two pedodontists with practices in Knoxville. The dental personnel in both offices were extremely cooperative and agreed to have the researcher distribute questionnaires to parents as they brought their children in for dental examinations or treatment. The researcher identified herself, and described the nature of the study to the parents, and asked them to participate in the research by filling out a questionnaire. Most parents were more than willing to comply. One hundred and eight parents were approached and 107 agreed to complete the questionnaire. Ninety-nine questionnaires were complete enough to be incorporated into the analysis.

In office A, parents had the option of completing the questionnaire in the waiting room, or if they preferred, in the private office of the dentist. In office B, arrangements were such that parents completed questionnaires in the waiting room only. The researcher was present in all cases to answer any questions informants may have had.

Each questionnaire was placed in a brown envelope with a cover letter placed on the outside. This letter was designed to reiterate in written form the verbal description of the study given by the researcher and to obtain parental authorization to release the DMF

data from their children's dental records. In addition, each parent was asked if he/she would be willing to be contacted by telephone for further information regarding the questionnaire. A copy of this questionnaire and cover letter are found in Appendix A.

After this aspect of the data gathering process was completed, the researcher returned to the dental offices to obtain DMF scores for each child. In office B the dental records contained a three dimensional drawing of the jaws and teeth. These drawings clearly showed decayed, missing, and filled teeth. After being instructed how to read the records, the researcher collected the DMF data herself. In office A, however, the dental records contained no pictures of the teeth and the necessary information was in coded form. The dental receptionist supplied the researcher with the number of DMF teeth for each child.

Questionnaire Content and Hypotheses

The purpose of the questionnaire was to generate data on a wide range of biographic variables. The author wanted to test specific hypotheses relating the data derived from the questionnaire to DMF scores in children. What follows is a description of each section of the questionnaire and the specific hypotheses to be tested.

Demographic variables. This section of the questionnaire elicited information pertaining to the educational level, income, occupation, ethnic group, and religious affiliation of the parent. The Standard Occupational Classification Manual (1980) was used to code occupation.

The purpose here was to determine if demographic data were associated with dental health in children. No specific hypotheses were formulated.

Dental behavior. Parents were asked to report any negative experiences they may have had with a dentist, how frequently they visit a dentist, if pre-paid dental visits would affect this frequency, how often they brush their teeth, and if they act as tooth fairy when their child loses a tooth.

Parents were asked to report the following information with regard to their child: sex, age, height, weight, reason for present dental visit, length of time since last visit, age at first visit, times per day child brushes teeth, and general health status of child.

The standards for height and weight supplied by Hamilton and Whitney (1978) were used to evaluate child's height and weight for age. Children were classified as normal if their weight deviated no more than 10% either side of the average. Children more than 10% above the average were considered overweight. Children more than 10% below the average were considered underweight. No specific hypotheses regarding health status of children were formulated.

The researcher wanted to determine if dental behavior was associated with dental health. The general hypothesis to be tested here was as follows:

> Children with high DMF scores and their parents will be characterized by more maladaptive behavior, including less frequent dental visits and toothbrushing than their low DMF counterparts.

Dietary Variables

Dietary preferences. This portion of the questionnaire elicited information from parents regarding their children's favorite foods for breakfast, lunch, dinner, and snacks. Food preferences were coded in terms of the presence or absence of high sugar foodstuffs at each meal and snack. The purpose here was to determine if preferences for cariogenic foods were associated with DMF score. The specific hypothesis were as follows:

> Children who prefer cariogenic foods for meals and snacks will have a high DMF score, whereas children who do not prefer these foods will have low DMF scores.

Food consumption frequencies. Parents were asked to indicate how often their child ate certain foods from a list of 51 food items. The responses available for selection included: everyday, once a week, once every two weeks, once a month, and never.

When reporting food consumption frequencies, some informants placed a numerical value in the space provided for marking. Other informants told the researcher that they had trouble deciding, for example, if their child ate a certain food everyday or once a week. Foods may be eaten more than one time a week but not as often as once a day. For purposes of coding the researcher collapsed the categories, so that "frequently" included once a day and once a week, "occasionally" included once every two weeks and once a month, and "never" remained the same.

Foods were classified as either members of the basic four food groups, and included, for example, dairy products, grains, fruits

and vegetables, and meats, or were classified as high sugar foods and included foods such as caramel, chocolate, cookies, and soft drinks. Some foods, including pancakes with syrup and honey bread and butter, were classified as basic four foods as well as high sugar foods because they contain items from each of these food groups.

There were 35 basic four foods and 16 high sugar foods included on the list and these are included in Appendix B. An average basic four food consumption score and a high sugar food consumption score were obtained for each individual by summing the frequency for each group and dividing by 35 and 16 respectively. Frequent consumption of foods was coded as (1), occasional consumption as (2), and never consumed as (3). Basic four and high sugar food means were calculated for the whole sample and individual scores above the respective means were designated as high frequency of consumption and scores below the mean were designated as a low frequency of consumption.

The purpose here was to determine if above or below average consumption of basic four or high sugar foods were associated with DMF score. The specific hypotheses to be tested are as follows:

> An above average consumption of basic four foods will characterize the diets of children with low DMF scores and a below average consumption will characterize the diets of children with high DMF scores.

and

> An above average consumption of high sugar foods will characterize the diets of children with high DMF scores and a below average consumption of these foods will characterize the diets of children with low DMF scores.

Knowledge Variables

Knowledge of cariogenic foods. This section of the questionnaire consisted of 51 foods. Parents were asked to rate these foods as extremely decay producing, somewhat decay producing, or non-decay producing. The researcher then assigned these foods to one of three decay producing categories based on sucrose content and caries potentiality as found in Dunning (1962). Sixteen foods were regarded by the researcher as highly cariogenic, 18 as somewhat decay producing, and 17 were regarded as having a low caries potentiality and these appear in Appendix B.

The total number of "correct answers" for each informant was tabulated. An informant's categorization of a food into one of three decay producing categories was considered correct if it agreed with that of the researcher. A mean score of correct answers was calculated for the sample. Individual scores above the mean were considered to reflect a good knowledge of cariogenic foods and scores below the mean were considered to indicate a poor knowledge of cariogenic foods. The aim here was to determine if good or poor knowledge of cariogenicity on the part of parents was associated with DMF scores in children.

The specific hypothesis is as follows:

> Parents with a poor knowledge of cariogenicity will have children with high DMF scores, whereas parents with a good knowledge of cariogenicity will have children with a low DMF score.

Knowledge concerning dental health. This portion of the questionnaire presented the informant with 14 statements concerning

knowledge in the area of dental health (See Appendix B). Informants were asked to indicate strength of agreement with each statement by placing an "X" under one of five category headings as follows: strongly agree, agree, uncertain, disagree, and strongly disagree.

Some statements were presented in correct form, such as "Flouridated water helps prevent dental decay," whereas others were stated in incorrect form, such as "It is not necessary to take a child to the dentist before the age of five." A statement was considered to be correct if it agreed with the professional viewpoint. The total number of "correct answers" was tabulated for each informant and a mean score for the entire group was calculated. Individual scores above the mean were considered to reflect a high level of knowledge, whereas scores below the mean were considered to reflect a low level of knowledge in the area of dental health.

The specific hypothesis to be tested is as follows:

> Parents of children with a high DMF score will have poor knowledge, whereas parents of children with a low DMF score will have good knowledge of dental health.

Attitude Variables

Attitudes regarding dental health. This portion of the questionnaire presented the informant with 11 statements concerning attitudes in the area of dental health. Informants were asked to indicate strength of agreement with each statement by placing an "X" under one of five category headings which ranged from strongly agree to strongly disagree.

Some statements reflected favorable attitudes toward dental health, such as, "A person should brush their teeth three times per day." Other statements reflected negative attitudes, such as, "Losing one's teeth is part of the normal aging process." Informants' responses were coded where 1 = strongly agree and 5 = strongly disagree. Informants' responses were tabulated and were divided by 11 to obtain an average score for each parent. A mean score for the entire sample was derived and individual scores were placed above or below the mean. Individual scores above the mean were considered to reflect a good or favorable attitude toward dental health, whereas scores below the mean were considered to reflect a poor or unfavorable attitude toward dental health. The purpose here was to determine if parents of high and low DMF children differed in terms of their attitudes toward dental health. The specific hypothesis to be tested is as follows:

> Parents of children with high DMF scores will have less favorable attitudes toward dental health than parents of children with low DMF scores.

Attitudes towards dentists. A Leikert scale was used to assess the attitudes of parents towards dentists and was based on the scale developed by Miller et al. (1981) to assess attitudes persons have toward medical regimen. Informants were asked to rate dentists in terms of 8 positive and 8 negative adjectives where 5 indicated strongest agreement and 1 weakest agreement. Some examples are as follows:

Dentists are:

	5	4	3	2	1
useful	___	___	___	___	___
arrogant	___	___	___	___	___
humble	___	___	___	___	___

Two mean scores, one for positive and one for negative adjectives were derived for the entire group and individual scores were placed above or below the mean indicating favorable or unfavorable attitudes towards dentists. The purpose here was to determine if parental attitudes regarding dentists were associated with dental health in children. The specific hypothesis to be tested is:

> Parents of children with high DMF scores will hold unfavorable attitudes towards dentists, whereas parents of low DMF children will hold favorable ones.

Folk Beliefs Concerning Dental Health

Informants were asked to indicate strength of agreement with 7 statements pertaining to folklore and dental health. Informants' responses were coded where 1 = strongly agree, 2 = agree, 3 = uncertain, 4 = disagree, and 5 = strongly disagree. In addition, informants were asked to list home remedies they use or may have used in the treatment of dental disorders.

This section was included as some East Tennesseans adhere to a traditional lifeway which includes folk beliefs surrounding health. Specific statements regarding folk beliefs toward dental health were derived from Garrett (1978:56-66). The primary goal was to determine if any informants in this sample hold any of these folk beliefs or use home remedies in the treatment of dental problems. In addition,

the researcher wanted to determine if DMF scores were associated with use of home remedies. No specific hypotheses were formulated.

Popular Opinions on the Cause and Prevention of Dental Decay

This section of the questionnaire consisted of two open ended questions where informants were asked to report what factors they feel are involved in the cause and prevention of decay.

Four categories of answers were frequently noted by informants and they are listed in Table 1 in descending order of frequency. Some informants reported only one factor for each question whereas others listed more than one answer for one or both questions. Informants' responses were coded in terms of the presence or absence of each category in their answers regarding the cause and prevention of dental decay. Therefore, if any informant listed toothbrushing as a preventive measure and sugar as a cause of decay, then item 2 under the heading "Cause of Decay" would be marked present and item 1 under the heading "Prevention of Decay" would be marked present (see Tab e 1).

TABLE 1. Rank Ordering of Informant Responses Regarding the Cause and Prevention of Decay

Cause of Decay	Prevention of Decay
1. Neglect of self performed oral hygiene	1. Self performed oral hygiene
2. Dietary sugar	2. Balanced diet
3. Poor nutrition	3. Regular dental visits
4. Failure to visit dental on a regular basis	4. Eliminating dietary sugar

Three informants reported flouride as a factor in the prevention of decay and one informant reported plaque as a factor involved in the cause of dental decay. No other factors were reported.

The goal here was to discover lay beliefs regarding the cause and prevention of decay and to determine if any responses were associated with DMF. No specific hypotheses were formulated.

Statistical Analysis

The Statistical Package for the Social Sciences (Nie et al. 1975) was the system of computer programs used to analyze the data. Subprograms FREQUENCIES and CROSSTABS were employed. As noted earlier the dependent variable, DMF score, and many of the independent variables derived from the questionnaire were operationalized into two ordinal categories reflecting high and low DMF, good and poor dental knowledge, etc., in an attempt to produce four celled cross-tabulations whenever possible. The .05 level of significance was the criterion employed for acceptance or rejection of the specific hypotheses in Chi-Square tests relating general questionnaire results and DMF scores. A summary of the specific hypotheses to be tested follows:

1. Maladaptive dental behavior will characterize high DMF children and their parents rather than their low DMF counterparts.

2. Children who prefer cariogenic foods for meals or snacks will have high DMF scores, whereas children who do not prefer these foods will have low DMF scores.

3. An above average consumption of basic four foods will characterize the diets of children with low DMF

scores, whereas an above average consumption of high sugar foods will characterize the diets of children with high DMF scores.

4. Parents with a poor knowledge of cariogenicity will have children with high DMF scores, whereas parents with a good knowledge of cariogenicity will have children with low DMF scores.

5. Parents with a poor knowledge of dental health will have children with high DMF scores, whereas parents with a good knowledge of dental health will have children with low DMF scores.

6. Parents of children with high DMF scores will have less favorable attitudes toward dental health than parents of children with low DMF scores.

7. Parents of children with high DMF scores will hold less favorable attitudes towards dentists than their low DMF counterparts.

CHAPTER IV

RESULTS AND DISCUSSION OF THE GENERAL QUESTIONNAIRE

The purpose of this chapter is to present and discuss data derived from children's dental records (DMF scores) and the general questionnaire. Results from crosstabulations of DMF scores with all the variables derived from the questionnaire are presented in Appendix B. Crosstabulations which reflect significant associations between DMF scores and questionnaire variables are presented and discussed below.

I. DMF SCORES

The mean number and range of DMF teeth for each age group is presented in Table 2. There was great variability in the number of DMF teeth among children for all age groups. Forty seven children had low DMF scores and 52 had high DMF scores.

The 2 to 5 year age group exhibited a high mean number of DMF teeth in comparison to that reported for other Tennessee children (Tennessee Department of Public Health Report 1979). Five of 7 children, between the ages of 2 and 3 had rampant decay where 8 or more teeth were carious, and 4 of 11 children between the ages of 4 and 5 had 11 or more carious teeth. There appeared to be a bias toward dental problems among children in this age group. Perhaps a parent would not be inclined to take their child to a dentist before age 5 unless the child exhibited dental problems.

TABLE 2. Number of DMF Teeth for Children by Age (N = 99)

Age Group (Years)	2-5	6-7	8-10	11-12	13-17
Number of Individuals	18	17	29	20	15
Range of DMF Teeth	0-20	0-24	0-9	0-18	0-21
Mean Number of DMF Teeth	8.33	8.8	3.17	9.4	10.0

The mean number of DMF teeth for 6 and 7 year old children was higher than averages reported for East Tennessee children (Tennessee Department of Public Health Report 1979). This was expected as both permanent and deciduous teeth were included in the tabulations of DMF score for the present study.

The mean number of DMF teeth declines dramatically among 8 through 10 year old children as many decayed deciduous teeth have exfoliated and permanent teeth are newly erupted.

Eleven and 12 year old children exhibit a sharp increase in the number of DMF teeth because the exfoliation process slows down and more time is allotted for permanent tooth surfaces to decay. The carious process levels off in the final age group where the average caries increment is .5 per individual.

II. GENERAL QUESTIONNAIRE

One hundred and seven guardians and their children participated in this study. Questionnaires from 99 informants were complete enough to be incorporated into the analysis. Because most informants did not answer every question, each crosstabulation is based on a different N or sample size.

Demographic Variables

The crosstabulations of DMF with education, occupation, religion, and health status of the child are presented and discussed below. The crosstabulations of DMF with all other demographic variables are presented in Appendix B, page 103 (significance levels ranged from .50 to .88).

Education of the father and mother was not significantly associated with DMF scores. A trend (significance = .07) was evident, however, where children of parents with at least a high school education had a lower DMF score than children of parents with a lower level of educational attainment (See Table 3).

Only high status occupations (executive, administrative, or managerial) and low status occupations (factory or mechanic work) were examined in relation to DMF scores in order to have a four celled crosstabulation suitable for the chi-square statistic. Occupation of the father and mother was significantly associated with DMF scores, where children of parents who hold executive, administrative, and/or managerial positions had lower DMF scores than children of parents

TABLE 3. Crosstabulations of DMF with Education and Occupation

Variable Name	Low DMF	High DMF
Education of Father (N = 95)		
Less than a high school education	16	28
At least a high school education	29	22
Chi-Square = 3.2 with 1 degree of freedom, significance = .07		
Education of Mother (N = 98)		
Less than a high school education	20	27
At least a high school education	32	19
Chi-Square = 3.2 with 1 degree of freedom, significance = .07		
Occupation of Father (N = 39)		
Executive, Administrative, and Management	15	8
Mechanic and Factory Workers	4	12
Chi-Square = 10.5 with 1 degree of freedom, significance = .001		
Occupation of Mother (N = 11)		
Executive, Administrative, or Management	4	0
Mechanic and Factory Workers	0	7
Chi-Square = 10.5 with 1 degree of freedom, significance = .001		

employed in mechanic or factory work (see Table 3, significance = .001). These findings would support research which suggests that education and occupation as part of socio-economic status has an inverse relation with dental caries experience.

The finding that occupation of mother was significantly associated with DMF scores may possibly be attributed to the mother's

role as custodian of her children's health. The mother is primarily responsible for making sure that children avoid cariogenic foods, brush their teeth often, and visit the dentist regularly. Perhaps women who have at least a high school education, or hold jobs which require a high school education, may better fulfill the role of health custodian than their less educated counterparts.

Income was not significantly associated with DMF scores. This may have been due to the fact that many (55%) of the families reported earnings in the upper ranges ($25,000 or more) for household income.

Parent's religion was a variable significantly associated with DMF score where children of parents whose reported religious affiliation was Baptist or sectarian (including Church of Christ, Church of God, and Assembly of God) had higher DMF scores in comparison to children whose parents reported other religious affiliations (see Table 4).

TABLE 4. Crosstabulation of DMF with Religion

Variable Name	Low DMF	High DMF
Parent's Religion		
Baptist/Sectarian	23	37
Other Religious Affiliations	24	13

Chi-Square = 5.4 with 1 degree of freedon, significance = .02

In order to test whether religious affiliation may have been associated with socio-economic status for informants in this sample, crosstabulations of religion with variables related to socio-economic status were run (see Table 5). Religion was significantly associated with education and occupation. Baptist and sectarian mothers and fathers had a lower level of educational attainment than non-Baptist/sectarians. Furthermore, Baptist/sectarian mothers were employed as factory or mechanic workers while non-Baptist mothers held executive, administrative, or managerial positions (see Table 5).

TABLE 5. Crosstabulations of Religion with Socio-economic Variables

Variable Name	Baptist/Sectarian	Non-Baptist
Education of Father (N = 94)		
Less than a high school education	37	6
At least a high school education	21	30
Chi-Square = 18.02 with 1 degree of freedom, significance = .00		
Education of Mother (N = 96)		
Less than a high school education	36	14
At least a high school education	23	23
Chi-Square = 4.01 with 1 degree of freedom, significance = .05		
Occupation of the Mother (N = 95)		
Executive, Administrative or Managerial	1	3
Mechanic or Factory work	6	1
Chi-Square = 4.06 with 1 degree of freedom, significance = .05		

Photiadis and Maurer (1978) report similar associations between religion and other socio-economic variables in their study of rural Appalachians where members of sectarian or fundamentalist churches, characterized by high levels of emotionality and religiosity, hold a lower socio-economic status than their non-sectarian counterparts. Stephenson (1968:56), in his study of a rural community in North Carolina, reports that church membership is related to social levels within the community. Lower status residents belong to sectarian or fundamentalist Baptist churches and residents holding a higher social status belong to modern non-sectarian Baptist churches. Stephenson also notes that members of the fundamentalist churches change to more modern churches when they experience a rise in income levels and social status.

Children with a history of stress related health disorders, including allergies and asthma, had a higher DMF score than their non-stressed counterparts and this was significant at the .04 level (see Table 6). This finding supports the work of Strongin and Hinsie (1938), Sutton (1962), and Manhold (1980) which suggests that stress may be an etiological factor involved in dental caries.

Children who were classified as either overweight or normal weight had a higher DMF score than those who were regarded as underweight and this was significant at the .03 level (see Table 6). Perhaps children who are overweight or normal consume more foods which are cariogenic in nature than their underweight counterparts. Research may be needed which examines the carious effects of differing quantities of cariogenic foods.

TABLE 6. Crosstabulations of DMF with Health Status Variables

Variable Name	Low DMF	High DMF
Reported History of Health Disorders (N = 84)		
Absent	5	13
Present	38	28
Chi-Square = 3.9 with 1 degree of freedom, significance = .05		
Reported History of Allergies/Asthma (N = 79)		
Absent	3	10
Present	38	28
Chi-Square = 3.9 with 1 degree of freedom, significance = .05		
Weight of Child (N = 19)		
Underweight	9	2
Normal	15	24
Overweight	12	17
Chi-Square = 6.8 with 2 degrees of freedom, significance = .03		

Dental Behavior

Appendix B, page 103, presents crosstabulations of DMF scores with variables related to dental behavior. None of these variables were significantly associated with DMF scores at the .05 level. Significance levels ranged from .18 to .82.

The finding that the frequency of toothbrushing on the part of parent or child was not significantly associated with DMF scores supports suggestions offered by Ripa et al. (1977) that self performed oral hygiene measures do not appear to minimize the frequency of caries.

Twenty-two percent of the informants (N = 97) reported having had negative experiences with a dentist. Negative experiences listed

included pain, improper diagnosis, verbal or physical abuse, poor attitude, and/or careless work on the part of a dentist. Sixty-seven percent of the informants (N = 97) reported that the reason for their child's present dental visit was for a check-up. Thirty-three percent reported a problem.

Dietary Variables

The crosstabulations of all dietary variables and the informant reported frequency of consumption for each of the 51 food items listed in the questionnaire appear in Appendix B, page 108. Only one variable, preference for cariogenic foods at lunch, was significantly associated with DMF scores at the .05 level. Other significance levels ranged from .10 to 1.

Preferences for cariogenic foods. Preferences for cariogenic foods at lunch were significantly associated with DMF scores, where interestingly, children with low DMF scores preferred cariogenic foods at this meal rather than children with high DMF scores (see Table 7). This finding may support research which suggests that sugary foods consumed at meals are less harmful to teeth than those which are consumed between meals (Bibby 1980). In addition, parents of low DMF children may control their children's intake of cariogenic foods at meals and snacks, except for lunch, when many children are at school and may be able to choose cariogenic foods. No differences between high and low DMF groups were noted with regard to preferences for cariogenic foods at other meals or snacks.

TABLE 7. Crosstabulation of DMF with Preferences for Cariogenic Foods at Lunch (N = 93)

Variable	Low DMF	High DMF
At Lunch		
Yes	11	4
No	33	45

Chi-Square = 3.69 with 1 degree of freedom, significance = .05

Frequency of consumption of basic four foods. The mean score obtained for the sample with regard to this variable was 1.92, indicating a slightly more frequent than occasional consumption of basic four foods for the group (where 1 = frequent consumption, 2 = occasional consumption, and 3 = never consumed). No significant differences between high and low DMF groups were noted with regard to this variable (see Table 8).

TABLE 8. Crosstabulation of DMF with Frequency of Consumption of Basic Four Foods (N = 71)

Variable	Low DMF	High DMF
Frequent Consumption	15	19
Infrequent Consumption	20	17

Chi-Square = .36 with 1 degree of freedom, significance = .55

Frequency of consumption of high sugar foods.. The mean score obtained for the sample with regard to this variable was 2.06, indicating a slightly less frequent than occasional consumption of high sugar foods for the group (where 1 - frequent consumption, 2 = occasional consumption, and 3 = never consumed) (see Table 9).

TABLE 9. Crosstabulation of DMF with Frequency of Consumption of High Sugar Foods (N = 81)

Variable	Low DMF	High DMF
Frequent Consumption	27	18
Infrequent Consumption	14	22

Chi-Square = 2.77 with 1 degree of freedom, significance = .10

Although consumption of high sugar foods was not significantly associated with DMF scores, there was a trend (significance = .10), where children with a low DMF score consumed high sugar foods more often than their high DMF counterparts (see Table 9). Other researchers have reported similar findings in their studies of diet and dental caries. Schroder et al. (1981:81) attribute such findings to a "psychological phenomenon" where parents are influenced by their child's dental health status, offering "expected, rather than true replies." Perhaps results such as these should not be discarded simply because they are unexpected. The role of diet in dental caries may need to be re-examined, where diet may be a cause of dental decay,

but not the only factor responsible for high rates of decay in humans. Perhaps observation of dietary intake rather than informant reporting would be a more useful method to assess the effect of diet on dental caries.

Dental Knowledge Variables

The crosstabulations of DMF scores with knowledge of cariogenicity and knowledge of dental health are presented below. Information regarding how informants rated the cariogenicity of each food and how they responded to each knowledge statement is presented in Appendix B, pages 113-115.

Knowledge of cariogenicity. Of 51 test items the mean number of correct answers obtained for the sample was 20.5. Knowledge of cariogenicity was associated with DMF scores where, interestingly, parents of children with high DMF scores had a better knowledge of cariogenic foods than their low DMF counterparts, and this was significant at the .02 level (see Table 10).

Perhaps parents of children with high DMF scores are informed of which foods are cariogenic by dental personnel or make an effort to become aware of these foods, as such foods represent a particular problem for their children.

TABLE 10. Crosstabulation of DMF with Knowledge of Cariogenicity (N = 71)

Variable	Low DMF	High DMF
Poor knowledge of cariogenicity	22	12
Good knowledge of cariogenicity	13	24

Chi-Square = 5.07 with 1 degree of freedom, significance = .02

Knowledge of dental health. Of 14 test items the mean number of correct answers obtained for the sample was 9.35. No significant differences were noted between parents of high and low DMF children with regard to this variable (see Table 11).

TABLE 11. Crosstabulation of DMF with Knowledge of Dental Health (N = 84)

Variable	Low DMF	High DMF
Poor knowledge of dental health	21	24
Good knowledge of dental health	22	17

Chi-Square = .34 with 1 degree of freedom, significance = .58.

The following two statements pertaining to dental health are incorrect as stated. The majority of informants, however, agreed with these statements indicating incorrect knowledge on the part of the informants. These were the only two items answered incorrectly by the majority of informants.

1. Sugar, whether it is found in cola, ice cream, or chocolate has the same effect on teeth. (N = 97), 58% agree, 20% disagree, 22% uncertain.
2. It does not really matter if sugar is consumed at meals or in-between meals, the effects on teeth are still the same. (N = 96), 56% agree, 29% disagree, 15% uncertain.

With regard to the former statement, no differences were noted in the responses of high and low DMF parents. With regard to the latter statement, 59% of the incorrect responses were offered by parents of children with high DMF scores.

Dental Attitude Variables

The crosstabulations of DMF with attitudes towards dentists and attitudes toward dental health appear below. Information regarding how informants rated dentists with regard to each adjective on the Leikert scale and how they responded to each attitude statement is presented in Appendix B, pages 116-117.

Attitudes toward dentists. The mean score obtained for the sample with regard to positive adjectives describing dentists using a Leikert scale (where 5 indicated strongest agreement and 1 indicated weakest agreement), was 3.27 and the mean score for negative adjectives was 2. These scores indicate an overall favorable attitude concerning dentists. No significant differences were noted between parents of high and low DMF groups with regard to this variable (see Table 12).

TABLE 12. Crosstabulation of DMF with Attitudes Towards Dentists

Variable	Low DMF	High DMF
Positive Adjectives (N = 74)		
Favorable Attitudes	19	21
Unfavorable Attitudes	18	16
Chi-Square = .05 with 1 degree of freedom, significance = .82		
Negative Adjectives (N = 64)		
Favorable Attitudes	23	20
Unfavorable Attitudes	12	14
Chi-Square = .18 with 1 degree of freedom, significance = .73		

Attitudes toward dental health. The crosstabulation of this variable with DMF scores appears in Table 13. The average score for the sample with regard to this variable was 2.53 (where 1 = most favorable and 5 = least favorable) reflecting a favorable attitude toward dental health. No significant differences were noted between DMF groups with regard to this variable.

TABLE 13. Crosstabulation of DMF with Attitudes Toward Dental Health (N = 74)

Variable	Low DMF	High DMF
Favorable Attitudes	19	20
Unfavorable Attitudes	19	16
Chi-Square = .06 with 1 degree of freedom, significance = .80		

The overwhelming majority (90%, N = 96) of informants agreed with the statement that:

> It is probably more important to see your doctor on a regular basis rather than your dentist.

Seventy-two percent of the informants (N = 94) disagreed with the statement that:

> Cavities are not as serious as broken bones.

On the other hand, the following two statements reflect negative attitudes toward dental health, yet many informants agreed with these statements indicating negative attitudes toward dental health on the part of informants.

> Dental health is important, but other aspects of an individual's health, such as kidneys, heart and lungs are more important. (N = 96), 48% agree, 40% disagree, 12% uncertain.

and

> Dental services are too expensive. (N = 99). 44% agree, 27% disagree, 29% uncertain.

Folk Beliefs Pertaining to Dental Health

Many informants in the sample did not agree with folk beliefs pertaining to dental health and did not use home remedies. The frequency of responses reflecting strength of agreement with each folk statement is presented in Appendix B, page 119.

Fifteen informants reported use of home remedies. Home remedies listed include: aspirin, salt water, ora-jel, ice, tea, herbs, oil of cloves, and anbesol. The use of home remedies was not significantly associated with DMF scores (see Appendix B, page 120, significance = .14). However, there was a trend where parents of

children with high DMF scores use home remedies, whereas parents of children with low DMF scores do not. Perhaps home remedies are used by individuals because they have dental problems or the use of home remedies may precede professional dental care in the hierarchy of resort for dental problems, thus delaying necessary dental visits.

Cause and Prevention of Decay

Table 14 presents the frequency of responses pertaining to the cause and prevention of dental caries. Self performed oral hygiene, including toothbrushing, was the most frequent response offered by informants for the prevention of decay and lack of self performed oral hygiene measures was the most frequent response offered by informants as the leading cause of dental decay. This contrasts sharply with the professional viewpoint, which emphasizes dental visits. Toothbrushing may have been emphasized by informants as a result of mass media advertising. Jenny (1974a:1153) discusses the problem:

> Mass media advertising plays a major and relentless role in the public's education in oral hygiene. Manufacturers of dentrifices, mouthwashes, breath mints, and chewing gum vie for the opportunity to sell their product, not primarily for oral hygiene, but to sweeten the breath of the nation. The public is reported to buy $350,000,000 worth of toothpaste a year with few factual guidelines as to which products have therapeutic value. Commercial messages advertising dentrifices fail to mention plaque removal as a goal or brushing and flossing techniques even though toothbrushing as usually practiced is an inefficient procedure.

TABLE 14. Frequency of Informant Responses Regarding the Cause and Prevention of Decay

Variable	Low DMF	High DMF
Cause of Decay		
Not brushing teeth	36	36
Too much sugar	11	19
Poor nutrition	8	11
Not visiting dentist regularly	4	4
Prevention of Decay		
Brushing teeth	40	46
Balanced diet	22	20
Regular dental visits	14	20
Less sugar in diet	5	5

Summary

In summary, variables related to socio-economic status, including religion, occupation, and education were strongly associated with dental health status of children. Stress was also associated with DMF scores where children who had a history of stress related health disorders, such as allergies and asthma, had a significantly higher rate of dental decay than their healthy counterparts. In addition, the data demonstrated that the popular notion with regard to the cause and prevention of dental decay centered on self performed oral hygiene measures, such as toothbrushing, and thus differed from the professional viewpoint which questions the role of toothbrushing in the prevention of decay and emphasizes professional plaque removal and frequent dental visits.

Variables related to dental behavior and attitudes were not found to be associated with dental health status in the sample of children studied. In fact, some variables including knowledge of cariogenicity and preference for cariogenic foods at lunch were inversely correlated with DMF scores, where a poor knowledge of cariogenicity and preferences for cariogenic foods at lunch were significantly associated with low DMF scores.

CHAPTER V

FOLLOW-UP RESEARCH

Two findings of stage one suggested fruitful areas for follow-up research: (1) stress as an etiological variable in dental caries, and (2) folk orientations toward dental health. These factors were pursued through the use of a questionnaire which was sent to 60 parents of children who agreed to be contacted by the researcher for further information regarding this study. An attempt was also made to investigate stress and caries rates in an Arikara Indian population.

I. QUESTIONNAIRE: METHODS

This questionnaire consisted to two parts and can be found in Appendix C. The first section elicited information regarding stress in children. To determine if parent's marital status (married or divorced), child's school performance (excellent to poor), and child's personality (timid or outgoing; makes or does not make friends easily) were associated with dental health status, information regarding these factors was elicited. The specific questions used and the responses available for selection can be found in Appendix C. Parents were also asked to provide information regarding the presence or absence of specific stress indicators in their child. A list of 19 stress indicators was chosen with the recommendations of a local pediatrician. Individuals were assigned to one of two groups based on DMF score. Because the absence or presence of fluoride in drinking

water can substantially influence rates of dental decay, parents were also asked to indicate the source of their water supply (fluoridated tap or well water) at home. The goal here was to ensure that absence of fluoride in drinking water was not responsible for high DMF scores.

Crosstabulations of DMF with variables related to parent's marital status, child's school performance, personality, and source of drinking water at home were run in order to determine if any significant associations between DMF and these variables existed. No specific hypotheses were formulated.

A Pearson correlation matrix was calculated to determine which, if any, stress indicators were associated with one another. The matrix revealed that nailbiting, periods of overeating, and periods of under-eating were significantly associated with one another and they were accordingly regarded as one item when totalling number of stress indicators.

The total number of stress indicators was calculated for each individual and group means were derived for both high and low DMF groups. A one-tailed T-TEST was used to determine whether the mean number of stress indicators for children with high DMF scores was larger than the mean for children with low DMF scores. The hypothesis is as follows:

> The mean number of stress indicators for children with high DMF scores will be larger than that for children with low DMF scores.

The second part of the questionnaire elicited information pertaining to the locus of illness control for dental problems and was

based on the scale developed by Coreil and Marshall (1982:134) to ascertain the locus of illness control for Appalachians and Haitians. Respondents were asked to circle TRUE or FALSE to 15 statements reflecting internal, external, curative, and/or preventive orientations toward dental health. The goal was to describe the locus of illness control for the sample.

The researcher also wanted to determine if high and low DMF groups differed in terms of their orientations toward dental health. No specific hypotheses were formulated.

The results from the general questionnaire presented in Chapter 3 revealed that children whose parents reported Baptist and sectarian religious affiliations had a significantly higher rate of dental decay than their non-Baptist/sectarian counterparts. Baptists and sectarians were also associated with a lower socio-economic status than individuals who reported other religious affiliations. Photiadis and Maurer (1978:178) report that members of sectarian churches are characterized by high levels of emotionality and religiosity and that this acts as a buffer against "alienation and in turn anxiety of the lower strata of our society." In addition, these individuals tend to be characterized by a fatalistic or external orientation toward life and life's problems, where it is believed that "one's destiny is in God's hands" (Gerrard 1970:275).

In order to determine whether an external orientation toward dental problems may have been responsible for high decay rates in Baptist and sectarian children, a T-TEST was used to compare the mean

number of true responses reflecting an external orientation between Baptist/sectarians and members of other religious affiliations. The hypothesis to be tested is as follows:

> The mean number of true responses reflecting an external orientation toward dental problems will be higher for Baptists/sectarians than that for non-Baptist/sectarians.

Stress and Caries in the Arikara

To further explore the relation between stress and dental caries, a sample from an Arikara Indian population from South Dakota was examined. Two sites, Mobridge 1 and Leavenworth were chosen for investigation. The former dates to the early 1600's and represents a pre-contact situation. The Leavenworth site dates to the middle of the nineteenth century and represents a post contact situation where stresses associated with the arrival of the white man were introduced, such as widespread disease and periods of famine. For the most part, the diet of the Arikara remained fairly constant through time and was based primarily on the consumption of maize.

The molar teeth of children between the ages of 2-3 and 12 were examined for evidence of caries and the percentage of carious teeth for each group was calculated. The teeth of 85 children were examined, but only 50 had molar teeth present or preserved with enough enamel to permit identification of a carious lesion. Thirty-two burials from Leavenworth and 18 from Mobridge were included in the sample. Identification of caries was performed by the researcher with the assistance of Henry Case, a physical anthropologist. The specific hypothesis to be tested here is as follows:

The non-stressed Arikara from the Mobridge site will have a lower frequency of dental caries than their stressed counterparts from the Leavenworth site.

II. THE QUESTIONNAIRE: RESULTS

Fifty-eight percent of the 60 parents contacted returned the mail-home questionnaire. Sixteen of these were parents of children with high DMF scores and 19 were parents of children with low DMF scores. Because the sample size was small (N = 35), results from statistical tests can only be suggestive rather than conclusive.

Stress Indicators

No significant differences between high and low DMF groups were noted with regard to variables related to parent's marital status, child's school performance, or child's personality (see Appendix D, page 126). Significance levels ranged from .25 to .65.

Pearson correlation coefficients revealed that three stress indicators including periods of overeating, periods of undereating, and frequent nailbiting were significantly associated with one another (see Table 15). Therefore, the presence of any of these stress indicators was counted only once in the tabulations of total number of stress indicators for each child.

TABLE 15. Pearson Correlation Coefficients for Stress Indicators

Variable	Probability
Overeating with Undereating	0.00
Overeating with Nailbiting	0.00
Undereating with Nailbiting	0.02

The mean number of stress indicators for the low DMF group was 1.69 and 3.0 for the high DMF group. A one-tailed probability revealed that the mean for the high DMF group was not significantly higher than that of the low DMF group, however, a trend (significance = .07) was evident where high DMF children had a higher number of stress indicators than their low DMF counterparts (see Table 16).

TABLE 16. Comparison of Number of Stress Indicators for High and Low DMF (N = 35)

Variable	High DMF	Low DMF
Mean number of stress indicators	3.0	1.7
T-Value = -1.48 with 33 degrees of freedom.		
One-tailed Probability .07		

Stressed children may have had a higher rate of dental decay than their non-stressed counterparts because stress may lower an individual's resistance to infection or may impair the proper functioning of the salivary glands, thus creating an oral environment more conducive to dental decay.

Source of Water Supply

The absence or presence of fluoride in drinking water was not significantly associated with DMF scores (see Appendix D, page 126). Only 11.5% of the informants reported non-fluoridated water supplies.

Orientations Toward Dental Health

Table 17 presents the mean number of true responses for the sample with regard to curative, preventive, external, and internal orientations toward dental health. Overall, the sample appeared to have curative and internal orientations toward dental problems as reflected by the higher percentage of true responses for statements reflecting these orientations. A curative orientation may reflect the opinion that most dental diseases have a cure, whereas an internal orientation may reflect the opinion that self performed measures, such as toothbrushing, may alleviate dental problems.

TABLE 17. Mean Number of True Responses with Regard to Four Orientations Toward Dental Health (N = 31)

	Mean number of true responses	Number of statements	% True
Curative	2.5	6	41
Preventive	1.9	9	21
External	1.6	9	17
Internal	3.1	6	52

Perhaps the locus of illness control for dental problems is internal, where individuals are made aware of the importance of self-performed oral hygiene measures such as toothbrushing through media advertising, yet also curative as individuals realize that failure to perform these measures will result in dental problems, such as caries, which are easily corrected or cured. However, a one-tailed

probability revealed that no significant differences between high and low DMF groups were noted with regard to the four orientations toward dental health (see Table 18).

TABLE 18. Comparison of High and Low DMF Groups with Regard to Locus of Control for Dental Problems (N = 31)

	Low DMF	High DMF
Mean Number of True Curative Responses	2.9	3.0
T-Value = -.23 with 28 degrees of freedom, Two-Tailed Probability = .80		
Mean Number of True Preventive Responses	1.8	2.0
T-Value = -.49 with 29 degrees of freedom, Two-Tailed Probability = .64		
Mean Number of True Internal Responses	3.3	3.1
T-Value = .60 with 29 degrees of freedom, Two-Tailed Probability = .56		
Mean Number of True External Responses	.92	1.8
T-Value = .67 with 29 degrees of freedom, Two-Tailed Probability = .50		

A one-tailed probability revealed that a trend was apparent where Baptists and sectarians had a higher rate of dental decay and a larger number of responses reflecting an external orientation toward dental problems than informants of other religious affiliations (see Tables 19 and 20). An external orientation toward dental health on the part of Baptists and sectarians may have been partially responsible for the high rates of decay in their children, where God is viewed as responsible for dental problems. Such an orientation may result in neglect of dental health.

TABLE 19. Crosstabulation of DMF with Religion (N = 31)

	High DMF	Low DMF
Parent's Religion		
Baptist	14	8
Non-Baptist/sectarian	2	7

Chi-Square = 4.386 with 1 degree of freedom, significance = .09

TABLE 20. Comparison of Number of True External Responses for Baptists and Non-Baptist/Sectarian (N = 31)

	Baptist/sectarian	Non-Baptist
Mean number of true external responses	1.8	1.2

T-Value = 1.56 with 26.8 degrees of freedom, One-Tailed Probability = .065

Caries and Stress in the Arikara

No significant differences were noted between the two Arikara sites examined with regard to the number of carious teeth (see Tables 21 and 22). In fact, the frequency of caries from both sites was lower than that reported for other prehistoric agricultural populations (Turner 1979). Extraneous variables which were not controlled for may have influenced the rate of dental decay for these Indians. For example, a high fluoride content in the soil may have counteracted the carious effects of a high carbohydrate diet.

TABLE 21. Number of Carious Teeth from Two Arikara Sites

	Mobridge	Leavenworth
Number of molars present	77	205
Number of carious molars	5	10
Percentage carious	6.5	4.9

TABLE 22. Crosstabulation of Arikara Sites with Number of Carious Molars

	Mobridge	Leavenworth
Non-carious molars	72	195
Carious molars	5	10

Chi-Square = .29 with 1 degree of freedom, significance = .62.

Summary

The data presented in this chapter suggest that stress may be an etiological variable involved in dental caries. In addition, Baptists and sectarians were characterized by an external orientation toward dental problems which may have been partially responsible for high rates of decay in their children.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this chapter is to present a brief summary of the research findings, to discuss the major conclusions of this study, and finally, to advance recommendations for future research on dental caries.

I. SUMMARY

Ten hypotheses were formulated relating questionnaire variables and DMF scores. These are listed below and the research findings are summarized with reference to each hypothesis.

Hypothesis 1

> Children with high DMF scores and their parents will be characterized by more maladaptive dental behavior including less frequent dental visits and toothbrushing than their low DMF counterparts.

No differences were noted between high and low DMF groups with respect to dental behavior (see Appendix B, Table 23, page 103). This hypothesis was rejected.

Hypothesis 2

> Children who prefer cariogenic foods for meals and snacks will have high DMF scores, whereas children who do not prefer these foods will have low DMF scores.

Interestingly, low DMF scores were significantly associated with preferences for cariogenic foods at lunch (see Table 7, page 53).

This finding contradicts much of the professional literature on diet and dental caries (Finn and Glass 1975, Newbrun 1979) which suggests that consumption of cariogenic foods leads to high rates of dental decay. It has been demonstrated, however, that sugary foods eaten with meals are less caries producing than those eaten between meals. Or, it may be the case that food preferences do not always translate into actual food consumption. No differences were noted between high and low DMF groups with regard to preferences for cariogenic foods at other meals or snacks (see Appendix B, Table 24, page 108). This hypothesis was rejected.

Hypothesis 3

> An above average consumption of basic four foods will characterize the diets of children with low DMF scores, whereas an above average consumption of high sugar foods will characterize the diets of children with high DMF scores.

No differences were found between high and low DMF groups with regard to reported frequency of consumption of basic four foods (see Table 8, page 53). However, children with low DMF scores unexpectedly consumed high sugar foods more frequently than their high DMF counterparts (see Table 9, page 54). Here again, as was the case with hypothesis 2, popular and professional views on the relation between diet and dental caries are contradicted. There may be several reasons for this. First, informants may have offered ideal rather than true responses regarding the dietary intake of their children. Or, the sample may have been skewed where children with low DMF scores and high sugar intakes were over represented in

the sample. However, other researchers have reported similar findings in their studies of diet and dental caries, where consumption of cariogenic foods was not associated with high rates of dental decay (Retief 1981, Schamschula 1981). New research may be needed where diet is viewed as one of many factors involved in the etiology of dental caries and not the only factor responsible for the growth of this disease. In view of the data obtained, hypothesis 3 was rejected.

Hypothesis 4

> Parents with a poor knowledge of cariogenicity will have children with high DMF scores, whereas parents with a good knowledge of cariogenicity will have children with low DMF scores.

Here again an inverse correlation was found to exist, where parents of high DMF children had a good knowledge of cariogenicity and parents of children with low DMF scores had a poor knowledge of cariogenicity (see Table 10, page 56). Dental personnel may provide special nutritional counseling for parents of caries prone children or high DMF parents may make an effort to learn which foods are cariogenic as these foods may present a particular problem for their children. Hypothesis 4 was rejected.

Hypothesis 5

> Parents with a poor knowledge of dental health will have children with high DMF scores, whereas parents with a good knowledge of dental health will have children with low DMF scores.

No differences were noted between high and low DMF groups with regard to knowledge of dental health (see Table 11, page 56). This hypothesis was rejected.

Hypothesis 6

Parents of children with high DMF scores will hold less favorable attitudes toward dentists than their low DMF counterparts.

No differences were noted between high and low DMF groups with regard to attitudes towards dentists (see Table 12, page 58). This hypothesis was rejected.

Hypothesis 7

Parents of children with high DMF scores will hold less favorable attitudes toward dental health than parents of children with low DMF scores.

No differences were noted between high and low DMF groups with regard to attitudes toward dental health (see Table 13, page 58). This hypothesis was rejected.

Hypothesis 8

The mean number of stress indicators for children with high DMF scores will be larger than that for children with low DMF scores.

A T-Test revealed that children with high DMF scores had a higher mean number of stress indicators than their low DMF counterparts and this was significant at the .07 level (see Table 16, page 68). This finding supports the work of researchers (Sutton 1962, Manhold 1981) who have found that stressed individuals have a higher rate of dental decay than their non-stressed counterparts. Stress may influence the occurrence of dental caries by lowering an individual's resistance to infectious disease and by interfering with the proper functioning of the salivary glands.

Hypothesis 9

The mean number of true responses reflecting an external orientation toward dental problems will be higher for Baptists and sectarians than for non-Baptist/sectarians.

A T-Test revealed that Baptists had a higher number of true responses reflecting an external orientation toward dental problems than non-Baptist/sectarians and this was significant at the .065 level (see Table 20, page 71). Baptists and sectarians were also associated with high rates of dental decay, where an external orientation toward dental problems may have been partially responsible.

Hypothesis 10

The non-stressed Arikara Indians from the Mobridge 1 site will have a lower frequency of caries than their stressed counterparts from the Leavenworth site.

No significant differences were noted between the two sites with regard to frequency of caries (see Tables 21 and 22, page 72). This hypothesis was rejected.

Summarizing the research findings as they pertain to the hypotheses listed above, dental attitudes, behavior, and knowledge of dental health were not significantly associated with DMF scores in the sample of children studied. Variables related to diet and knowledge of cariogenicity were inversely correlated with dental health status. Stress was strongly associated with DMF scores. Informants who reported Baptist and sectarian religious affiliations were characterized by an external orientation toward dental problems which may have been partially responsible for the high rates of decay in their children.

Although no hypothesis was formulated relating socio-economic status to DMF scores, parents' education and occupation were strongly associated with dental health status in children. Parents with a low level of educational attainment and low status occupations had children with high rates of dental decay. Beck and Drake (1975:224) also report an inverse relation between caries and socio-economic status and attribute this to "a combination of crowding, inadequate oral hygiene, and poor nutrition."

II. CONCLUSIONS

The data in this study demonstrated marked variability in the number of DMF teeth for children in all age groups (see Table 2, page 45), but no one factor could explain this variability. However, stress and variables related to socio-economic status were strongly associated with dental health in the sample of children studied.

In addition, popular opinions on the cause and prevention of dental decay focused on self performed oral hygiene measures, such as toothbrushing, and differed from the professional viewpoint which emphasizes professional plaque removal and frequent dental visits. Perhaps dentists should inform their patients of the professional view with regard to caries causation and prevention. Much of the counseling patients receive from dentists pertains to the nutritional aspects of dental health, but individuals need to be made more aware of the complex nature of dental caries.

It may be useful for dentists to distribute a short questionnaire to their patients which elicits, for example, information pertaining

to socio-economic background and stress, so as to identify individuals who may be at high risk to dental disease. Dentists could then administer topical flouride treatments or other preventive measures to these patients and emphasize the need for frequent dental visits and plaque removal.

The most challenging and important conclusion drawn from this study is that dietary variables were inversely correlated with dental health in the sample of children studied. Preferences for cariogenic foods at lunch and an overall frequent consumption of high sugar foods were strongly associated with low rates of dental decay. Diet has long been regarded as the major etiological factor responsible for high rates of decay observed the world over. But this study along with other recent research (Schamschula 1981) draws this belief into question.

Krasner's (1978:27) discussion of proximal and distal etiological factors is relevant here:

> Perhaps for too long we have looked primarily at the proximal etiological factors (e.g., diet and oral hygiene) in dental disease without considering the more distal factors of which stress is the most important. These distal factors, in fact, modify and help to control the more proximal factors. For example, we can be exposed to a noxious agent and not become overtly ill. Only when host resistance is lowered will an overt ailment be discernable. So it is with dentistry. Patients can be on high cariogenic diets and not develop caries.

Caries etiology is multi-factorial but the complex nature of the problem has been obscured by the profuse amount of research devoted to discovering the "leading cause" of this disease. Krasner's (1978)

statement is an important one, spelling out the need for the study of distal as well as proximal etiological factors. Diet may be an important factor in caries etiology, but other variables, including stress, deserve increased research attention.

III. RECOMMENDATIONS FOR FUTURE RESEARCH

The major recommendation for future study on dental caries is that researchers examine variable decay rates in relation to a wide range of factors, such as those investigated in this report. In addition, information obtained on fluoride history, genetic factors, and saliva composition would be most useful. The complex etiology of dental caries points to the need for statistically multifactorial studies as well. The etiology of dental caries is in need of clarification and replications of this study incorporating the suggestions mentioned above may help elucidate the role of diet, stress, and other variables in caries etiology.

Armelagos, Goodman, and Jacobs (1976:79) have advanced an ecological model for the study of disease, where "the concept of disease is expanded to include a number of chemical, biological, social, and psychological factors which can insult the organism, causing the disease." The authors write that

> For a disease of uncertain etiology, it suggests ways in which the etiology may best be viewed multifactorially. Atheriosclerosis, for example, can best be analyzed from the perspective of the relevant input: organic imbalances of diet, internalized agression, tension from symbolic input and inorganic material such as trace element, and the genetic makeup of the individual may help to explain the inability to arrive at an adequate unifactorial explanation for atheriosclerosis.

Atheriosclerosis, like dental caries, is a disease of modern, complex society where a comprehensive etiology underlies its occurrence. Investigation of diet, stress, genetics, and a host of other factors is necessary for dental caries as well as in the case of atheriosclerosis.

Finally, it is recommended that caries be viewed from the perspective that "health, disease and medicine are integral parts of culture" (Logan and Hunt 1978:xiii). Dental caries may be the most common disease in the modern world and are increasing in prevalence in traditional societies undergoing modernization. Yet no effort has been made to examine the cultural conditions of the modern world (other than diet) which may contribute to high rates of decay. Stress may be one of these conditions, thereby spelling a need for increased research on dental decay among traditional peoples undergoing acculturation and among members of the Western world.

REFERENCES CITED

REFERENCES CITED

Armelagos, G., A. Goodman and K. Jacobs
1978 The ecological perspective in disease. In Health and the Human Condition. Logan and Hunt, eds. pp. 71-24. Belmont, Calif.: Pathopax.

Barmes, David
1977 Epidemiology of dental disease. Journal of Clinical Periodontology 4:80-93.

1981 Oral health in the year 2000. World Health June: 3-5.

Beal, John and S. Dickson
1975 Differences in dental attitudes and behavior in Westmoreland mothers of various ethnic origins. Public Health (London) 89:65-70.

Beck, James and Claude Drake
1975 Some epidemiologic evidence on the etiology of caries. Community Dentistry and Oral Epidemiology 3:223-27.

Bellini, Hamilton Taddei, P. Arneburg and F. R. Von Der Fehr
1981 Oral hygiene and caries--a review. Acta Odontologica Scandinavica. 39:257-265.

Bibby, Basil
1935 Neglected factors in the study of dental caries. Journal of the American Dental Association 222-239.

1981 Food relationships to caries. In Foods, Nutrition and Dental Health. Hefferren and Koehler, eds. pp. 19-33. Park Forest, Ill.: Pathopax.

Bulman, John, Geoffrey Slack, N. David Richards and Arthur Wilcocks
1968 A survey of dental health and attitudes toward dentistry in two communities. British Dental Journal 125:102-6.

Burstone, Marvin
1946 The psychosomatic aspects of dental problems. Journal of the American Dental Association 33:862-871.

Caldwell, Robert
1970 Physical properties of foods and their caries producing potential. Journal of Dental Research 49:1293-1298.

Chapman, P. J., A. M. Mc Donald, A. J. Stoddart and E. V. Mac Kay
1971 Dental health of pregnant women. The Medical Journal of Australia 1113-1116.

Cleaton-Jones, P., B. D. Richardson. J. M. Rantsho, L. Pietiers and P. M. Mc Inness
1979 Patterns of oral hygiene and dental caries in rural and urban South African pre-school children. Tropical Dental Journal 11:27-33.

Colby, Robert A.
1971 Color Atlas of Oral Pathology. Philadelphia: Lipponcott.

Colella, R. F. A.
1968 Dental care. Pediatric Clinics of North America 15:325:336.

Coriel, Jeannine and Patricia Marshall
1982 Locus of illness control--A cross cultural study. Human Organization 41:131-138.

Curzon, M. E. J. and J. A. Curzon
1979 Dental caries prevalence in the Baffin Island Eskimo. Pediatric Dentristry 1:169-173.

De La Rosa, Manuel
1978 Dental caries and socio-economic status in Mexican children. Journal of Dental Research 5:453-7.

Donnelly, C. J., L. A. Thomsen, H. M. Stiles, C. Brewer, J. V. Neel and J. A. Brunelle
1977 Plaque, caries, periodontal diseases, and acculturation among Yanomamo Indians, Venezuela. Community Dentistry and Oral Epidemiology 5:30-39.

Dunning, James, Robert Hyde and Peter Dalton
1951 Dental disease in psychiatric patients. Journal of Dental Research 30:806-814.

Dunning, James
1962 Principles of Public Health Dentistry. Cambridge: Harvard University Press.

East Tennessee Health Improvement Council
1978 Health Systems Plan 1978-1983. Knoxville.

Finn, S. B. and R. B. Glass
1975 Sugar and dental decay. World Review of Nutrition and Dietetics 22:304-326.

Fisher, F. J.
1968 A field survey of dental caries, periodontal disease and enamel defects in Tristan da Cunha: Part 2. British Dental Journal 22:447-453.

Foster, George M.
1974 Medical anthropology: some contrasts with medical sociology. In Health and the Human Condition. Logan and Hunt, eds. pp. 2-11. Belmont, Calif.: Pathopax.

Garrett, Ruby Burriss
1978 Traditional Southern Appalachian Dental Practices. In Glimpses of Southern Appalachian Folk Culture. Charles C. Faulkner and C. Buckler, eds. pp. 56-66. Tennessee Anthropological Association Miscellaneous Papers #3.

Gerrard, Nathan
1972 Churches of the stationary poor in southern Appalachia. In Religion in Appalachia. Photiadis, ed. pp. 271-284. Morgantown: West Virginia University.

Hamilton, Eva May and Eleanor Whitney
1982 Nutrition. St. Paul: West Publishing.

Hazelwood, Jane
1977 Dental Visits, Tennessee 1973-1974. Tennessee Department of Public Health.

Heifetz, S., H. Horowitz and D. Katz
1976 Prevalence of dental caries in white and black schoolchildren in Nelson County, Virginia. Journal of Public Health Dentistry 36:79-87.

Heloe, Leif and Ola Haugejordan
1981 The rise and fall of dental caries. Community Dentistry and Oral Epidemiology 9:294-299.

Hyams, I. B.
1948 Dental caries and psychosomatics. Dental Items of Interest 70:302.

Infante, Peter and George Gillespie
1977 Enamel hypoplasia in relation to caries in Guatemalan children. Journal of Dental Research 56:493-498.

Jenny, Joanna
1974a Preventing dental disease in children. American Journal of Public Health 64:1147-1155.

Jenny, Joanna, Jean Frazier, Robert Bagramian and John Proshek
1974b Explaining variability in caries experience using an ecological model. Journal of Dental Research 53:554-564.

1975 Dental health status of third grade children and their families within the context of a communities dental health care system. Medical Care 13:174-186.

Kegeles, Stephen
1974 Current status of preventive dental health behavior in the population. Health Education Monographs 2:197-200.

Krasner, David
1978 Stress as a distal etiological factor in dental disease. Journal of Preventive Dentistry 5:24-27.

Leigh, R. W.
1925 Dental pathologies of Indian tribes of varied environmental and food conditions. American Journal of Physical Anthropology 8:179-199.

Leus, Peter
1981 Dental caries. World Health June:10-13.

Logan, Michael and Edward Hunt (eds.)
1978 Health and the Human Condition. Belmont: Wadsworth.

Manhold, John
1979 Stress, disease and general illness. Psychosomatics 20:83-87.

Miller, P., Richard Wikoff, Margaret McMahon, Mary Jane Garrett and Nancy Johnson
1982 Development of a health attitude scale. Nursing Research 31:132-136.

Neuman, H. E. and N. A. Di Salvo
1958 Caries of the Indians of the Mexican Cordillera, the Peruvian Andes, and at the Amazon Headwaters. British Dental Journal 102:13-16.

Newbrun, Ernest
1979 Dietary carbohydrates: their role in cariogenicity. Medical Clinics of North America 63:1069-1094.

1982 Sugar and dental caries: A review of human studies. Science 217:418-423.

Nie, Norman, H. Hull, J. Jenkins, K. Steinbrenner and D. Bent
1975 Statistical Package for the Social Sciences. New York: McGraw Hill.

Oranje, P. N. Noriskin and Osborn
1935 The effect of diet upon dental caries in the South African Bantu. The South African Journal of Medical Sciences: 57-62.

Phipps, G. and F. L. Marcuse
1972 Anxiety and dental caries. In Psychology and Dentistry. Ayer and Hirschman eds. pp. 29-37. Springfield, Ill.: Charles C. Thomas.

Photiadis, John and B. B. Maurer
1978 Religion in an Appalachian state. In Religion in Appalachia. Photiadis, ed. pp. 171-228. Morgantown: West Virginia University.

Retief, D. H.
1981 Dental caries and sugar intake of 16 to 17 year old pupils in four South African population groups. In Foods, Nutrition and Dental Health. Hefferren and Koehler, eds. pp. 240-256. Park Forest, Ill.: Pathopax.

Richardson, Barbara
1982 The historical background of research on diet and dental caries in South Africa. Journal of the South African Dental Association 37:327-333.

Richmond, Julius
1978 Toward a definition of questions. In International Dental Care Delivery Systems. Blair and Ingle, eds. pp. 9-12. Cambridge, Mass.: Balinger.

Ripa, Loius, James Barenie and Gary Leske
1977 The relation between oral hygiene and dental health. New York State Dental Journal 43:530-535.

Rosebury, T. and L. M. Waugh
1939 Dental caries among the Eskimos of the Kuskokwin area of Alaska. American Journal of Diseases of Children 57:871-893.

Roskin, Gerald and Charles Rabiner
1979 Dental anxiety: a psychiatric approach. New York State Dental Journal 234-236.

Rowe, N. H., S. Garn, D. C. Clark and K. E. Guire
1976 The effect of age, sex, race and economic status on dental caries experience of the permanent dentition. Pediatrics 57: 457-461.

Schamschula, Rudi
1981 Social causes of dental disease. World Health June:26-29.

Schroder, Vela, Lars Goran Lindstrom and Lena Ollson
1981 Interview or questionnaire? A comparison based on the relation between caries and dietary habits in pre-school children. Community Dentistry and Oral Epidemiology 9:79-82.

Scott, Donald and Richard Hirschmann
1982 Psychological aspects of dental anxiety in adults. Journal of the American Dental Association 104:27-31.

Stephenson, John
1968 Shiloh: A Mountain Community. Lexington: University of Kentucky Press.

Strongin, Edward and Leland Hinsie
1949 Parotid gland secretions of manic depressive patients. American Journal of Psychiatry 94:1459-1466.

Sutton, Philip
1962 Mental stress and acute dental caries. Nature July:254-256

Tennessee Department of Public Health
1979 Report of Statewide Dental Health Survey. Nashville, Tennessee Department of Public Health.

Tijmstra, Tjeerd
1981 How successful are surveys on the relation between caries and socio-economic variables? Community Dentistry and Oral Epidemiology 9:230-235.

Tucker, C. J., R. J. Andlaw and C. K. Burchell
1976 The relationship between oral hygiene and dental caries incidence in 11 year old children. British Dental Journal 141:75-79.

Turner, Christy
1979 Dental anthropological indications of agriculture among the Jomon people of Central Japan. American Anthropology 51:619-636.

United States Bureau of the Census
1980 Characteristics of the Population: General Social and Economic Characteristics. Part 44, Tennessee.

Weddell, James and Arthur Klein
1981 Socio-economic correlation of 6 to 36 month children. Pediatric Dentistry 3:306-310.

White, George
1977 Microbiology and dental caries. Journal of Pedodontics 2:39-55.

WHO
1971 WHO Scientific Group on the Etiology and Prevention of Dental Caries. Geneva.

APPENDICES

APPENDIX A

COVER LETTER AND GENERAL QUESTIONNAIRE

Dear Parent,

Your dentist is cooperating with the University of Tennessee in research on dental caries (cavities). Debbie McGrath, a graduate student in the Department of Anthropology, is exploring the factors which may influence the rate of dental decay in children. Your participation in this research, by filling out the following questionnaire, will be greatly appreciated. Please respond to all questions in an honest and sincere manner. Your answers will be confidential and results will be pooled so that no names will be used in any publication resulting from this research.

Thank you for your time and consideration.

Sincerely yours,

Debbie Mc Grath

In order to successfully complete this study, the researcher needs to know the dental health status of your child as indicated by the DMF (decayed, missing, or filled teeth) index. Please sign your name on the line provided if you agree to have your dentist furnish this information, and only this information from your child's dental records.

X_____

Patient's name _____

Would you be willing to be contacted by telephone for further information regarding this questionnaire? YES NO

If so, please fill in the information below.

Name_____

Address #____ Street _____ City _____

State _____ Zip _____

Phone Number (_____) _____-_____

Best Time to Call _____

_____

Instructions to parent or legal guardian:

Please answer all questions with appropriate information and with reference to yourself

a. What is your relationship to the patient?_____

b. How many individuals live in your household?_____

c. How many of these are children?

d. What is (are) the occupations of the patient's parents?
Father _____ Mother _____

e. How many times per year do you visit the dentist?_____

f. Would you visit the dentist more frequently if dental visits were included in your medical insurance?_____

g. Have you ever had any bad or negative experiences with a dentist?
YES NO If so, please explain _____

h. What is the estimated annual income of your household? Please place an "X" next to the appropriate space.

_____ $50,000 or more	_____ $8000 to $9,999
_____ $25,000 to $49,000	_____ $6000 to $7,999
_____ $15,000 to $24,999	_____ $4500 to $5,999
_____ $12,000 to $14,999	_____ $3000 to $4,999
_____ $10,000 to $11,999	_____ Less than $3000

i. Education completed by the patient's parents or guardian:

FATHER	MOTHER
a. elementary school	a. elementary school
b. 1-3 years of high school	b. 1-3 years of high school
c. high school graduate	c. high school graduate
d. 1-3 years of college	d. 1-3 years of college
e. 4 or more years college	e. 4 or more years college

j. Please supply appropriate information for the following with respect to yourself.

Sex _____
Ethnic group _____
Religious affiliation _____

k. How many times per day do you brush your teeth?_____

l. Do you act as a "tooth fairy" when your child loses "baby" teeth, placing money under his pillow or rewarding him/her with some other item?_____

Please answer the following questions with reference to the child who is a patient today.

a. Weight _____ lbs.

b. Height _____ feet _____ inches

c. Age _____

d. Sex _____

e. Ethnic group _____

f. Religious affiliation _____

g. School grade _____

h. What was the reason for this child's present dental visit?

_____

i. How long has it been since this child's last visit to the dentist?

_____

j. At what age did this child first visit the dentist?_____

k. How would you describe the general health status of the child who is a patient today? (Circle one)

EXCELLENT VERY GOOD GOOD FAIR POOR

l. Please describe any chronic health problems this child has had.

_____

_____

m. How many times per day does this child brush his/her teeth?

_____

Please list favorite foods of your child who is the dentist's patient today.

BREAKFAST FOODS:

LUNCH FOODS:

DINNER FOODS:

Please list this child's favorite "snack" foods:

Please describe dentists in terms of the following concepts. Please mark an "X" in the appropriate space, with 5 indicating the strongest agreement.

Dentists are:

	5	4	3	2	1
valuable	___	___	___	___	___
bad	___	___	___	___	___
trusting	___	___	___	___	___
slow	___	___	___	___	___
underpaid	___	___	___	___	___
useless	___	___	___	___	___
good	___	___	___	___	___
distrustful	___	___	___	___	___
unfeeling	___	___	___	___	___
friendly	___	___	___	___	___
humble	___	___	___	___	___
caring	___	___	___	___	___
distant	___	___	___	___	___
arrogant	___	___	___	___	___
fast	___	___	___	___	___
overpaid	___	___	___	___	___

Please mark an "X" under the appropriate heading, indicating how often your child, the patient, eats the following foods.

	EVERYDAY	ONCE A WEEK	ONCE EVERY TWO WEEKS	ONCE A MONTH	NEVER
Milk					
Ice Cream					
Potatoes (boiled)					
Potatoes (fried)					
Caramel					
Chocolate					
Wheat Bread					
Apples					
Oranges					
Honey, Bread & Butter					
Honey (alone)					
Carrots					
Cookies					
Jam or Jelly					
Marmalade, Bread & Butter					
Marmalade (alone)					
Lemonade					
Tomato Juice					
Fruit Cocktail					
Orange Juice					
Grapefruit Juice					
Veal Cutlet					
Eggs					
Chocolate Milk					
Danish Pastry					
Peaches (canned in syrup)					
Fried Chicken					
Peanuts					
Almonds					
Apple Pie					

How often does the patient eat the following foods (Continued)

	EVERYDAY	ONCE A WEEK	ONCE EVERY TWO WEEKS	ONCE A MONTH	NEVER
Cherry Pie					
Cream Cheese and Jelly Sandwich					
Tuna Fish Sandwich					
Hamburger on Bun					
Peas					
Coleslaw					
Pancakes with Syrup					
Plain Donut					
Chewing Gum					
Lollipop					
Cola					
Ginger Ale					
Oatmeal					
Collard Greens					
Macaroni & Cheese					
Spaghetti					
Brownies					
Bananas					
Prunes					
Custard					
Dried Fruit					

Do you think of the following food as one that is decay producing or non-decay producing? Mark an "X" to indicate your response.

	EXTREMELY DECAY PRODUCING	SOMEWHAT DECAY PRODUCING	NON DECAY PRODUCING
Milk			
Ice Cream			
Potatoes (boiled)			
Potatoes (fried)			
Caramel Candy			
Chocolate			
Wheat Bread			
Apples			
Oranges			
Honey, Bread & Butter			
Honey (alone)			
Carrots			
Cookies			
Jam or Jelly			
Marmalade, Bread & Butter			
Marmalade (alone)			
Lemonade			
Tomato Juice			
Fruit Cocktail			
Orange Juice			
Grapefruit Juice			
Veal Cutlet			
Eggs			
Chocolate Milk			
Danish Pastry			
Peaches (canned syrup)			
Fried Chicken			
Peanuts			
Almonds			

What do you think of the following foods (Continued)

	EXTREMELY DECAY PRODUCING	SOMEWHAT DECAY PRODUCING	NON DECAY PRODUCING
Apple Pie			
Cherry Pie			
Cream Cheese & Jelly Sandwich			
Tuna Fish Sandwich			
Hamburger on Bun			
Peas			
Coleslaw			
Pancakes with syrup			
Plain Donut			
Chewing Gum			
Lollipop			
Cola			
Ginger Ale			
Oatmeal			
Collard Greens			
Macaroni & Cheese			
Spaghetti			
Brownies			
Bananas			
Prunes			
Custard			
Dried Fruit			

Please mark an "X" under the appropriate heading, indicating whether you strongly agree, agree, are uncertain, disagree, or strongly disagree with the following statements.

	STRONGLY AGREE	AGREE	UNCERTAIN	DISAGREE	STRONGLY DISAGREE
Brushing teeth helps prevent tooth decay					
Bad teeth are inherited					
Flouridated water helps prevent dental decay					
Flouride tablets are not useful in the prevention of cavities					
Cavities in "baby" teeth are not serious since they fall out anyway					
It is probably more important to see your doctor on a regular basis than your dentist					
Cavities are not as serious as broken bones					
Dental health is important, but other aspects of an individual's health, such as kidneys lungs and heart are more important					
The only serious side effect of prolonged dental decay is loss of teeth					
It is perfectly normal to have cavities					
It is not necessary to take a child to the dentist before the age of five					
Too much sugar in the diet can cause cavities					
It does not really matter if sugar is consumed at meals or in-between meals, the effects on teeth are still the same					
Only food containing sugar is decay producing					
Sugar, whether it is found in cola, ice cream or chocolate has the same effect on teeth					
Honey is not as decay producing as is "white" sugar					
Because diabetics consume little sugar they have few cavities					

	STRONGLY AGREE	AGREE	UNCERTAIN	DISAGREE	STRONGLY DISAGREE
Losing one's teeth is part of the normal aging process					
A person should brush their teeth three times per day					
Dental services are too expensive					
I generally associate pain and fear with going to the dentist					
The last time I visited the dentist was because I had a toothache					
I think that I need dental treatment at the present time					
Brushing teeth three times per day can totally eliminate cavities					
Lack of funds to pay for dental services limits my child's visits to the dentist					
A woman loses a tooth for every baby she has					
Pregnancy causes teeth to fall out					
Tootaches can be caused by strong cold winds					
If a loose baby tooth won't fall out naturally you should pull it out					
Chewing tobacco or placing it directly on a tooth can alleviate a toothache					
Placing one's tongue in the cavity left by a tooth which has fallen out will prevent another tooth from coming in					
Vinegar is bad for healthy teeth but a good remedy for a toothache					

In your opinion, what is the single leading cause of dental decay?

_____

What do you think prevents dental decay?_____

_____

Do you use or have you used "home remedies" to treat dental disorders such as toothache or cavities? If so, what ?_____

_____

APPENDIX B

RESULTS OF GENERAL QUESTIONNAIRE

TABLE 23. Crosstabulations of DMF with Demographic and Behavioral Characteristics

Variable	Frequency	
	High DMF	Low DMF
Guardian's relationship to patient (N = 99)		
Father	5	8
Mother	43	36
Other relative	4	3
Chi-Square = 1.2 with 2 degrees of freedom, significance = .55		
Number of individuals living in parent's household (N = 98)		
Two	2	2
Three	11	7
Four	22	23
Five	12	12
Six	4	3
Chi-Square = .81 with 4 degrees of freedom, significance = .97		
Number of children in family (N = 96)		
One	12	8
Two	26	26
Three	10	11
Four	2	1
Chi-Square = 1.02 with 3 degrees of freedom, significance = .80		
Occupation of father (N = 96)		
Executive, administrative or managerial	8	15
Scientist, mathematician or engineer	5	3
Social scientist, social worker or lawyer	1	0
Teacher, librarian, or counselor	4	2
Health professional	2	3
Technologist (other than health)	0	2
Support and service	13	11
Mechanic or factory worker, carpenter	12	4
Other, unemployed	5	6
Chi-Square = 10.6 with 8 degrees of freedom, significance = .23		

TABLE 23 (Continued)

Variable	Frequency High DMF	Low DMF
Occupation of mother (N = 98)		
Executive, administrative or managerial	0	4
Scientist, mathematician or engineer	0	1
Social scientist, social worker or lawyer	1	3
Teacher, librarian or counselor	6	3
Health professional	5	3
Technologist (other than health)	2	0
Support and service	9	14
Mechanic or factory worker, carpenter	7	0
Other, unemployed	21	19
Chi-Square = 17.6 with 8 degrees of freedom, significance = .02		
Times per year parent visits dentist (N = 94)		
Once every six months	30	31
Once every year	15	10
Less often than once a year	3	5
Would parent visit dentist more often if dental visits were pre-paid (N = 87)		
Yes	28	19
No	17	22
Chi-Square = 2.18 with 1 degree of freedom, significance = .16		
Has parent had negative expeience with a dentist (N = 97)		
Yes	14	7
No	36	40
Chi-Square = 2.48 with 1 degree of freedom, significance = .12		
Household income (N = 93)		
More than $50,000	5	7
$25,000--$49,999	23	20
$15,000--$24,999	15	10
$12,000--$14,999	2	2
$10,000--$11,999	2	1
$6,000--$9,999	1	1
$3,000--$5,999	1	1
Less than $3,000	1	1
Chi-Square = .65 with 6 degrees of freedom, significance = .70		

TABLE 23 (Continued)

Variable	Frequency High DMF	Low DMF
Education of father (N = 95)		
Elementary school	2	0
1-3 years high school	7	0
High school graduate	19	16
1-3 years college	8	15
4 or more years college	14	14
Chi-Square = 11.2 with 4 degrees of freedom, significance = .025		
Education of mother (N = 98)		
Elementary school	1	0
1-3 years high school	2	0
High school graduate	29	20
1-3 years college	9	14
4 or more years college	10	13
Chi-Square = 5.98 with 4 degrees of freedom, significance = .20		
Parent's racial group (N = 81)		
Caucasian	38	30
Black	5	4
Oriental	3	1
Chi-Square = .57 with 2 degrees of freedom, significance = .75		
Parent's religion (N = 97)		
Baptist and sectarian	37	23
Other Protestant	11	15
Catholic	0	2
Jew	0	3
Chi-Square = 6.45 with 1 degree of freedom, significance = .01		
Times per day parent brushes teeth (N = 96)		
One	4	4
Two	38	36
Three	7	4
Four	1	1
Five	1	0
Six		
Chi-Square = 1.5 with 4 degrees of freedom, significance = .83		

TABLE 23 (Continued)

Variable	Frequency	
	High DMF	Low DMF
Does parent act as tooth fairy when child loses tooth? (N = 98)		
Yes	46	45
No	6	1
Chi-Square 3.2 with 1 degree of freedom, significance = .16		
Height/weight of patient (N = 79)		
Underweight	2	9
Normal	24	15
Overweight	17	12
Chi-Square = 6.8 with 2 degrees of freedom, significance = .03		
Reason for child's present dental visit (N = 96)		
Dental check-up	31	19
Dental problems	33	13
Chi-Square = 1.02 with 1 degree of freedom, significance = .34		
Length of time since child's last dental visit (N = 95)		
Two months or less	20	16
Between 2 and 4 months	4	1
Between 4 and 6 months	14	19
Between 6 months and one year	7	6
More than one year	5	3
Chi-Square = 3.3 with 4 degrees of freedom, significance = .51		
Child's age at first dental visit (N = 94)		
One	3	0
Two	9	10
Three	16	18
Four	12	8
Five	4	9
Six	5	0
Chi-Square = 10.7 with 5 degrees of freedom, significance = .06		

TABLE 23 (Continued)

Variable	Frequency	
	High DMF	Low DMF
General health status of child (N = 98)		
Excellent	23	23
Very Good	16	17
Good	8	4
Fair	3	1
Poor	1	1
Chi-Square = 2.1 with 4 degrees of freedom, significance = .70		
Chronic health problems of child (N - 98)		
Allergies	10	3
Asthma	3	2
Respiratory or ear infections	3	2
Bladder infections	1	0
Intestinal disorders	1	0
Milk intolerance	1	1
Tonsillitis	1	1
Other	3	0
Chi-Square = 10.5 with 8 degrees of freedom, significance = .23		
Times per day child brushes teeth (N - 97)		
None	1	0
One	14	9
Two	28	32
Three	7	4
Four	1	0
Five	1	0
Chi-Square = 4.7 with 5 degrees of freedom, significance = .45		

TABLE 24. Crosstabulations of DMF with Dietary Variables

Variable	Frequency High DMF	Low DMF
Does child prefer cariogenic foods		
For breakfast (N = 95)		
Yes	10	9
No	40	36
Chi-Square = 0.0 with 1 degree of freedom, significance = 1.0		
For lunch (N = 93)		
Yes	4	11
No	45	33
Chi-Square = 4.9 with 1 degree of freedom, significance = .03		
For dinner (N - 93)		
Yes	1	3
No	47	42
Chi-Square = 1.2 with 1 degree of freedom, significance = .29		
For snacks (N = 92)		
Yes	24	24
No	25	19
Chi-Square = .43 with 1 degree of freedom, significance = .51		
Frequency of Consumption of Basic Four Foods (N = 71)		
Frequent Consumption	15	19
Infrequent Consumption	20	17
Chi-Square = .36 with 1 degree of freedom, significance = .55		
Frequency of Consumption of High Sugar Foods (N = 81)		
Frequent Consumption	27	18
Infrequent Consumption	14	22
Chi-Square = 2.77 with 1 degree of freedom, significance = .10		

TABLE 25. Frequency of Consumption of Basic Four Foods and High Sugar Foods

Foods	High DMF			Low DMF		
	Frequently	Occasionally	Never	Frequently	Occasionally	Never
Basic Four Foods						
Milk	40	1	2	37	0	2
Ice Cream	35	12	3	27	19	0
Boiled Potatoes	26	16	9	27	15	5
Fried Potatoes	33	15	2	27	18	1
Wheat Bread	23	8	20	27	6	14
Apples	33	15	3	39	6	2
Oranges	28	16	7	29	14	3
Honey, Bread & Butter	16	10	25	17	7	23
Carrots	20	19		23	20	4
Marmalade, Bread & Butter	9	10	31	12	9	25
Tomato Juice	3	16	32	3	10	34
Fruit Cocktail		30	10	13	25	8
Orange Juice	38	7	5	40	6	1
Grapefruit Juice	4	10	36	5	5	37
Veal Cutlet	3	7	40	1	13	33
Eggs	39	6	5	38	4	5
Chocolate Milk	22	20	7	22	17	8
Peaches (canned in syrup)		28		10	29	7
Fried Chicken	27	20	3	25	20	2
Peanuts	13	30	8	7	35	5
Almonds	3	13	35	1	14	31
Cream Cheese and Jelly Sandwich	3	2	46	4	3	40
Tuna Salad Sandwich	9	23	18	4	21	20
Hamburger on a Bun	36		3	32	14	1

TABLE 25 (Continued)

Foods	High DMF			Low DMF		
	Frequently	Occasionally	Never	Frequently	Occasionally	Never
Peas	28	11	12	28	8	11
Coleslaw	18	14	19	13	16	18
Pancakes with syrup	16	28	7	17	28	2
Oatmeal	21	14	16	21	13	13
Collard Greens	9	16	26	1	16	30
Macaroni & Cheese	34	14	3	19	25	3
Spaghetti	31	19	1	23	22	2
Bananas	29	15	7	28	16	3
Prunes	2	11	37	1	5	41
Custard	1	8	42	2	14	31
Dried Fruit	7	14	29	4	17	26
High Sugar Foods						
Caramel	3	18	26	4	24	18
Chocolate	29	18	4	24	1	5
Honey, Bread & Butter	17	10	24	17	7	23
Honey	88	12	29	5	12	29
Cookies	36	11	4	35	12	0
Jam or Jelly	30	16	5	33	8	6
Marlamade, Bread & Butter	9	10	31	12	9	25
Marmalade	1	6	42	2	3	39
Lemonade	5	31	15	4	36	7
Fruit Cocktail	11	30	10	14	24	8
Chocolate Milk	22	21	7	20	19	8
Danish Pastry	2	19	27	2	26	18
Peaches (in syrup)	11	27	12	9	30	8
Apple Pie	1	28	21	1	33	13

TABLE 25 (Continued)

Foods	High DMF			Low DMF		
	Frequency	Occasionally	Never	Frequency	Occasionally	Never
Cherry Pie	0	23	28	1	26	20
Cream Cheese and Jelly Sandwich	3	2	46	4	3	40
Pancakes with syrup	16	28	7	17	28	2
Plain Donut	8	33	10	8	29	10
Gum	38	7	6	39	6	2
Lollipop	23	20	8	19	23	5
Cola	44	4	2	35	10	2
Ginger ale	4	7	39	2	11	34

TABLE 26. Crosstabulation of DMF with Dental Knowledge Variables

Variable	Low DMF	High DMF
Knowledge of Cariogenicity (N = 71)		
Poor knowledge	22	12
Good knowledge	13	24
Chi-Square = 5.07 with 1 degree of freedom, significance - .02		
Knowledge of Dental Health (N = 84)		
Poor knowledge	21	24
Good knowledge	22	17
Chi-Square = .34 with 1 degree of freedom, significance = .58		

TABLE 27. Informant Rating of the Cariogenicity of 51 Foods

Food	Frequency of Response					
	High DMF			Low DMF		
	Extremely Decay Producing	Somewhat Decay Producing	Non Decay Producing	Extremely Decay Producing	Somewhat Decay Producing	Non Decay Producing
Highly decay producing foods						
Caramel	45	3	2	46	0	0
Chocolate	43	7	0	43	1	1
Honey, Bread and Butter	19	29	2	21	18	7
Honey	30	13	7	31	8	7
Cookies	33	15	0	34	11	1
Jam or Jelly	40	10	0	40	5	1
Danish Pastry	39	8	3	38	7	0
Apple Pie	37	12	0	32	14	0
Cherry Pie	38	12	0	32	14	0
Cream Cheese and Jelly Sandwich	32	16	2	33	12	1
Pancakes with syrup	38	12	0	40	6	0
Gum	37	12	1	39	7	0
Lollipop	44	6	0	46	0	0
Brownies	42	7	1	34	12	0
Prunes	4	21	25	3	26	17
Dried Fruit	3	22	25	11	17	18
Somewhat decay producing foods						
Ice Cream	10	31	9	12	29	5
Boiled Potatoes	0	15	34	0	17	29
Fried Potatoes	3	26	21	3	24	19
Wheat Bread	2	11	37	1	11	35
Marmalade, Bread and Butter	24	22	4	29	15	3
Marmalade	35	12	3	38	7	2
Fruit Cocktail	11	30	9	15	29	3
Chocolate Milk	15	28	5	21	22	3
Peaches Canned in Syrup	29	19	0	29	16	2
Fried Chicken	1	24	25	0	32	14
Tuna Sandwich	1	23	25	1	19	27
Hamburger	0	28	22	1	20	25
Plain Donut	26	24	0	26	17	3

TABLE 27 (Continued)

Food	Frequency of Response: High DMF — Extremely Decay Producing	High DMF — Somewhat Decay Producing	High DMF — Non Decay Producing	Low DMF — Extremely Decay Producing	Low DMF — Somewhat Decay Producing	Low DMF — Non Decay Producing
Cola	43	7	0	42	4	0
Ginger Ale	23	25	2	30	14	2
Oatmeal	1	31	18	3	20	23
Macaroni and Cheese	1	29	20	0	20	26
Spaghetti	1	28	21	1	19	24
Low decay producing foods						
Milk	1	24	24	0	20	24
Apples	0	9	40	1	15	30
Oranges	0	14	36	1	16	29
Carrots	1	5	44	0	4	42
Lemonade	17	30	2	8	36	3
Tomato Juice	0	15	35	0	18	29
Orange Juice	4	18	28	1	24	22
Grapefruit Juice	2	17	31	0	21	25
Veal Cutlet	1	14	34	0	18	29
Eggs	0	13	37	1	14	32
Peanuts	0	22	28	1	25	21
Almonds	1	22	26	4	24	19
Peas	1	20	29	0	14	32
Coleslaw	0	31	19	2	24	20
Collard greens	0	8	42	0	7	38
Bananas	2	22	26	1	28	17
Custard	23	20	7	21	20	5

TABLE 28. Frequency of Informant Responses Regarding Statements Pertaining to Knowledge of Dental Health

	Frequency									
	High DMF					Low DMF				
	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Knowledge of dental health										
Correct Statements:										
Brushing teeth helps prevent tooth decay	45	3	0	0	2	41	5	0	0	0
Fluoridated water helps prevent tooth decay	18	23	7	0	2	25	20	1	0	0
Too much sugar in the diet can cause cavities.	26	24	0	0	0	21	21	4	0	0
Incorrect Statements:										
Bad teeth are inherited.	4	13	17	10	6	1	16	19	5	6
Fluoride tablets are not useful in the prevention of cavities.	2	6	19	17	6	1	2	21	18	4
Cavities in "baby" teeth are not serious since they fall out anyway	2	2	6	21	19	2	0	1	26	18
The only serious side effect of prolonged dental decay is loss of teeth.	1	0	3	27	16	0	3	2	26	16
It is not necessary to take a child to the dentist before the age of five.	4	0	1	31	13	2	5	0	26	14
It does not really matter if sugar is consumed at meals or in-between meals, the effects on teeth are still the same.	10	22	7	7	4	10	12	7	17	0
Only foods containing sugar are decay producing.	3	3	6	30	8	1	2	4	33	7
Sugar, whether it is found in cola, ice cream or chocolate has the same effect on teeth.	6	24	10	8	2	6	21	11	9	0
Honey is not as decay producing as is "white" sugar.	2	16	15	13	4	3	15	18	9	2
Because diabetics consume little sugar, they have few cavities.	1	1	17	29	2	0	1	21	23	2
Brushing three times per day can totally eliminate cavities.	2	3	4	35	5	1	2	4	37	3

TABLE 29. Crosstabulations of DMF with Dental Attitude Variables

Variable	Low DMF	High DMF
Attitudes Toward Dentists		
Positive Adjectives (N = 74)		
Favorable	19	21
Unfavorable	18	16
Chi-Square = .05 with 1 degree of freedom, significance = .82		
Negative Adjectives (N = 69)		
Favorable	23	20
Unfavorable	12	14
Chi-Square = .18 with 1 degree of freedom, significance = .73		
Attitudes Toward Dental Health (N = 74)		
Favorable	19	20
Unfavorable	19	16
Chi-Square = .06 with 1 degree of freedom, significance = .80		

TABLE 30. Frequency of Informant Responses Describing Dentists with Reference to Adjectives on a Leikert Scale

	Frequency									
	High DMF					Low DMF				
Dentists are:*	5	4	3	2	1	5	4	3	2	1
Valuable	47	1	1	0	0	38	3	1	0	0
Trusting	24	19	6	0	1	17	12	7	3	4
Underpaid	2	3	12	10	21	1	2	14	6	18
Good	37	11	0	1	1	26	3	9	2	3
Friendly	27	17	3	1	1	23	14	3	2	2
Humble	6	9	16	5	9	7	8	15	4	7
Caring	27	15	7	0	1	18	14	4	3	3
Fast	4	5	25	2	8	2	4	28	3	5
Bad	2	1	3	1	34	2	1	2	0	40
Slow	8	9	13	6	11	0	9	10	4	17
Useless	3	1	1	0	39	3	0	2	1	35
Distrustful	3	3	2	3	34	0	3	2	4	31
Unfeeling	5	5	8	2	25	1	1	7	4	27
Distant	5	4	10	9	17	0	4	9	6	21
Arrogant	1	1	9	12	18	0	1	5	8	26
Overpaid	5	6	24	4	6	3	3	22	4	7

*5 indicates agreement; 1 indicates disagreement.

TABLE 31. Frequency of Informant Responses Regarding Attitudes Toward Dental Health

	Frequency									
	High DMF					Low DMF				
	Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Attitudes concerning dental health										
Negative attitudes:										
It is probably more important to see your doctor on a regular basis than your dentist	2	2	3	29	13	0	1	3	36	6
Cavities are not as serious as broken bones.	1	6	8	27	7	2	6	3	30	4
Dental health is important, but other aspects of an individual's health, such as kidneys, lungs and heart are more important.	3	27	6	12	1	3	13	6	23	2
Losing one's teeth is a part of the normal aging process.	3	13	7	23	4	0	4	6	26	10
It is perfectly normal to have cavities	1	16	7	22	3	0	10	10	22	5
Dental services are too expensive.	1	20	17	11	0	2	18	11	13	5
I generally associate pain and fear with going to the dentist.	6	13	6	17	6	3	14	0	23	6
The last time I visited the dentist was because I had a tootache.	2	8	1	25	11	0	7	4	24	11
I think I need dental treatment at this time.	4	17	3	14	11	7	9	1	20	8
Lack of funds to pay for dental services limits my child's visits to the dentist.	2	7	1	27	11	1	4	2	28	11
Positive attitudes:										
A person should brush their teeth three times per day.	14	30	3	3	0	8	22	8	9	0

TABLE 32. Frequency of Informant Responses Pertaining to Folk Beliefs Regarding Dental Health

Variable	Frequency	
	High DMF	Low DMF
A woman loses a tooth for every baby she has. (N = 90)		
Strongly Agree	0	0
Agree	0	0
Uncertain	6	6
Disagree	21	24
Strongly Disagree	19	20
Pregnancy causes tooth loss. (N = 96)		
Strongly Agree	0	0
Agree	3	0
Uncertain	6	9
Disagree	20	22
Strongly Disagree	17	19
Toothaches can be caused by strong, cold winds. (N = 92)		
Strongly Agree	0	1
Agree	4	8
Uncertain	8	15
Disagree	15	12
Strongly Disagree	17	12
If a loose baby tooth won't fall out naturally, you should pull it out. (N = 94)		
Strongly Agree	1	1
Agree	12	19
Uncertain	16	9
Disagree	13	14
Strongly Disagree	4	5
Chewing tobacco or placing it directly on a tooth can alleviate a toothache. (N = 97)		
Strongly Agree	0	3
Agree	2	4
Uncertain	15	17
Disagree	18	16
Strongly Disagree	11	10

TABLE 32 (Continued)

Variable	Frequency	
	High DMF	Low DMF
Placing one's tongue in the cavity left by a tooth which has fallen out will prevent another tooth from coming in. (N = 94)		
Strongly Agree	0	0
Agree	1	0
Uncertain	3	3
Disagree	18	23
Strongly Disagree	24	22
Vinegar is bad for healthy teeth but is a good remedy for a tootache. (N = 94)		
Strongly agree	0	0
Agree	0	3
Uncertain	32	28
Disagree	9	10
Strongly Disagree	5	7
Use of home remedies (N = 91)		
Yes	11	4
No	37	39

Chi-Square 2.14 with 1 degree of freedom, significance = .14.

APPENDIX C

COVER LETTER AND MAIL HOME QUESTIONNAIRE

July 13, 1983

Dear parent,

Thank you for your previous participation in the dental health research at the University of Tennessee by completing a questionnaire in Dr. _____ office with reference to your child _____. Because of cooperation on the part of parents, such as yourself, over 100 questionnaires were available for analysis.

The researcher would like to give you an update on the findings in the study so far. Dental health status in children, as measured by the number of cavities (filled and unfilled) and teeth extracted due to decay, exhibited a great deal of variability in the sample. But very few of the variables derived from the questionnaire could explain the differential health status. One significant association, however, was found between general health and dental health. Children with chronic and/or stress related illnesses had a higher rate of dental decay than their healthy counterparts. The researcher would like to pursue this association further.

Again, your help is needed and greatly appreciated. Enclosed you will find a short, one page (front and back) questionnaire and a stamped self addressed envelope. All you need to do is complete the questionnaire, place it in the envelope and drop it in a mailbox.

With your continued help and cooperation this study may be able to highlight factors which contribute to dental decay in your children. It is important that all the questionnaires are returned so that reliable and accurate results may be obtained.

When completed, a copy of the report will be given to your child's dentist and available for you to read. If you have any questions feel free to contact me at my office 974-4408. Thank you for your cooperation!

Sincerely yours,

Debbie Mc Grath

Please note: Answer all questions with reference to your child named above.

Please circle the appropriate response.

Has this child's parents ever been divorced or separated? YES NO

Does this child make friends easily? YES NO

With regard to personality, how would you classify this child?
OUTGOING TIMID

How would you rate this child's school performance?
EXCELLENT VERY GOOD GOOD FAIR POOR

Has this child ever had any emotional problems? YES NO
If so, explain.

What is the source of your drinking water at home?
FLUORIDATED TAP WELL WATER NON-FLUORIDATED TAP

Has this child ever experienced any of the following: Please place a check mark next to those that are applicable and indicate how long the condition lasted.

Insomnia or sleep disorder

Grinding teeth

Frequent temper tantrums

Withdrawal from friends or family

Stuttering or hesitation in speaking

Stomach ulcers

Allergies or asthma

Loss of a loved one: parent, friend, or pet

Excessive crying

Periods of overeating

Periods of undereating

Bedwetting

Frequent nailbiting

Loss of hair or bald spots

Rejection from friends

Nervous habits or ticks

Frequent or noticeable twisting or pulling hair

Failure to do well in school or make friends

Frequent periods of hyperactivity

Please circle TRUE or FALSE indicating how you feel about each of the following statements.

1.	When people have dental problems there is usually not much they can do about it.	TRUE	FALSE
2.	If you lead a good life you will rarely have dental problems.	TRUE	FALSE
3.	Almost all dental diseases have a cure.	TRUE	FALSE
4.	If the Lord wants to send you dental problems there is nothing you can do to stop it.	TRUE	FALSE
5.	Some people seem to get cavities while others do not.	TRUE	FALSE
6.	Most dental problems will be cured in a matter of time regardless of which treatments are used.	TRUE	FALSE
7.	People who don't have cavities are just lucky.	TRUE	FALSE
8.	If you have dental problems it is because you live under alot of pressure	TRUE	FALSE
9.	In the future, modern science will find a cure for all dental problems.	TRUE	FALSE
10.	Most people get cavities because they worry too much.	TRUE	FALSE
11.	When people eat right and take care of their bodies they seldom get cavities.	TRUE	FALSE
12.	When people suffer from oral disease, it is ultimately up to God whether or not they will get well.	TRUE	FALSE
13.	There is no use worrying about cavities or gum disease, what will be will be.	TRUE	FALSE
14.	When people get cavities it is usually a result of fate or bad luck.	TRUE	FALSE
15.	Most dental diseases can be cured by a good dentist with the right medicine.	TRUE	FALSE

APPENDIX D

RESULTS OF MAIL HOME QUESTIONNAIRE

TABLE 33. Crosstabulations of DMF with Variables Related to Parents' Marital Status, Child's Personality, and School Performance

Variable	Frequency	
	High DMF	Low DMF
Have the child's parents ever been divorced or separated? (N = 35)		
Yes	5	2
No	14	14
Chi-Square = 1.04 with 1 degree of freedom, significance = .31		
Does the child make friends easily? (N = 35)		
Yes	17	15
No	2	1
Chi-Square = .20 with 1 degree of freedom, significance = .65		
Child's personality (N = 33)		
Outgoing	14	12
Timid	5	2
Chi-Square = 0.70 with 1 degree of freedom, significance = .43		
Child's school performance (N = 33)		
Excellent	5	4
Very good	7	9
Good	4	0
Poor	2	2
Chi-Square = 4.1 with 3 degrees of freedom, significance = .25		
Has the child ever had any emotional problems? (N = 35)		
Yes	0	1
No	19	15
Chi-Square = 1.22 with 1 degree of freedom, significance = .27		
Source of drinking water (N = 26)		
Fluoridated tap water	13	10
Nonfluoridated tap water	0	1
Well water	2	0
Chi-Square = 2.84 with 2 degrees of freedom, significance = .24		

TABLE 34. Frequency of Informant Responses Regarding the Presence or Absence of Stress Indicators in Children

Variable	Frequency	
	High DMF	Low DMF
Insomnia or sleep disorders?		
Yes	1	0
No	15	15
Grinding teeth?		
Yes	3	2
No	13	13
Frequent temper tantrums?		
Yes	1	3
No	15	12
Withdrawal from friends or family?		
Yes	2	1
No	14	14
Stuttering or hesitation in speaking?		
Yes	2	1
No	14	14
Stomach ulcers?		
Yes	2	0
No	14	15
Allergies or asthma?		
Yes	10	2
No	6	13
Loss of loved one: parent, friend, or pet?		
Yes	9	5
No	7	10
Excessive crying?		
Yes	3	1
No	13	14
Periods of overeating?		
Yes	2	2
No	14	13

TABLE 34 (Continued)

Variable	Frequency	
	High DMF	Low DMF
Periods of undereating?		
Yes	2	2
No	14	13
Bedwetting?		
Yes	2	4
No	11	14
Frequent nailbiting?		
Yes	2	4
No	14	11
Loss of hair or baldspots?		
Yes	0	0
No	16	15
Rejection from friends?		
Yes	3	0
No	13	15
Nervous habits or ticks?		
Yes	2	2
No	14	13
Pulling or twisting of hair?		
Yes	2	1
No	14	14
Failure to do well in school or make friends?		
Yes	2	1
No	14	14
Hyperactivity?		
Yes	1	2
No	15	13

TABLE 34 (Continued)

Variable	Frequency	
	High DMF	Low DMF
Total number of stress indicators		
0	3	6
1	4	5
2	4	0
3	2	3
4	2	0
5	1	0
6	0	1
7	1	1
8	0	0
9	1	0
10	1	0

TABLE 35. Frequency of True and False Responses Regarding Statements Reflecting Orientations Toward Dental Health

Variable	Frequency	
	High DMF	Low DMF
When people have dental problems, there is usually not much they can do about it. (curative, external)		
True	0	0
False	16	15
If you lead a good life, you will rarely have dental problems. (preventive, internal)		
True	2	1
False	14	14
Almost all dental disease have a cure. (curative, internal)		
True	15	14
False	1	1
If the Lord wants to send you dental problems, there is nothing you can do to stop it. (preventive, external)		
True	2	1
False	14	14
Some people seem to get cavities while others do not. (preventive, external)		
True	16	14
False	0	1
Most dental problems will be cured in a matter of time regardless of which treatments are used. (curative, external)		
True	4	3
False	12	12
People who don't have cavities are just lucky. (preventive, external)		
True	2	2
False	14	13

TABLE 35 (Continued)

Variable	Frequency	
	High DMF	Low DMF
If you have dental problems, it is because you live under alot of pressure. (preventive, external)		
True	1	0
False	15	15
In the future, modern science will find a cure for all dental problems. (curative, internal)		
True	13	13
False	3	2
Most people get cavities because they worry too much. (preventive, external)		
True	1	0
False	15	15
When people eat right and take care of their bodies, they seldom get cavities. (preventive, external)		
True	7	9
False	9	6
When people suffer from oral disease, it is ultimately up to God whether or not they will get well. (curative, external)		
True	2	1
False	14	14
There is no use worrying about cavities or gum disease; what will be, will be. (preventive, external)		
True	1	0
False	15	15
When people get cavities, it is usually a result of fate or bad luck. (preventive, external)		
True	1	0
False	15	15

TABLE 35 (Continued)

Variable	Frequency	
	High DMF	Low DMF
Most dental diseases can be cured by a good dentist with the right medicine. (curative, internal)		
True	13	13
False	3	2

VITA

Deborah Marie Mc Grath was born in Staten Island, New York on October 10, 1958. She attended schools in New York and Pennsylvania and graduated from Conestoga High School in Berwyn, Pennsylvania in June 1976. Deborah received a Bachelor of Arts degree in Anthropology from Syracuse University in May 1980.

In September 1980, Ms. Mc Grath entered The University of Tennessee, Knoxville and received a Master of Arts degree with a major in Anthropology in December 1983. During this time, she held a Teaching Assistantship in cultural anthropology, was a laboratory assistant for classes in physical anthropology, and worked for various archeological projects.

The author was a member of the Anthropology Honor Society at Syracuse University from 1979-1980 and the American Anthropological Association in 1982.