VITAL and HEALTH STATISTICS

DATA FROM THE NATIONAL HEALTH SURVEY

Total Loss of Teeth

in Adults

United States - 1960 - 1962

Estimates of the prevalence of edentulous persons by age, sex, race, and various other demographic characteristics.

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In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

CONTENTS

IN THIS REPORT are presented national estimates of the number of adults who have lost all of their permanent teeth. The prevalence of edentulous persons is described by age, sex, race, and various other demographic characteristics. In addition, estimates are included of the number of edentulous persons who have satisfactory artificial teeth and in a concluding section tentative estimates are offered of the number of persons with seriously failing natural teeth.

The estimates are based on examinations conducted by the Health Examination Survey during 1960-62 on a probability sample of U.S. adults aged 18-79 years selected from the civilian population at large.

An estimated 20.1 million men and women—18 out of every 100—had lost all of their permanent teeth from both of their jaws. The proportion of toothless persons increased rapidly with advancing age, rising from about 1 in 100 among the youngest men and women to as many as 1 in every 2 among those who were 65 years of age or older. Within any given age group, relatively more women than men were edentulous and relatively more white than Negro adults.

The prevalence of men and women who had no natural teeth became progressively lower with rising levels of education and family income. Among people with the same income or education, relatively more women than men were edentulous and relatively more white than Negro men and women.

The prevalence of total tooth loss in three broad regions of the country did not vary significantly. Edentulous persons were proportionately more numerous in less densely populated places, however, than they were in denser ones.

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TOTAL LOSS OF TEETH IN ADULTS

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INTRODUCTION

Estimates of the prevalence and distribution of edentulous persons—men and women who have lost all of their natural teeth—are in essence statistical summaries reflecting both the amount and extent of dental disease and the failure to obtain prompt and adequate dental care. Tooth decay and periodontal disease—a degenerative process which affects the structures that support the teeth— are, without question, the two leading causes of tooth loss. It is also true that both disorders are extremely prevalent throughout the United States. When treatment is not delayed too long, however, either can usually be arrested by the skills and methods commanded by most dentists. Failing that, tooth removal is a harsh but inescapable consequence which culminates for many men and women in the loss of all natural teeth.

The first estimates which presented in true perspective the magnitude and extent of total tooth loss throughout the United States were published in 1960.[1] The estimates were based on responses to the following question which was asked during 1957-58 at approximately 36,000 households comprising about 115,000 people: "Is there anyone in the family who has lost all of his teeth?" Responses from the interviewed households indicated that about 22 million people—13 percent of the Nation's population had indeed lost all of their permanent teeth. The existence of significant, nationwide trends associated with various demographic characteristics was also clearly revealed. The

prevalence of total tooth loss which, as expected, mounted rapidly with age was higher among women than among men, higher among white than among Negro adults, and higher among poorer and less educated people than among more advantaged ones. In addition, some variation in prevalence by region appeared in the estimates. No difference in prevalence associated with population density was found.

This present report also contains national estimates of the number and distribution of edentulous adults by age, sex, and race as well as by various other characteristics customarily used to describe large populations. In addition, the number of edentulous men and women by age who use artificial teeth is estimated. Finally, to approximate the prevalence of people who are but one step from losing all of their teeth, estimates are included of the number of men and women whose few remaining teeth and the unsound condition they are in suggest that in all likelihood they, too, will be extracted when appropriate dental care is sought.

The estimates are based on findings from 6,653 men and women who were given the dental examination during 1960-62. By virtue of the statistical principles which determined their selection, the sample adults represented within a known range of probability approximately 111 million men and women—the civilian, noninstitutional population of the United States 18-79 years of age. The selection of sample persons, the content of the dental examination, and the method of deriving national estimates have been described in detail in

previous publications.[2,3] Some of the estimates of edentulous persons by age, race, and sex have appeared in a previous publication.[4]

The mouth and teeth of virtually every adult who participated in the survey were examined by one of five dentists previously trained to obtain their findings by the same orderly procedure. The dentist decided who was edentulous and who was not in a way that was sufficiently straightforward and simple that little if any room was left for appreciable examiner error. When removable dentures were in the mouth, they were always taken out before the examination began to gain as unhindered a view as possible of the teeth they abutted and of the tissue they covered. Incidentally, removable dentures include those which were constructed to replace all of the teeth in either jaw as well as those intended to replace only some of them.

Persons who had neither any upper nor any lower teeth that could actually be seen were edentulous by definition even though some of them doubtless had teeth which had never erupted. A relatively small number of others had either erupting teeth or root remnants but no fully erupted teeth; they, too, were arbitrarily included in the edentulous group if they used full dentures.

Every denture worn or carried to the dental examination was designated as either satisfactory or defective. Defective dentures were defined as those that were not being used for whatever reason as well as those that were being used despite the extensive injury they had caused to the primary stress-bearing areas of the ridges or palate. The tissue in these sites may have been acutely inflamed, resorption of underlying bone may have occurred, and hypertrophied tissue may have been present. Any denture which was being used without incurring serious injury was considered satisfactory.

FINDINGS

Age and Sex

In the adult population at large, an estimated 20.1 million people—18 out of every 100—had lost all of their natural teeth from both of their jaws. Loss of teeth had occurred more frequently among women, however, than among men, result-

ing in a significantly higher percent of edentulous women—19.7 compared with 16.5 for men. The proportion of edentulous women also exceeded the proportion of edentulous men within each of the various age ranges listed in table 1.

The relative number of toothless persons increased rapidly with advancing age, rising from as few as 1 in 100 among the youngest men and women to approximately 1 in 5 among those who were 45-54 years of age. Among those who were 65 years or older, as many as one in every two had lost all of his or her teeth. The strong trend with age reflects the excessive tooth loss which
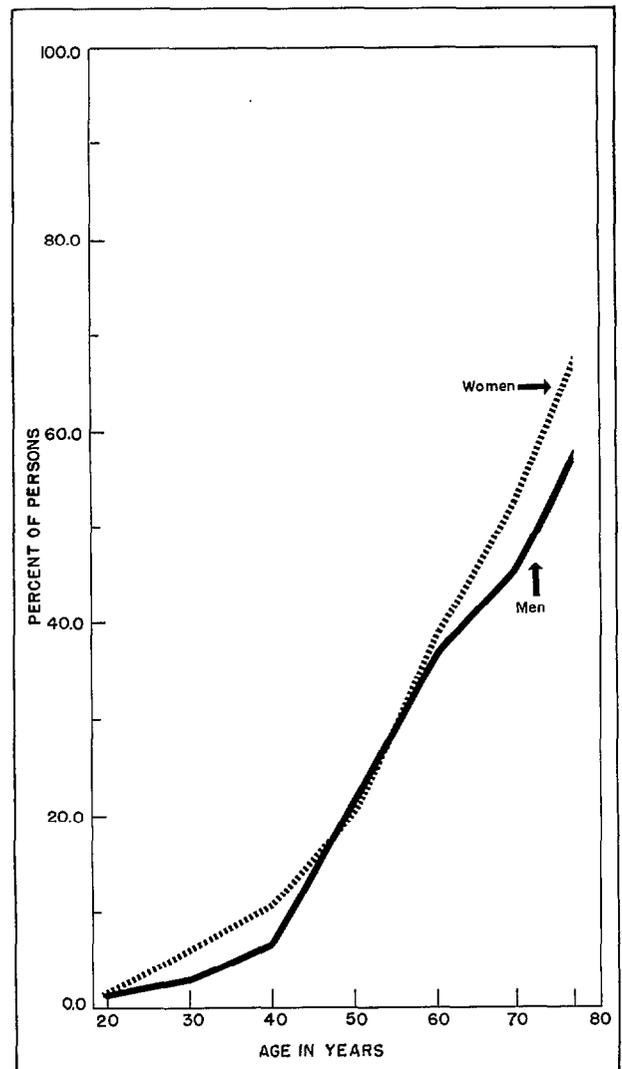

Figure 1. Prevalence rates of edentulous white persons, by sex and age.

inevitably occurs whenever dental disease is extremely common and negligence in seeking periodic care is persistently widespread.

Race

The estimates in table 1 and figures 1 and 2 show the relative frequency of toothless persons in both white and Negro populations. The percent of Negro men and women who were edentulous was 11.4 or only about two-thirds as large as the percent of edentulous white adults (19.2). In every **age group except two there were proportionately**

Figure 3. Prevalence rates of edentulous men, by race and age.

fewer edentulous men and women who were Negro than were white (figs. 3 and 4).

The proportion of edentulous people grew steadily and rapidly in both races with increasing years of age. At any given age the difference by race was greater between men, however, than it was between women.

The prevalence of total tooth loss among other racial groups cannot be estimated because of the extremely small number of sample persons who represented them.

Artificial Teeth by Sex and Age

Approximately 15.8 million men and women— four out of every five of those who lacked all of their natural teeth—possessed sets of artificial teeth which were adjudged satisfactory by the dentist who evaluated them. The remaining 4.3 million people did not have a complete set or if they did at least one denture was defective to the extent of having seriously injured the oral structures upon which it rested.
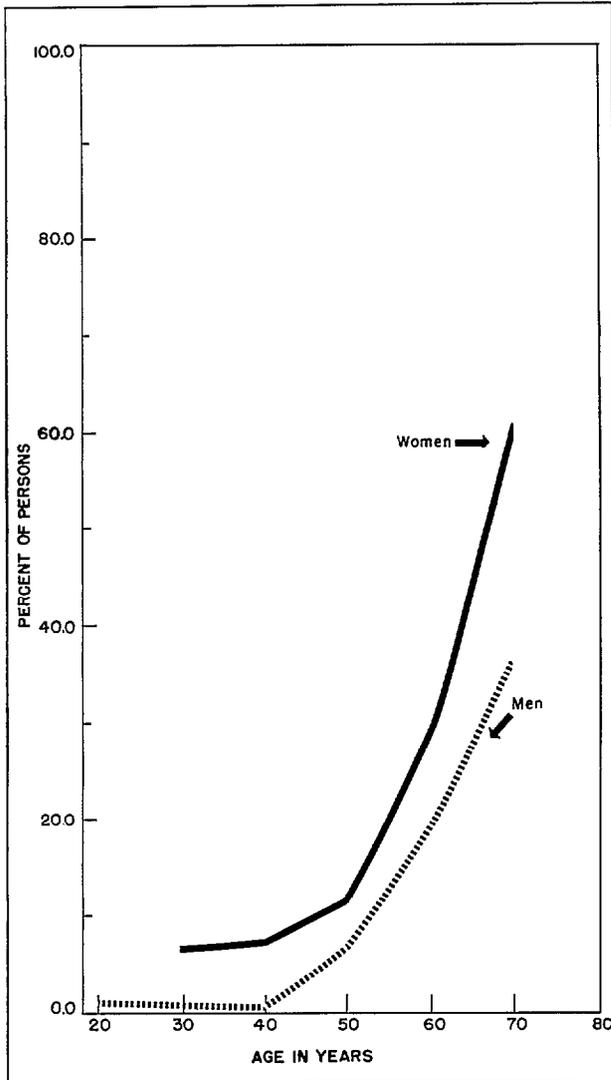

Figure 2. Prevalence rates of edentulous Negro persons, by sex and age.

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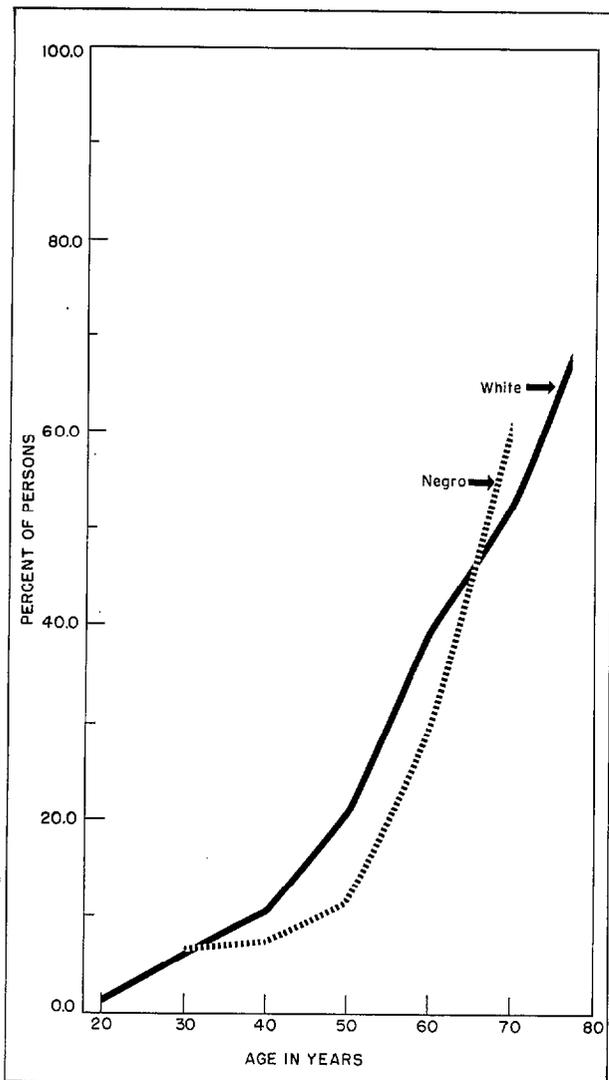
Figure 4. Prevalence rates of edentulous women, by race and age.

more likely than older ones to have satisfactory dentures; by contrast, both young and older women were about equally likely to have them.

OTHER DEMOGRAPHIC VARIABLES

The prevalence of several dental conditions has been found to vary significantly by various levels of education and family income as well as by age, sex, and race. The Health Examination Survey found, for instance, that the presence and severity of periodontal disease in adults was inversely related to rising levels of both education and income.[5] In the remainder of this report edentulous men and women have been classified by specified ranges of education and family income and by specified place of residence.

After the edentulous population was grouped, any differences which occurred in the rate of toothless persons among the various groups were examined. For example, the rates of edentulous persons among white and Negro adults whose family income was within one of five different income ranges were examined to determine whether the frequency of total tooth loss was significantly

The distribution by age of edentulous men and women whose natural teeth were satisfactorily replaced by artificial ones is shown in table 2 and figure 5. Owing to the relatively small number of sample persons, estimates for men and women under 35 and over 74 years of age were not sufficiently reliable to be included.

Proportionately more edentulous women than men had satisfactory artificial teeth—83.5 percent compared with 71.8 percent. The same trend by sex prevailed within three of the four age groups for which sufficiently reliable estimates were obtained. Interestingly, young men were

Figure 5. Percent of edentulous men and women with satisfactory dentures, by age.

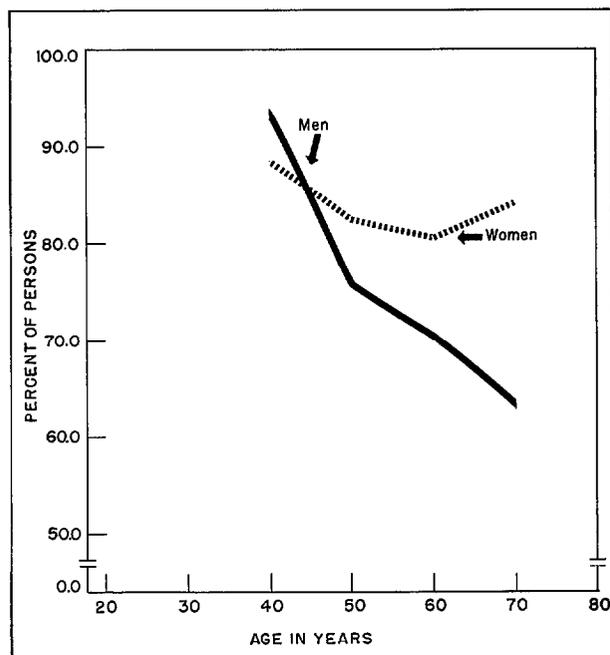higher in one group than it was in others. Allowance was made for differences in the age and sex distribution of people composing the various groups because the frequency of total tooth loss has already been shown to differ significantly by age and sex.

Expected rates were calculated by weighting the age- and sex-specific mean number of edentulous people in the total U.S. population by the age-sex distribution of respective groups. Actual and expected values may occasionally be expected to differ by chance. But when the difference is not statistically significant, it can generally be assumed that differences in the rates of edentulous persons among the component age-sex groups fluctuated randomly.

Because of the relatively limited number of sample persons, sampling variability for specific age and sex groupings was usually quite large. It is for this reason that summary comparisons of actual and expected rates were preferred to a comparison of age-specific rates.

Income and Education

Men and women whose family income was relatively low tended to lose all of their teeth earlier than did those whose families achieved higher earnings. The strong inverse relationship between total tooth loss and size of family income can be readily traced in table 3. Among women of all races, for example, the number who were edentulous per 100 population declined in successive steps from 33 among those with the smallest family incomes—under $2,000 yearly—to only about a third as many among those whose yearly earnings surpassed $9,999.

Closely associated with family income, total tooth loss was also highly correlated with the educational levels attained by men and women. The number of edentulous individuals per 100 women of all races was about 38 among those whose formal schooling had not continued beyond the fifth grade (table 4). Among those who had successfully completed 1 year of college or more the corresponding number was only nine. The rate thus fell a total of 29 per 100 women in ranging from the bottom to the topmost educational group.

Expected (age-adjusted) rates are also contained in tables 3 and 4. Differences between actual and expected estimates continue to reflect a significant inverse relationship between loss of teeth and increasing levels of income and education (figs. 6 and 7). This demonstrates statistically that the trends encountered in the population at large did not arise, as they conceivably might have, from a diminishing proportion of older persons within each higher level of income and education.

The trend associated with both income and education was more pronounced among women than among men and among white adults as compared with Negro adults. Again, owing to the relatively small number of sample persons, reliable estimates for Negro men and women were not obtained at several levels of income and education.

It will also be noted in tables 3 and 4 that trends by sex were not erased by controlling for differences in education and family income. Within most of the tabulated levels of income and education, proportionately more women than men were edentulous.

Race by Income and Education

Estimates of the prevalence of white and Negro men and women who lacked all of their natural teeth are shown in table 5 by various levels of education and family income. Within any given level the rate (adjusted to the age distribution of the Negro population) prevailing among white adults is still substantially greater than that among Negro adults, indicating that the variation observed by race did not stem from an underlying difference in either income or education. Because proportionately few Negro adults had family incomes exceeding $6,999 per year or education beyond high school, prevalence rates could not meaningfully be compared at these levels.

Place of Residence

Estimates of the prevalence of edentulous men and women residing in three broad, specially defined regions of the country were as follows:

	Men	Women
Northeast	16.1	19.8
South	14.6	18.6
West	18.1	20.5
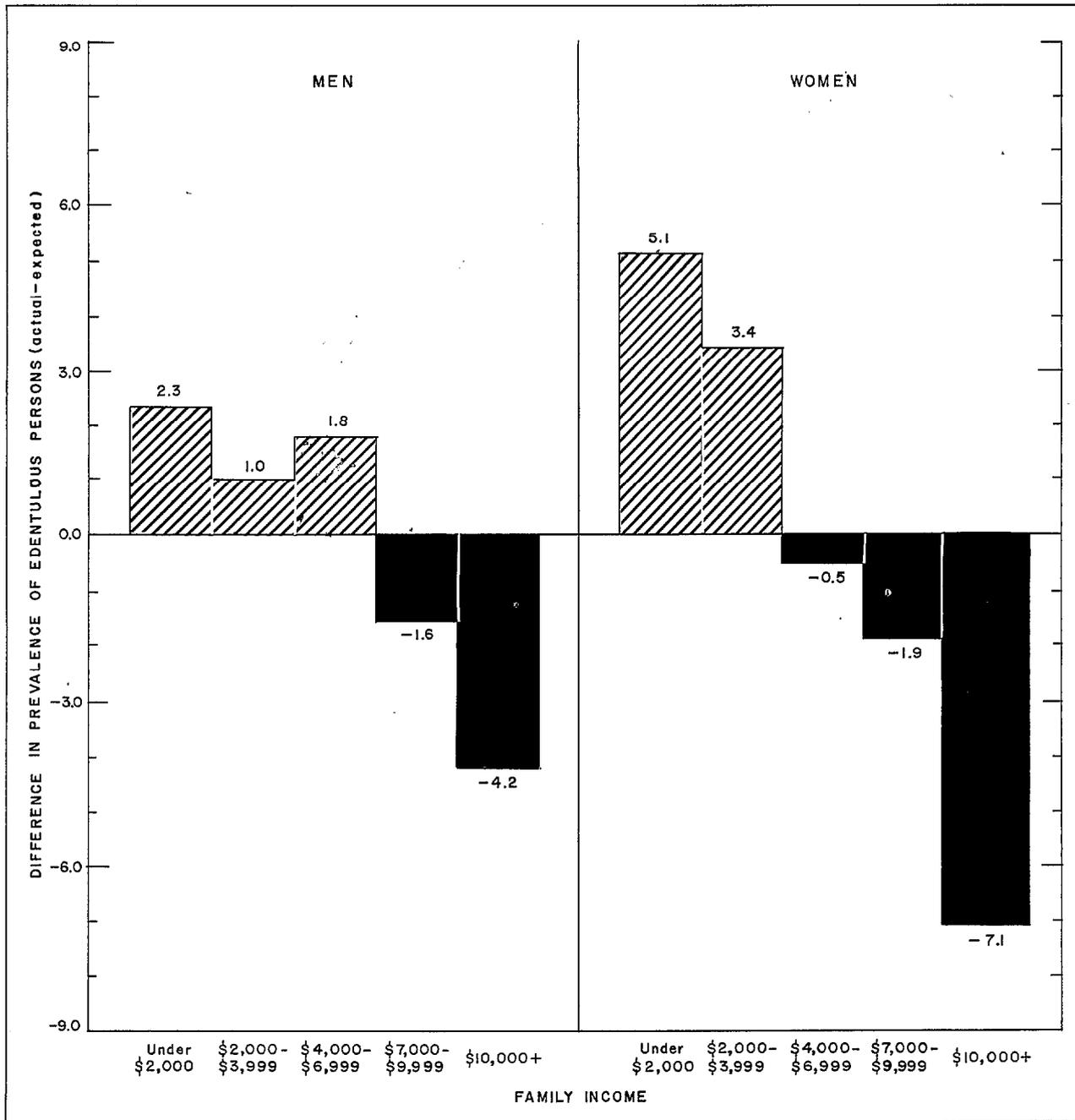
Figure 6.   Differences between actual and expected prevalences of edentulous men and women, by family
income.

Proportionately more men and women who lived in the West and proportionately fewer of those living in the South were without any of their natural teeth. However, differences between actual and expected rates for men and women of all races as well as for white and Negro men and women (table 6) were not statistically significant. In short, the regional estimates do not conclusively indicate that men and women of the same age and race were either more or less likely to lose their teeth
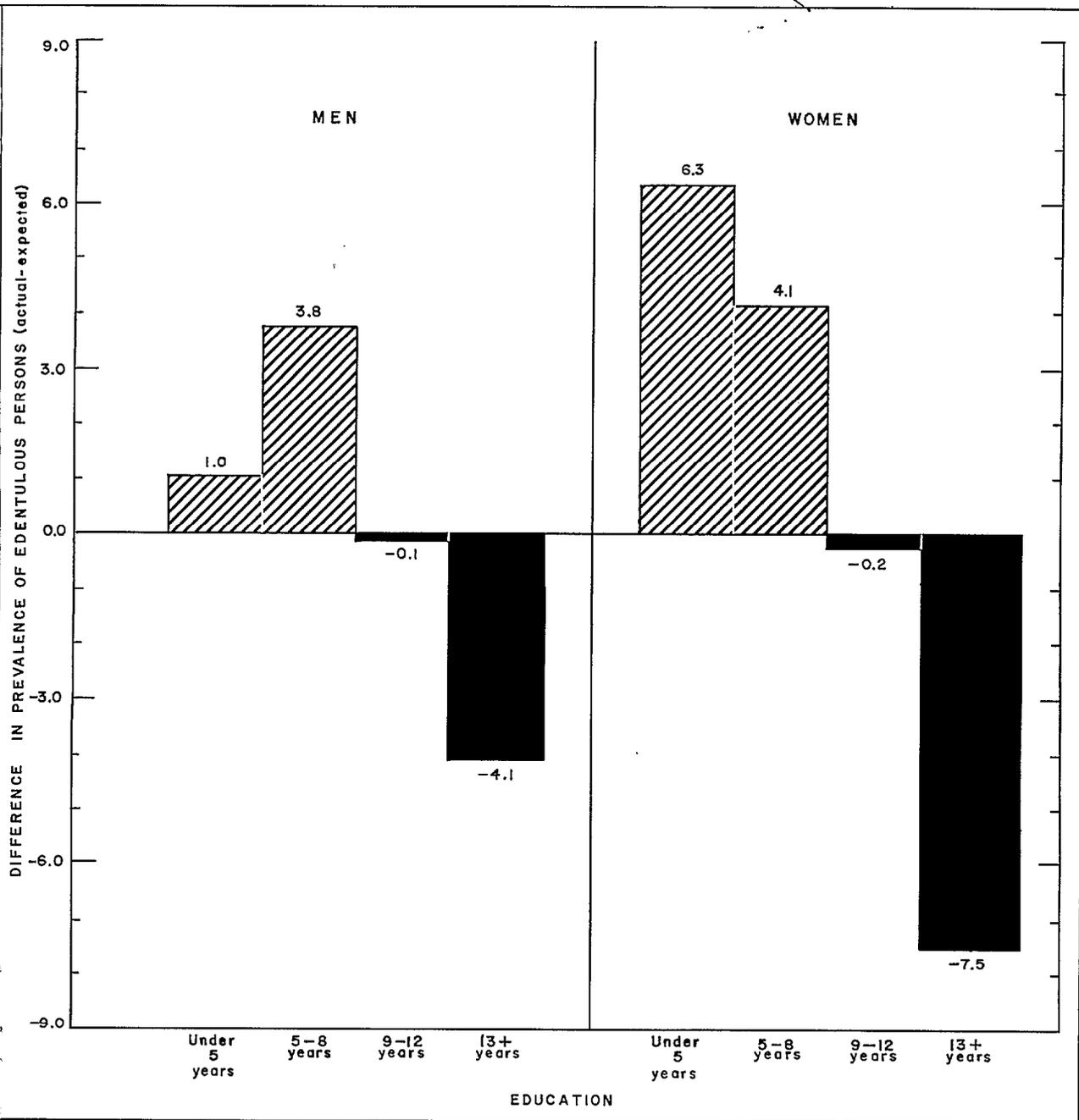
Figure 7. Differences between actual and expected prevalences of edentulous men and women, by education.

f they resided in one broad region of the country rather than in another.

Estimates of the prevalence of edentulous persons were also obtained by place description, population size, and urban-rural residence (tables 7-9). A trend associated with population density is apparent among white men and women in the contents of all three tables. The estimates indicate that, in general, relatively fewer of the men and women who live in more densely inhabited places

had lost all of their teeth than had those who live in less densely populated areas. The trend, like those by income and education, was more pronounced among women than among men. There was no trend by population density among Negro men and women.

People With Failing Natural Teeth

Compared with cancer, stroke, and other dread diseases which frequently kill or cripple for life, most dental disorders seem if not inconsequential at least relatively innocuous. Many people, it is true, are driven to the dentist by pain from an abscessed tooth or by fear of a spreading infection. It is no secret, however, that most of the services rendered by dentists are optional in the sense that they are rarely lifesaving.

It is this so-called optional reputation of dental care that makes it particularly difficult to foretell which people are about to lose their remaining teeth or even to ascertain who among them should have their teeth extracted. Men and women whose livelihood depends to an important extent on personal appearance perceive their need for dental care quite differently than do many others. Owing to the large variety of processed foods that are widely available, teeth (either natural or artificial ones) are no longer as necessary for adequate nutrition as they once were. In brief, the troublesome problem of determining at exactly what point someone's remaining teeth must or should be extracted has no ready answer. In actual life the decision more often than not is an uneasy compromise between, on the one hand, how many and which teeth are present as well as their condition, and, on the other, one's attitude toward dental care and financial position or station in life.

In this concluding section tentative estimates are offered of the number of men and women whose remaining teeth would probably be removed if every obstacle to obtaining dental care could be successfully set aside. A decision to extract someone's remaining teeth or not to extract them was arrived at through specified requirements which were uniformly applied to everyone who was not already edentulous. The standards were but some of the many that might have been reason-

ably stipulated because, after all, any particular set could hardly be stubbornly defended as anything but tentative. One important reason, however, for using the ones that were chosen is the conviction that they yielded conservative estimates of the number of men and women who in actual fact will shortly become edentulous.

The point of departure for the estimation was the assumption that anyone who had eight lower teeth or more (excluding third molars) that were missing and either unreplaced or unsatisfactorily replaced had too few to enable adequate function. It naturally followed that the many missing teeth among them ought to be restored by either partial or full dentures. Subsequent requirements were uniformly imposed to determine in a systematic way which alternative seemed the likelier one. Specifically, if at least one of the teeth that are almost invariably needed to support and retain partial dentures—cuspids, bicuspids, first and second molars—was present in each lower quadrant, and provided it was free of advanced periodontal disease, the remaining functional teeth were not to be extracted. When the required teeth were not present, extraction of all remaining natural teeth was deemed to be the more expedient prescription. Teeth in the upper jaw were not taken into account because only under exceptional circumstances should a full lower denture be opposed by natural teeth.

Approximately 2.8 million people were estimated to have natural teeth sufficiently wanting in number and soundness that they failed to meet the above standards. The proportion of persons among them tended to become increasingly larger with advancing age; in addition, relatively more were male than female and relatively more were Negro than white (table 10). It will be noted in table 11 that they also included a disproportionately large percent of people whose family income totaled less than $2,000 yearly.

But regardless of whether these are in truth the adults who will become edentulous in the near future, they must nevertheless include many of the people with natural teeth whose dental problems are in urgent need of remedy. Moreover, multiple attacks by dental disease and habitual neglect of dental health have already made them not too unlike the edentulous population. If they are typical of the people who still have natural

teeth only because they have postponed care, their composition throws some light on a possible explanation of at least part of the difference in the prevalence of edentulous persons by sex and race. It was pointed out that people with seriously failing natural teeth include proportionately more men than women and more Negro than white adults. In the edentulous population, however, opposite trends prevailed by sex and race. The reversal of trends from one group to the other suggests that among people who are on the verge of losing their remaining natural teeth women are more apt than men and white adults are more apt than Negro adults to seek the comparative gain in function and appearance that can at some point often be provided by full dentures.

SUMMARY

An estimated 20.1 million Americans—18 in every 100—had no permanent teeth in either of their jaws. Women were more likely to have lost all of their teeth than were men, with 19.7 percent of the former edentulous but only 16.5 percent of the latter.

The estimates are based on examinations conducted during 1960-62 on a probability sample of U.S. adults selected from the civilian, noninstitutional population 18-79 years of age.

A large difference was found to exist between the relative number of white and Negro adults who had become edentulous. While 11.4 percent of the Negro population had lost all of their natural teeth, nearly twice as many (19.2) white adults had lost all of theirs. Among men and women of all races, the proportion of toothless persons mounted rapidly with age, rising from only about 1 in 100 among those 18-24 years of age to 1 in every 2 among those 65-79 years old.

Approximately 15.8 million people, or about four in five of those who lacked all natural teeth, possessed satisfactory sets of artificial dentures. The 4.3 million people who did not have satisfactory sets comprised 16.5 percent of all edentulous women and 28.2 percent of all edentulous men.

The prevalence of men and women without natural teeth was inversely related to rising levels of education and family income. Among people with equivalent levels of education and family income, edentulous persons were relatively more numerous among women than among men and among white men and women compared with Negro men and women.

No significant difference was found in the prevalence of toothless people in three broad regions of the country. Men and women who lived in more densely populated places, however, were more likely to have natural teeth than were those who resided in less dense areas.

Among the people who still had some of their natural teeth, an estimated 2.8 million had teeth sufficiently wanting in number and soundness that they would perhaps be extracted if appropriate dental care were sought. Like the edentulous population, relatively more in this group were older than younger and relatively many had family incomes which did not exceed $2,000 yearly. Unlike the edentulous group, however, they included proportionately more men than women and more Negro than white adults. This suggests that among people who are on the verge of becoming edentulous women are more likely than men and white adults are more likely than Negro adults to seek appropriate dental care.

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DETAILED TABLES

Table 1. Prevalence rates of edentulous persons, by race, sex, and age: United States, 1960-62

Sex and age	All races	White	Negro
Both sexes	Rate per 100 adults		
Total, 18-79 years	18.1	19.2	11.4
Men			
Total, 18-79 years	16.5	17.7	7.8
18-24 years	1.3	1.4	1.1
25-34 years	2.7	3.0	-
35-44 years	5.9	6.6	0.6
45-54 years	20.0	21.8	6.8
55-64 years	34.7	37.0	19.5
65-74 years	45.1	45.8	36.3
75-79 years	55.7	57.5	*
Women			
Total, 18-79 years	19.7	20.6	14.3
18-24 years	1.4	1.6	-
25-34 years	6.1	6.2	6.6
35-44 years	10.1	10.6	7.3
45-54 years	20.1	20.9	11.4
55-64 years	38.0	39.1	29.1
65-74 years	53.0	52.8	60.7
75-79 years	65.6	67.9	*

Table 2. Prevalence rates of edentulous persons with satisfactory, defective, or incomplete dentures, by sex and age: United States, 1960-62

Age	Both sexes			Men			Women		
	Satis-factory	Defec-tive	In-com-plete	Satis-factory	Defec-tive	In-com-plete	Satis-factory	Defec-tive	In-com-plete
	Rate per 100 adults								
Total, 35-74 years	78.4	5.5	16.1	71.8	6.2	22.0	83.5	4.9	11.6
35-44 years	90.5	1.7	7.9	93.6	-	6.4	88.7	2.6	8.7
45-54 years	79.4	6.6	14.1	76.0	8.4	15.6	82.6	4.9	12.6
55-64 years	76.0	6.8	17.2	70.3	8.1	21.6	80.7	5.8	13.5
65-74 years	75.9	4.6	18.5	63.1	4.0	32.9	84.6	5.1	10.3

Table 3. Actual and expected prevalence rates of edentulous persons, by sex, race, and family income: United States, 1960-62

Race and family income	Men			Women		
	Actual	Ex-pected	Differ-ence	Actual	Ex-pected	Differ-ence
All races	Rate per 100 adults					
Under $2,000-------------------------------------	28.5	26.2	2.3	33.0	27.9	5.1
$2,000-$3,999-----------------------------------	19.9	18.9	1.0	23.9	20.5	3.4
$4,000-$6,999-----------------------------------	15.0	13.2	1.8	15.0	15.5	-0.5
$7,000-$9,999-----------------------------------	10.6	12.2	-1.6	14.4	16.3	-1.9
$10,000 and over--------------------------------	11.5	15.7	-4.2	10.8	17.9	-7.1
Unknown---	15.4	17.8	-2.4	21.7	23.3	-1.6
White						
Under $2,000-------------------------------------	37.1	31.2	5.9	40.5	32.1	8.4
$2,000-$3,999-----------------------------------	23.0	20.9	2.1	26.4	22.3	4.1
$4,000-$6,999-----------------------------------	15.6	14.2	1.4	15.1	16.0	-0.9
$7,000-$9,999-----------------------------------	10.8	13.4	-2.6	14.2	16.9	-2.7
$10,000 and over--------------------------------	11.8	17.1	-5.3	11.0	18.7	-7.7
Unknown---	17.1	19.1	-2.0	23.6	24.5	-0.9
Negro						
Under $2,000-------------------------------------	9.5	10.3	-0.8	17.9	17.4	0.5
$2,000-$3,999-----------------------------------	7.6	7.4	0.2	9.5	10.3	-0.8
$4,000-$6,999-----------------------------------	8.9	5.2	3.7	12.4	13.1	-0.7

NOTE: Where categories are not listed for a specific race-sex group, the sample size was too small for reliable estimates to be presented.

Table 4. Actual and expected prevalence rates of edentulous persons, by sex, race, and education: United States, 1960-62

Race and education	Men			Women		
	Actual	Ex-pected	Differ-ence	Actual	Ex-pected	Differ-ence
All races	Rate per 100 adults					
Under 5 years----------------------------------	29.8	28.8	1.0	38.4	32.1	6.3
5-8 years--------------------------------------	28.0	24.2	3.8	31.6	27.5	4.1
9-12 years-------------------------------------	11.5	11.6	-0.1	14.7	14.9	-0.2
13 years and over------------------------------	7.8	11.9	-4.1	9.0	16.5	-7.5
Unknown--	21.3	27.3	-6.0	36.1	37.8	-1.7
White						
Under 5 years----------------------------------	40.2	33.7	6.5	45.1	35.1	10.0
5-8 years--------------------------------------	31.6	26.8	4.8	34.4	29.3	5.1
9-12 years-------------------------------------	12.3	12.9	-0.6	15.6	16.0	-0.4
13 years and over------------------------------	7.9	12.7	-4.8	9.2	17.4	-8.2
Unknown--	25.2	31.3	-6.1	40.5	39.0	1.5
Negro						
Under 5 years----------------------------------	15.3	14.9	0.4	34.3	27.0	7.3
5-8 years--------------------------------------	8.0	9.1	-1.1	18.3	18.7	-0.4
9-12 years-------------------------------------	4.3	2.7	1.6	6.0	7.0	-1.0

NOTE: Where categories are not listed for a specific race-sex group, the sample size was too small for reliable estimates to be presented.

Table 5. Prevalence rates of edentulous white and Negro men and women, by family income and education: United States, 1960-62

Family income and education	Men		Women	
	White[1]	Negro	White[1]	Negro
Family income	Rate per 100 adults			
Under $2,000	25.4	9.5	32.3	17.9
$2,000-$3,999	18.6	7.6	16.6	9.5
$4,000-$6,999	14.8	8.9	14.9	12.4
Education				
Under 5 years	32.3	15.3	41.4	34.3
5-8 years	23.3	8.0	27.6	18.3
9-12 years	10.3	4.3	9.7	6.0

[1]Value for white population adjusted to be comparable with value for Negro population computation explained in Appendix I.

Table 6. Actual and expected prevalence rates of edentulous persons, by sex, race, and geographic region: United States, 1960-62

Race and region	Men			Women		
	Actual	Ex-pected	Differ-ence	Actual	Ex-pected	Differ-ence
All races	Rate per 100 adults					
Northeast	16.1	16.1	0.0	19.8	20.0	-0.2
South	14.6	15.6	-1.0	18.6	18.5	0.1
West	18.1	17.4	0.7	20.5	20.3	0.2
White						
Northeast	16.5	17.2	-0.7	20.4	20.9	-0.5
South	16.8	16.5	0.3	19.3	19.0	0.3
West	19.5	18.9	0.6	21.8	21.5	0.3
Negro						
Northeast	11.7	7.6	4.1	12.4	12.8	-0.4
South	6.4	8.6	-2.2	15.4	15.5	-0.1
West	7.2	6.2	1.0	13.8	12.8	1.0

Table 7. Actual and expected prevalence rates of edentulous persons, by sex, race, and place description: United States, 1960-62

Race and place description	Men			Women		
	Actual	Ex-pected	Differ-ence	Actual	Ex-pected	Differ-ence
All races	Rate per 100 adults					
SMSA-in central city----------------------------	16.6	17.8	-1.2	18.1	20.5	-2.4
SMSA-outside central city----------------------	13.4	14.5	-1.1	17.0	18.7	-1.7
Urban-not SMSA--------------------------------	15.5	15.1	0.4	23.6	18.6	5.0
Rural farm------------------------------------	24.3	20.5	3.8	25.0	20.0	5.0
Rural nonfarm--------------------------------	19.7	17.3	2.4	22.7	20.6	2.1
White						
SMSA-in central city----------------------------	18.4	19.5	-1.1	18.8	22.0	-3.2
SMSA-outside central city----------------------	13.8	15.7	-1.9	17.4	19.4	-2.0
Urban-not SMSA--------------------------------	15.9	15.4	0.5	24.6	19.3	5.3
Rural farm------------------------------------	28.1	23.5	4.6	29.6	22.2	7.4
Rural nonfarm--------------------------------	23.0	18.9	4.1	24.9	21.3	3.6
Negro						
SMSA-in central city----------------------------	8.7	7.7	1.0	14.3	13.6	0.7
SMSA-outside central city----------------------	2.7	4.3	-1.6	6.0	10.6	-4.6
Urban-not SMSA--------------------------------	11.5	11.5	0.0	15.3	15.2	0.1
Rural farm------------------------------------	8.1	6.2	1.9	16.2	13.2	3.0
Rural nonfarm--------------------------------	6.4	8.2	-1.8	16.9	18.1	-1.2

Table 8. Actual and expected prevalence rates of edentulous persons, by sex, race, and population-size group: United States, 1960-62

Race and population-size group	Men			Women		
	Actual	Ex-pected	Differ-ence	Actual	Ex-pected	Differ-ence
All races	Rate per 100 adults					
Giant metropolitan areas-------------------------	13.8	17.1	-3.3	17.4	20.2	-2.8
Other very large metropolitan areas------------	17.0	16.2	0.8	19.6	19.4	0.2
Other standard metropolitan statistical areas--	15.0	15.3	-0.3	16.1	19.3	-3.2
Other urban areas------------------------------	16.2	15.8	0.4	22.1	18.1	4.0
Rural areas------------------------------------	21.4	17.9	3.5	25.0	21.2	3.8
White						
Giant metropolitan areas------------------------	14.7	18.7	-4.0	18.7	21.5	-2.8
Other very large metropolitan areas------------	17.6	17.4	0.2	18.7	20.1	-1.4
Other standard metropolitan statistical areas--	15.7	16.2	-0.5	16.5	19.8	-3.3
Other urban areas------------------------------	17.6	16.4	1.2	23.2	18.7	4.5
Rural areas------------------------------------	24.9	19.9	5.0	28.4	22.5	5.9
Negro						
Giant metropolitan areas------------------------	6.7	5.7	1.0	6.3	11.1	-4.8
Other very large metropolitan areas------------	11.8	6.9	4.9	28.1	14.5	13.6
Other standard metropolitan statistical areas--	6.6	9.4	-2.8	10.0	16.4	-6.4
Other urban areas------------------------------	6.7	9.2	-2.5	14.9	14.1	0.8
Rural areas------------------------------------	8.7	7.8	0.9	16.5	16.3	0.2

Table 9. Actual and expected prevalence rates of edentulous persons, by sex, race, and urban-rural residence: United States, 1960-62

Race and residence	Men			Women		
	Actual	Ex-pected	Differ-ence	Actual	Ex-pected	Differ-ence
All races	Rate per 100 adults					
Urban---	15.3	16.6	-1.3	18.9	20.0	-1.1
Rural---	18.7	16.2	2.5	21.5	19.0	2.5
White						
Urban---	16.2	17.8	-1.6	19.5	21.0	-1.5
Rural---	20.7	17.6	3.1	23.1	19.7	3.4
Negro						
Urban---	8.5	8.1	0.4	14.0	13.7	0.3
Rural---	6.6	7.4	-0.8	15.1	15.7	-0.6

Table 10. Percent of those who should be edentulous, by race, sex, and age: United States, 1960-62

Sex and age	All races	White	Negro
Both sexes			
Total, 18-79 years---	3	2	4
Men			
Total, 18-79 years---	3	3	3
18-24 years---	-	-	-
25-34 years---	1	1	-
35-44 years---	2	2	-
45-54 years---	2	2	5
55-64 years---	8	8	7
65-74 years---	7	7	10
75-79 years---	11	10	19
Women			
Total, 18-79 years---	2	2	4
18-24 years---	-	-	-
25-34 years---	1	-	2
35-44 years---	2	1	4
45-54 years---	3	3	4
55-64 years---	3	2	7
65-74 years---	5	3	10
75-79 years---	8	3	24

Table 11. Percent of white and Negro men and women who should be edentulous, by family income: United States, 1960-62

Race and income	Both sexes	Men	Women
All races			
All incomes	3	3	2
Under $2,000	6	7	5
$2,000-$3,999	3	3	2
$4,000-$6,999	2	3	2
$7,000-$9,999	1	1	1
$10,000 and over	1	1	1
White			
All incomes	2	3	2
Under $2,000	6	9	4
$2,000-$3,999	3	3	2
$4,000-$6,999	2	3	1
$7,000-$9,999	1	1	1
$10,000 and over	1	1	1
Negro			
All incomes	4	3	4
Under $2,000	5	4	6
$2,000-$3,999	3	2	4
$4,000-$6,999	3	4	1

Note: Where categories are not listed for a specific race-sex group, the sample size was too small for reliable estimates to be presented.

APPENDIX I

STATISTICAL NOTES

The Survey Design

The first cycle of the Health Examination Survey employed a highly stratified multistage probability design in which a sample of the civilian, noninstitutional population of the conterminous United States 18-79 years of age was selected. At the first stage, a sample of 42 primary sampling units (PSU's) was drawn from among the 1,900 geographic units into which the United States was divided. Random selection was controlled within regional and size-of-urban-place strata into which the units were classified. As used here a PSU is a standard metropolitan statistical area or one to three contiguous counties. Later stages result in the random selection of clusters of typically about four persons from a neighborhood within the PSU. The total sample included some 7,700 persons in 29 different States. The detailed structure of the design and the conduct of the survey have been described in previous reports.[2,3]

Reliability

The methodological strength of the survey derives especially from its use of scientific probability sampling techniques and highly standardized and closely controlled measurement processes. This does not imply that statistics from the survey are exact or without error. Data from the survey are imperfect for three major reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement processes themselves are inexact even though standardized and controlled.

The first-stage evaluation of the survey was reported in reference 3, which dealt principally with an analysis of the faithfulness with which the sampling design was carried out. This study notes that out of the 7,700 sample persons the 6,672 who were examined—a response rate of over 86 percent—gave evidence that they were a highly representative sample of the

Table I. Standard errors in prevalence rates for edentulous adults, by race, sex, and age: United States, 1960-62

Age	All races		White		Negro	
	Men	Women	Men	Women	Men	Women
	Rate per 100 adults					
18-24 years	0.74	0.40	0.79	0.47	1.21	-
25-34 years	0.70	1.00	0.79	1.19	-	3.17
35-44 years	0.88	1.08	1.05	1.26	0.63	2.17
45-54 years	1.85	1.52	1.82	2.31	3.68	2.18
55-64 years	2.32	2.28	3.13	2.38	6.68	5.78
65-74 years	2.65	2.91	3.95	3.24	3.46	3.07
75-79 years	5.19	5.63	5.96	4.66	4.03	6.82

Table II. Standard errors in prevalence rates for edentulous adults, by selected characteristics, race, and sex: United States, 1960-62

Characteristic	All races		White		Negro	
	Men	Women	Men	Women	Men	Women
Family income	Rate per 100 adults					
Under $2,000---	3.24	2.39	4.35	3.37	1.97	2.01
$2,000-$3,999--	2.01	1.55	2.54	1.70	4.04	3.42
$4,000-$6,999--	1.39	2.55	1.39	1.92	4.84	4.58
$7,000-$9,999--	2.03	1.82	2.12	1.97	*	*
$10,000 and over---	1.91	1.79	2.06	1.97	*	*
Unknown---	2.54	2.50	2.86	2.44	*	*
Education						
Under 5 years---	3.37	3.63	5.19	4.87	2.19	7.03
5-8 years---	1.61	1.76	2.17	2.22	2.42	4.21
9-12 years--	0.80	0.92	1.15	1.29	2.08	1.21
13 years and over---	1.14	1.02	1.18	0.99	*	*
Unknown---	4.88	7.15	6.64	1.44	*	*
Region						
Northeast---	1.33	1.38	1.28	1.49	4.13	4.03
South---	1.42	1.54	2.13	2.05	1.83	1.66
West--	1.34	1.32	1.61	1.53	4.20	5.09
Population-size group						
Giant metropolitan areas--------------------------------------	1.70	1.66	1.94	1.88	3.87	2.35
Other very large metropolitan areas--------------------------	1.89	1.92	2.34	2.16	5.88	3.98
Other standard metropolitan statistical areas-----------	1.07	1.50	1.77	1.74	6.16	5.26
Other urban areas--	1.74	1.80	3.22	2.15	3.00	1.99
Rural areas---	1.73	1.69	2.76	2.60	1.80	2.97
Place description						
SMSA-in central city---	1.75	1.35	1.73	1.71	3.58	2.46
SMSA-outside central city------------------------------------	1.35	1.37	1.30	1.50	3.42	4.56
Urban-not SMSA---	1.77	2.01	1.78	2.39	4.54	4.87
Rural farm---	1.90	2.58	2.84	4.42	3.79	3.51
Rural nonfarm--	1.93	1.81	2.48	2.28	3.46	4.42
Urban-rural residence						
Urban---	1.99	2.49	2.30	2.74	2.89	4.68
Rural---	2.10	2.57	2.41	2.83	2.95	4.81

civilian, noninstitutional population of the United States. Imputation of nonrespondents was accomplished by attributing to nonexamined persons the characteristics of comparable examined persons as described in reference 3. The specific procedure used amounted to inflating the sampling weight for each examined person in order to compensate for sample persons at that stand of the same age-sex group who were not examined.

It is impossible to be certain that the mean number of edentulous persons is the same in the examined and the nonexamined groups. There were 6,672 persons who came in for examination. Of these, 19 did not receive a dental examination.

Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of the measurement techniques.

The probability design of the survey makes possible the calculation of sampling errors. Traditionally the role of the sampling error has been the determination of how imprecise the survey results may be because they come from a sample rather than from the measurement of all elements in the universe.

The estimation of sampling errors for a study of the type of the Health Examination Survey is difficult for at least three reasons: (1) measurement error and "pure" sampling error are confounded in the data—it is not easy to find a procedure which will either completely include both or treat one or the other separately, (2) the survey design and estimation procedure are complex and, accordingly, require computationally involved techniques for the calculation of variances, and (3) from the survey are coming thousands of statistics, many for subclasses of the population for which there are a small number of sample cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error when the number of cases in a cell is small or, even occasionally, when the number of cases is substantial.

Estimates of approximate sampling variability for selected statistics used in this report are presented in tables I and II. These estimates have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample. The method reflects both "pure" sampling variance and a part of the measurement variance.

In accordance with usual practice, the interval estimate for any statistic may be considered the range within one standard error of the tabulated statistic, with 68 percent confidence; or the range within two standard errors of the tabulated statistic, with 95 percent confidence.

Expected Values

In tables 3, 4, and 6-9, the actual number of edentulous persons for each of the selected demographic variables is compared with the expected. The computation of expected rates was done as follows:

> Suppose that in a subgroup the Health Examination Survey estimates that there are N_i persons in the ith age-sex-race group ($i = 1,2,...42$, sum of $N_i = N$).
>
> Suppose the Health Examination Survey estimates that the prevalence rate of edentulous persons for the United States in the ith age-sex-race group is X_i. Then the expected rate of edentulous persons in the subgroup is
>
> $$\frac{1}{N} \sum_i N_i X_i$$

Comparison of an actual value for, say, a region with the expected value for that region is undertaken on the assumption that a meaningful statement can be made which holds in some average way for all persons in the region. This may or may not be true. The specified region may have higher values for younger persons and lower values for older persons than are found in other regions.

In that case, an average comparison will obliterate one or both of these differentials. A similar remark may be made with respect to values computed for all races together, since relationships found in one race may not be found in another. In arriving at the general conclusions expressed in the text an effort was made to consider all the specific data, including data not presented in this report; but it must be recognized that balancing such evidence is a qualitative rather than a quantitative exercise. The standard error of the difference between an actual and expected value may be approximated by the standard error of the actual value (table II).

Adjusted Values

In table 5, the mean number of white persons who are edentulous in a specified income or educational group were adjusted to the distribution of the Negroes in the same group. The adjusted mean score for white persons in the kth sex-income or educational group was computed as follows:

> Let x_{ik} be the estimated rate of edentulous persons for white persons in the sex-income group or sex-educational group k who are in the age group i.
>
> Let n_{ik} be the number of Negro persons in that group.
>
> Let $\hat{X}_k = \dfrac{x_{ik} n_{ik}}{n_k}$ where $\sum_i n_{ik} = n_k$

Small Numbers

In some tables magnitudes are shown for cells for which the sample size is so small that the sampling error may be several times as great as the statistic itself. Obviously in such instances the statistic has no meaning in itself except to indicate that the true quantity is small. Such numbers, if shown, have been included to convey an impression of the overall story of the table.

Tests of Significance

The test of significance for demographic variables determined whether or not the difference between the actual and expected value was greater than 2 times its standard error. For example, for men with incomes of more than $10,000 the actual score was 5.3 lower than the expected and the standard error was 2.06. Since the difference was more than 2 times its standard error, it may be deemed statistically significant.

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APPENDIX II

DEMOGRAPHIC TERMS

Age.—The age recorded for each person is the age at last birthday. Age is recorded in single years.

Race.—Race is recorded as "white," "Negro," or "other." "Other" includes American Indian, Chinese, Japanese, and so forth. Mexican persons are included with "white" unless definitely known to be Indian or of another nonwhite race.

Income of family or unrelated individuals.—Each member of a family is classified according to the total income of the family of which he is a member. Within the household all persons related to each other by blood, marriage, or adoption constitute a family. Unrelated individuals are classified according to their own income.

The income recorded is the total of all income received by members of the family in the 12-month period preceding the week of interview. Income from all sources is included, e.g., wages, salaries, rents from properties, pensions, and help from relatives.

Education.—Each person is classified by education in terms of the highest grade of school completed. Only grades completed in regular schools, where persons are given a formal education, are included. A "regular" school is one which advances a person toward an elementary or high school diploma or a college, university, or professional school degree. Thus, education in vocational, trade, or business schools outside the regular school system is not counted in determining the highest grade of school completed.

Population size.—The five classes comprising this characteristic were derived from the design of the sample, which accomplished a stratification of the primary sampling units by population size in each of three broad geographic locations. Because the survey was started in 1960, the primary sampling units within each of the five population-size classes were necessarily based on populations and definitions of the 1950 census. The name of each selected primary sampling unit within each population-size class and geographic location along with other selected sample data is presented in an earlier report.[3]

The definitions for each of the five population-size classes are as follows:

Giant metropolitan areas.—This class includes primary sampling units defined in the census as standard metropolitan statistical areas (SMSA's) having a population of 3 million persons or more.

Other very large metropolitan areas.—Included in this class are standard metropolitan statistical areas with populations of 500,000 to 3,000,000 as defined by the 1950 census.

Other standard metropolitan statistical areas.—This class includes other SMSA's.

Other urban areas.—This includes primary sampling units which were highly urban in composition but are not defined as SMSA's.

Rural areas.—This includes primary sampling units which were primarily rural in composition according to census definitions.

Region.—For the purpose of classifying the population by geographic area, the United States was divided into three major regions. This division was especially made for the design of the HES sample. The regions and the States included are as follows:

Region	States Included
Northeast	Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Ohio, and Michigan
South	Delaware, Maryland, District of Columbia, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas
West	Washington, Oregon, California, Idaho, Nevada, Montana, Utah, Arizona, Wyoming, Colorado, New Mexico, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, and Indiana

Urban and rural.—For the first six primary sampling units where examinations were conducted, the definition of urban and rural is the same as that used in the 1950 census. These locations are Philadelphia, Pa., Valdosta, Ga., Akron, Ohio, Muskegon, Mich., Chicago, Ill., and Butler, Mo. For the remainder of the sampling units the 1960 census definitions are used.

The change from 1950 to 1960 definitions is of small consequence in the survey since only six locations were affected. The major difference is the designation in 1960 of urban towns in New England and of urban townships in New Jersey and Pennsylvania.

According to the 1960 definition, the urban population comprises all persons living in (a) places of 2,500 inhabitants or more incorporated as cities, boroughs, villages, and towns (except towns in New England, New York, and Wisconsin); (b) the densely settled urban fringe, whether incorporated or unincorporated, of urbanized areas; (c) towns in New England and townships in New Jersey and Pennsylvania which contain no incorporated municipalities as subdivisions and have either 25,000 inhabitants or more or a population of 2,500-25,000 and a density of 1,500 persons or more per square mile; (d) counties in States other than the New England States, New Jersey, and Pennsylvania that have no incorporated municipalities within their boundaries and have a density of 1,500 persons or more per square mile; and (e) unincorporated places of 2,500 inhabitants or more not included in any urban fringe. The remaining population is classified as rural.

Place description.—In this survey the urban population is classified as living "in the central city" or "outside the central city" of an SMSA. The remaining urban population is classified as "not in SMSA."

The definitions and titles of standard metropolitan statistical areas are established by the U.S. Bureau of the Budget with the advice of the Federal Committee on Standard Metropolitan Statistical Areas.

The definition of an individual standard metropolitan statistical area involves two considerations: first, a city or cities of specified population to constitute the central city and to identify the county in which it is located as the central county; and, second, economic and social relationships with contiguous counties which are metropolitan in character so that the periphery of the specific metropolitan area may be determined.

Persons "in the central city" of an SMSA are therefore defined as those whose residency is in the city appearing in the stand and metropolitan statistical area title. Persons residing in an SMSA but not in the city appearing in the SMSA title are considered to be residing "outside the central city."

The remaining population is allocated into rural-farm and rural-nonfarm groups. The farm population includes all persons living in rural territory on places of 10 acres or more from which sales of farm products amounted to $50 or more during the previous 12 months or on places of less than 10 acres from which sales of farm products amounted to $250 or more during the preceding 12 months. Other persons living in rural territory are classified as nonfarm. Persons are also classified as nonfarm if their household paid rent for the house but their rent did not include any land used for farming.

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