CHARACTERISTICS OF THE REGULAR ADULT BICYCLE USER

by
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ABSTRACT

A study of adult bicycle riders who ride at least three times a month was conducted as a Master's Thesis project in the spring of 1975. The subjects, ranging in age from 16 to 82 years old, were members of the national bicycling organization, the League of American Wheelmen. A mailback questionnaire was completed and returned by about 50 percent of the 8,405 members. Almost 39 percent, or 3,270 questionnaires, were used in the final analyses. Demographic and bicycle description data and information were recorded along with trip characteristics and accident experience for the year 1974.

An estimate of miles traveled was calculated through the respondent's use of an odometer, or similar mileage recording device. Over a third of all subjects reported using an odometer; those not using them reported mileages that did not differ significantly. The subjects traveled an average of 2,332 miles during 8.9 months that they rode a

bicycle. Males, who rode almost 40 percent more miles than females, had an accident rate 60 percent lower than females. The oldest respondents (ages 66-82 years old) traveled, on the average, more miles than any other age group, but experienced the lowest accident rate.

As cycling experience increased, accident involvement appeared to decrease dramatically. About one out of every 17 subjects was involved in a collision or serious fall that required professional medical treatment. Bicycle accident rates appear to be about twice as high as motor vehicle accident rates; age, sex, and years of experience of the bicycle rider all are influential on the rate. The data also suggest that safety conscious individuals (those wearing helmets, using rear view mirrors, and always obeying laws) are involved in less accidents than others.

Time did not permit complete analysis of the data collected. Travel characteristics and accident experience information is still available for further study by interested persons. The data file can be obtained by sending a nine-track tape (1,600 b.p.i., standard label) to the Federal Highway Administration, Urban Planning Division (HHP-24), Washington, D. C., 20590 - ATTN. Mr. Dan Bryant.

Copies of the 125-page report can be obtained from the Office of Highway Safety (HHS-20), Federal Highway Administration, Washington, D. C., 20590 - ATTN. Mr. Richard Richter, until the supply is exhausted.

ACKNOWLEDGMENTS

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CHAPTER I

INTRODUCTION

Bicycles have never really disappeared from the American scene altogether, for almost every child at one time or another owned a balloon-tired two-wheeler. The introduction and acceptance in the United States during the 1960's of the lightweight European derailleur-equipped bicycle which allowed almost effortless hill-climbing provided an opportunity for many to once again remount the velocipede.

During the six-year period from 1965 to 1971, the number of bicycles in use in the United States increased 61 percent from 32.9 million to 53.1 million. Since 1970, the bicycle boom has been even more pronounced. The Bicycle Institute of America estimated that there were 85 million users in 1972. For the first time in decades, more new bicycles were sold than automobiles in 1972 - 13.7 million versus 11 million. In 1973, 15.3 million bicycles were sold (14).

The reasons behind this large increase are many and varied. Apparently, a major reason has been the combination of increased leisure time and increases in per capita spendable income for Americans. The increase in bicycle usage coincides with the large-scale introduction in this country of the 10-geared "racing" bicycle. More emphasis on the environment and conservation of fuel have also been frequently mentioned as reasons for the great increase in bicycling.

However, recent studies that examined mode choice for different trip purposes showed that bicycles and motorcycles accounted for only 5 percent of the mode choice for the home-to-work trip which is the trip most commonly made (19). Recreation riding and riding for exercise appear to be the most frequent trip making purposes on a bicycle. The President's Council on Physical Fitness and Sports conducted a survey that showed bicycling to be the second most popular form of exercise (walking is first), and that 13 percent of all adult Americans ride a bicycle at least a few times a month (28).

It is possible, although not highly probable, that an appreciable number of commuter work trips could be made by bicycle. The National Personal Transportation Study reported that about 43 percent of all urban work trips are less than 4 miles in length (24). This is considered by many as a reasonable trip length to be made on a bicycle (8,15,16,33). A study conducted in Denver cited examples of more than 200 bicycle commuters traveling over 9 miles each way to work (27). However, environmental considerations, topographic features, dangerous traffic situations, and sometimes social pressures, all act as deterrents to the use of the bicycle for purposeful trip making. Nonetheless, there is a small but growing number of adults who are regularly using the bicycle for work or shop trips.

Recent studies conducted by the A.C. Nielsen Company, of television rating fame, attempted to enumerate the number of regular bicycle users in the states of Pennsylvania, Tennessee, and the District of Columbia (4,5,39). Nielsen defined a "bicycle user" as a person who had ridden a bicycle at least one time in the year previous to the survey. This very likely could include many persons who rent a bicycle for an hour once or twice a year at the beach or a park. The results in all three states showed an average positive bicycling response of 35 percent, which corresponded very closely to the Bicycle Institute of America's estimate of 37 percent (3). From these findings, it may be more reasonable to assume that, in actuality, very few adults use a bicycle with any regularity for purposeful trip making. Some experts feel that of the approximately 90 million bicycles currently owned in this country, perhaps as much as 50 percent are only taking up storage space in a basement or garage, or are used very infrequently, if at all (9,20). The remaining bicycling most likely consists of the child riding around his neighborhood, usually on the sidewalk, or the adult who uses his bicycle for recreation riding or purposeful trip making.

PROBLEM

To include the bicycle mode in any transportation planning process, information and data similar to that needed for automobile or mass transit planning are required. Trip purposes, trip lengths, environmental considerations, and characteristics of the user himself are all items that would greatly assist any planner or transportation engineer in designing and providing facilities. Accident data may also prove very helpful in order to avoid certain designs or practices that may show a higher involvement or seriousness rate than an alternative approach.

It appears that, at present, the greatest bicycle use involves the elementary and junior high level child interested in neighborhood riding and also the recently attracted adult rider who uses a bicycle for recreation or, to a limited degree, purposeful trip making. While some studies in the last few years (10,31) have investigated the riding habits and accident involvement of the young bicyclist of school age, there is a paucity of similar data available with regard to the adult who also uses a bicycle on a fairly regular basis. This is due primarily because of the past history of very few regular adult riders. With the current emphasis on energy conservation, combined with this country's preoccupation with physical fitness, the adult bicycle rider has grown to represent a more substantial segment of the population.

The problem arises from the fact that many states and local jurisdictions are spending hundreds of thousands of dollars in planning and constructing bicycle lanes and bicycle paths without having much, if any, information on the characteristics of the user or of his trips. Basic engineering and transportation planning philosophy should not allow this to happen. The bicycle boom and the resulting demand for some (any) action to be taken has reversed the process of traditional engineered construction by allowing implementation and construction without first looking at hard data and design requirements.

OBJECTIVE

The primary objective of this study is to determine the habits of the adult bicycle rider (16 or older), who uses his bicycle on a regular basis, in order to identify characteristics of the bicyclist and his trips. To accomplish this objective, members of the League of American Wheelmen, the largest organized group of bicyclists in this country, were requested to provide information on themselves and their bicycling activities through means of a mail questionnaire.

A secondary objective is to compare the results from the national survey with a sample of regular bicycle users who are only members of a local bicycle club. If the findings are similar, then the national data for regular users could be applied, under certain circumstances, in smaller areas with a good degree of confidence, and it would not be necessary to conduct another in-depth survey.

It is not the intention of this study to provide information which would be representative of the "average" adult bicyclist in the United States today. As stated earlier, the vast majority of adult owners of bicycles do not ride them on any type of regular basis. It can, however, be supposed that if transportation priorities and social mores changed enough in the future to make bicycle riding an attractive alternative mode of transport, the findings of this study may provide basic data that would be applicable to a much larger segment of the population.

For the purposes of this study, a "regular" user is defined as a person who rides a bicycle at least three times a month during any month he considers suitable for cycling. This number was chosen since many active cyclists may ride on tours or recreation rides only on weekends but still could total several hundred miles of riding a month and therefore should be included. The frequency of three times a month was used instead of four (or more) to allow a weekend rider to miss a ride due to weather or other activities and still be able to respond to the survey.

CHAPTER II

LITERATURE REVIEW AND SCOPE OF STUDY

LITERATURE REVIEW

In any planning process, before solutions or predictions can be developed, there is a necessary ingredient: facts, or data. Transportation planning is no exception to this requirement for data, and in the past, frequently half of an urban transportation planning study's budget has been allotted for data collection (18). These data can take the form of home interviews, roadside check points, parking lot surveys, postcard questionnaires, and similar techniques. Planning for the bicycle's return to the road as a viable means of transportation similarly requires information on the characteristics of the bicycle rider, his trip purposes and lengths of the trips, and where and when the trips are being made.

Literature in the area of bicycling has increased rapidly. Luebbers prepared a bibliography of bicycling material for the period 1957-1973 (26). This report includes articles from such diverse publications as Esquire, Popular Mechanics, and Civil Engineering. Another bibliography was prepared by the U.S. Department of the Interior that deals mostly with trail planning (42). As part of another report, the

Pan-Technology Consulting Corporation included an 11-page bibliography that covers all aspects of bicycling, including an extensive section on bicycle safety (21).

There is a scarcity of data concerning actual mileage traveled by a regular bicycle user and his or her trip characteristics. A 1971 University of North Carolina study researched the riding habits and accident experiences of school age children (31). The subjects in this study, which was conducted in Raleigh, North Carolina, rode an average of 199 miles a year. More recently, the A.C. Nielsen Company, as mentioned earlier, conducted samples of bicycling activity in three different states (4,5,39). Nielsen, in addition to determining the percentage of users in a state or area, also examined trip purposes and the number of days ridden in a one-month period. However, only limited mileage data were collected. Hanson and Hanson of the State University of New York at Buffalo have reported on detailed travel data gathered in Uppsala, Sweden (22). The study used a self-administered travel diary kept by all household members over 16 for a five-week period. The findings show that about 300 randomly selected households from six predefined life cycle groups used bicycles to account for over 11 percent of their total movements in any typical week period. Over 21 percent of all trips were made by bicycle. No trip length figures were reported in the Uppsala study.

In the past two to three years, many studies, reports, and papers have been written describing the construction methods, materials, and design standards and geometric characteristics that will provide the "best" bikeway for the money (1,25,37). Criteria for locating bikeways are being developed, intersection redesigns are under consideration, and specific signing for the bicyclist's use are being discussed (37,13,36). Other studies have sampled potential bicycle users to determine latent demand for bicycle facilities (7,8). While many times this latter type of data may provide a "feel" of what potential bicyclists may do if certain special bicycle facilities are constructed or improved, it also can often lead to unreliable results due to the subjectivity of the survey.

Current trends in transportation planning processes are leading away from the efforts to collect massive amounts of data and are emphasizing a more refined process, i.e., disaggregate data sampling (18). Disaggregate data collection is the process of collecting sample data in order to establish generalized relationships between variables that can then be applied in similar situations without having to collect basic data again. For example, the number of trips per household is directly related to the number of automobiles owned. This relationship, once determined from previous study, can then be used in similar undertakings, and trip making can be predicted on the basis of auto ownership. This reduces the need for a large home interview sample to be collected. Data on auto ownership are already available from other sources, such as the Bureau of the Census (11).

Unlike driving an automobile, which is a well established part of the average American's travel patterns, bicycling is still, to many, a recreational pastime only, similar to skiing in winter or swimming in summer. A regular year-round bicycle user is hard to find. Because of the obscurity of this individual, data collected on the habits of a regular user may likely be subject to small sample biases and resulting skepticism of the findings.

BACKGROUND

This paper attempts to expand on past research by providing a disaggregate data set of travel characteristics and accident experiences, including mileage figures, of the regular adult bicycle user. The data were obtained from a sample of the League of American Wheelmen members. Members of a local bicycling organization, the Washington Area Bicyclist Association, were also asked to respond to the questionnaire so that data from bicyclists belonging only to local clubs could be compared with cyclists who have joined a national organization.

The League of American Wheelmen (L.A.W.) was founded in 1880 by Issac B. Potter in Newport, Rhode Island, as a club dedicated to improvements in road surfaces for safer use by wheelmen, as bicyclists were called then. The Office of Road Inquiry, the predecessor to the current Federal Highway Administration, joined forces with L.A.W. in coordinating these efforts for good roads. In fact, General Roy Stone, who was appointed as head of the road agency, worked closely with Potter in the call for improved surfaces. The annual L.A.W. membership increased to a peak of 150,000 at a time when the United States' population was less than a third of what it is today. Construction began on cycle paths around the turn of the century. While the increased usage of the automobile definitely reduced bicycle riding, the takeover by the electric railway of the side paths originally constructed for bicycle use played a major role in the decline of the bicycle (29).

The League membership declined rapidly in the early 1900's but interest was still evident due to the sport of bicycle racing, sponsored and supervised by the League. When the Amateur Bicycle League of America was formed around 1920, L.A.W. became inactive until 1965 with only some minor attempts at rebuilding. In 1965, the 200 members remaining in L.A.W. and living in Chicago, the headquarters at the time, decided to reorganize the group. Since that year, beginning with the original 200 members, the organization has grown dramatically to 4,500 persons in mid-1973, and to just over 9,000 in early 1975. L.A.W.* has projected a membership as high as 100,000 within the next two to three years. Promotional efforts by the bicycle manufacturers combined with the increased interest in bicycling are expected to account for this increase (20).

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*Through communication with L.A.W. and the Washington Area Bicyclist Association (see page 12), the abbreviations as shown are preferred.

The Washington Area Bicyclist Association (WABA) was founded in 1972 to provide a voice for bicyclists in the Washington, D.C., metropolitan area. WABA, since that time, has been instrumental in a number of projects that have helped make Washington a safer and more enjoyable place to bicycle. For example, they have provided user input to the highway department in determining hazardous river crossings for cyclists. In early 1975, WABA had a membership of almost 1,000 persons (34).

METHODOLOGY

Conventional transportation studies concerned with travel and trip characteristics of a group of travelers or potential travelers usually involve a detailed interview survey of a random sample of the individuals under study. This method was chosen as the most advantageous for the purpose of this study. Because the regular bicycle user would be hard to locate in substantial number in any one area for the purpose of collecting enough data for reliability, the nationally recognized and largest bicycling organization in the country was selected to provide the sample.

League members were not chosen to represent the typical American bicyclist of today. This would be a gross misrepresentation of the facts. Instead, L.A.W. cyclists were asked to provide information on their cycling habits and accident experiences because of three reasons. One, they represent the largest organized group of bicyclists that could be reached in an orderly and efficient process through a mailback questionnaire. Two, because the membership had increased so dramatically in the last two to three years, the researcher hoped that many of the members were also new to bicycling, and therefore might have different riding patterns and accident involvement rates than older members. Third, as a further result of the premise that many new members were new to bicycling also, it might be easily assumed that their riding characteristics and purposes might very well reflect to what a person beginning to cycle, or considering it, might correspond.

The Washington Area Bicyclist Association was used in order to obtain samples from members of a bicycle organization that were not members of a national group. Each person sent the questionnaire was asked if he or she was a member of a national club. If the response was yes, their data were not used in the analysis.

In general, the study design for this investigation consists of four broad phases, namely: (1) defining the problem, (2) collecting the data, (3) analyzing the data, and (4) preparing summary statistics usable by the transportation planning community and others interested in the bicycle mode of travel. The analysis phase involves the use of methodologies somewhat similar to those employed by urban transportation planning studies, including the use of statistical computer programs available from the Federal

Highway Administration's IBM 360 library of transportation planning programs. The final phase consists of organizing and listing the findings in an easily accessible format. The flow chart in Figure 1 shows the method of approach followed in this thesis.

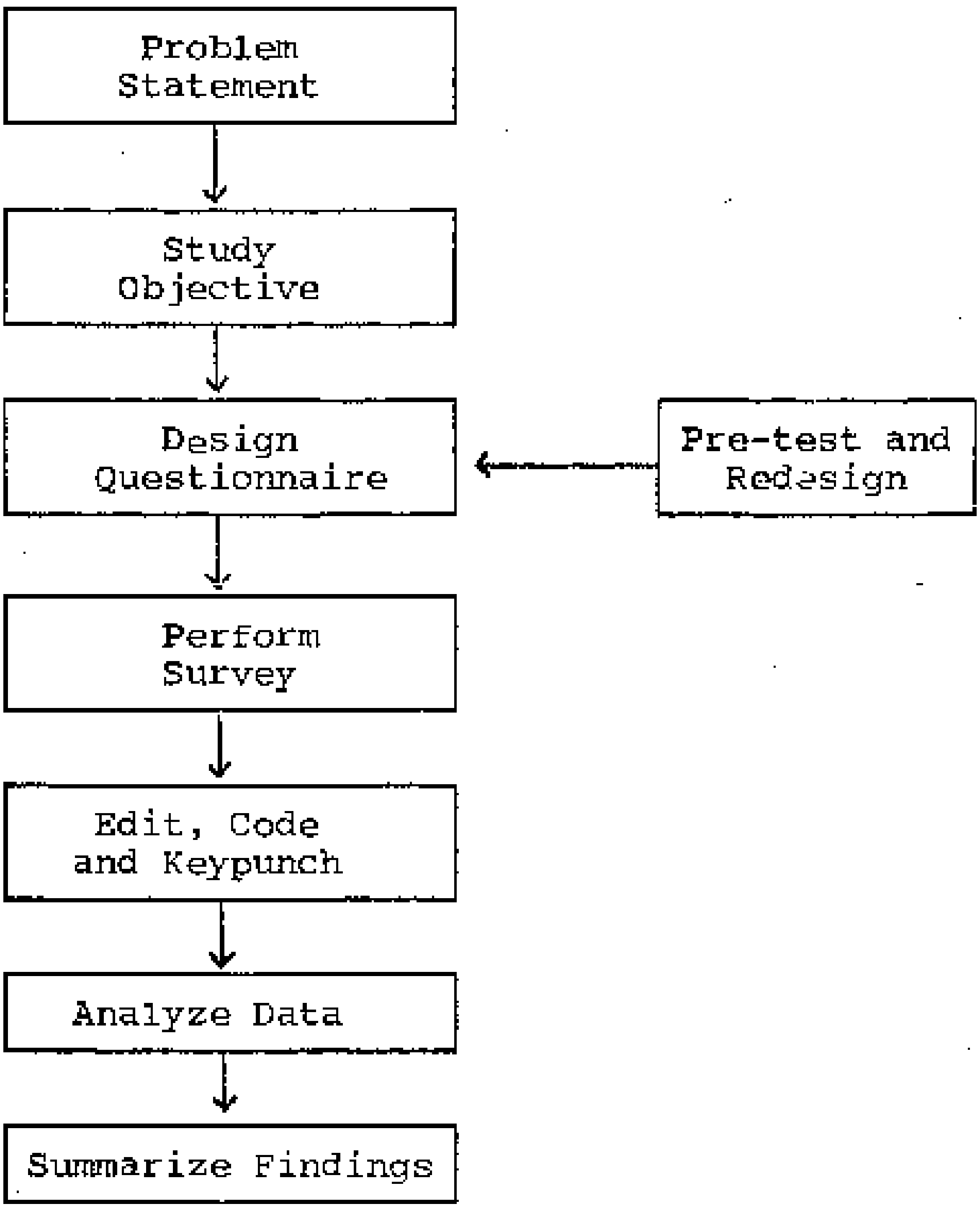


FIGURE 1 - FLOW CHART OF METHOD OF APPROACH

CHAPTER III

COLLECTION OF DATA

DESIGN OF QUESTIONNAIRE

It was determined that the scope of data collection efforts should be nationwide in order to discover if there were substantial differences in riding characteristics and distances traveled by bicyclists living in urban areas versus rural areas, hilly or mountainous areas versus flat terrain, cold climates versus warm climates, and other similar comparisons. However, only essential personal data and travel information would be asked of each respondent. The idea was not to overburden the effort with unnecessary data requests. Lengthy questionnaires tend to compromise the quality of the data that are being requested.

The national headquarters office of the League of American Wheelmen, located in Palatine, Illinois (a Chicago suburb) was preparing to mail a copy of the League's Annual Report to each of its approximately 9,000 members in Spring 1975. Included with the mailing would be a ballot to elect next year's Regional Directors, and a postage paid return envelope. After the idea of the questionnaire was discussed with the L.A.W. Board of Directors, an agreement was reached that allowed the form to be included in the mailing. The questionnaires would be collected and forwarded to the researcher for analysis. The Board felt that the data collected would also be beneficial to the League because they would have the opportunity to learn more about their rapidly growing membership.

The questionnaire was designed in cooperation with L.A.W., and with the idea that a simple checklist type of response would probably yield the greatest number of returns with the most accuracy. However, this checklist format could not be followed throughout because discrete numerical data on trip purpose and overall bicycle travel were desired. It was hoped that the enclosure of the questionnaire with the ballot would increase the number of responses received. Similarly, L.A.W. thought that people responding to the questionnaire would be more likely to cast their ballots, and mail both items together.

The instructions on the questionnaire stated that only persons 16 years of age or older were to respond. This was in order to obtain data only from those members who were most likely to have an automobile available for their use in addition to a bicycle. The instructions also requested that the most active rider fill out the form. Although family memberships are available in L.A.W., only a very small percentage of the total membership is in this category. Therefore, in some cases, only one member of a bicycling household filled out the questionnaire, probably a male. This would likely lead to a male bias in the final sample.

Nonetheless, it was felt that there would be a sufficient number of female respondents to identify any significant differences between the sexes.

The information asked of each respondent was divided into two broad categories. The first pertained to personal information including geographical location of the respondent, and the second category included questions relating to the respondent's bicycling activities, as well as any accident experiences encountered in the last year. Table 1 summarizes the information that was requested of each respondent.

The questionnaire was pre-tested on 18 individuals in the Washington, D.C., area who were considered very knowledgeable on the subject of bicycling, including planning, design, and safety-related issues. They were, in addition, regular bicycle users, by the definition in the questionnaire. The persons tested included U.S. Department of Transportation staff working in the field of bicycle transport and representatives of the local bicycle clubs. Comments and suggestions from these individuals were considered and appropriate deletions, additions, and rewording were accomplished. In particular, many subjects felt they could not adequately respond to the question involving "accidents". The researcher decided to use the term, "serious fall or collision", and allow the respondent to indicate severity. The final version of the questionnaire is presented in Appendix A.

TABLE 1

INFORMATION REQUESTED ON QUESTIONNAIRE

Category I - Personal Information

- Age
- Sex
- City, State, and Zip Code
- Population size and topography of area where respondent lives
- Number of automobiles available for respondent's use

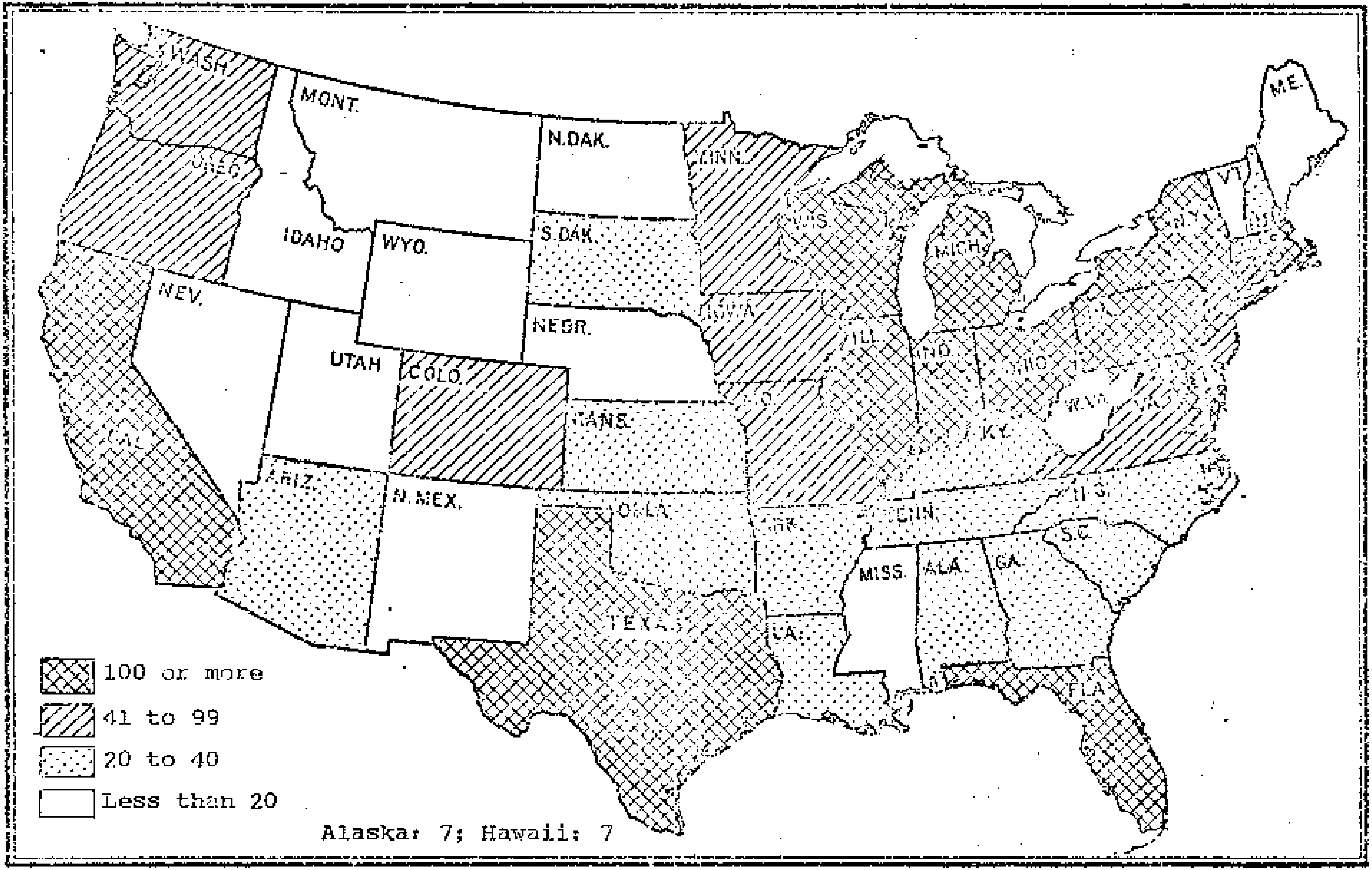
Category II - Bicycling Information

- Bicycle type and equipment on bicycle
- Respondent's cycling experience and riding habits with regard to rain, darkness, and temperature
- Riding activities in 1974 including total mileage, months ridden, percentage on weekdays, and number of trips and miles for different trip purposes
- Functional class of road where majority of cycling took place in 1974
- Accident experience in the last year, including location of crash, and what the bicycle collided with
- Estimate of 1975 bicycling compared with 1974 miles
- A "snapshot" of bicycling activity during the one-week period immediately preceding the filling out of the questionnaire.

PERFORMANCE OF SURVEY

On March 15, 1975, the questionnaire and the ballot were sent to 8,405 members of L.A.W. who were on the mailing list as of late February. It was stated in the mailing that all returns had to be received at L.A.W. headquarters by April 15 in order to be counted. The final number of ballots received was 4,342, or 51.7 percent of all those mailed. With the ballots, 3,270 questionnaires (38.9 percent of the total sent out) were returned that were used for this research. An additional 38 forms were unable to be used due to incomplete information provided for some basic questions. Also, 618 of the questionnaires were received after the data were analyzed. Therefore, 3,926 questionnaires were actually returned (46.7 percent).

Geographically, the returns represented all 50 states, although some states in the vicinity of the L.A.W. headquarters near Chicago have a very large membership and were somewhat over-represented in terms of each state's population. Map 1 displays the level of response from each state. The League of American Wheelmen is broken down into 15 different Regions for administrative purposes. The breakdown is based in part on geography and part on the number of members. The number of mailings that went to each Region was noted by L.A.W., so that tabulations of returns could be recorded. A complete summary of the number of returns and percentages by Region is included in Appendix B.



MAP 1 -- LEVEL OF RESPONSE FROM EACH STATE

DATA PROCESSING

A requirement of the questionnaire was that it should be as simple to code as possible in order to facilitate the processing of data. Any thought to make the form self-codable for the respondents was quickly rejected because of the necessary complexity expected in any instructions that might have to be provided. Also, the time required to carefully spot check every fifth or tenth return might better be used in actually coding the data. An 80-column format was developed where all the information provided could be coded on one form and then keypunched. An example of the coding form used is presented in Appendix C. Each response was carefully edited and coded before being keypunched and verified. After the data deck was produced for each day's returns, special edit programs were run to spot any abnormal or non-sensical data.

Difficulties arose with certain questions on the form. Questions 15 through 17 requested information on the respondent's most recent collision or fall. The individual was required to answer this set of questions only if he responded positively to question 14, "Have you had a collision or serious fall in the last year on your bicycle?" Evidently, many respondents did not notice the comment to continue answering at question 18 if the response was "No" to the question just discussed. Others wrote on their form that they understood the instructions but wished to provide information on past collisions or falls. This problem was solved by only considering positive responses to question 14 for establishing accident rates. The additional information provided by some of the respondents who did answer questions 15 through 17 was used when investigating accident patterns.

There also was a minor problem with the question that inquired as to the minimum temperature at which the respondent did not usually ride his bicycle. It appears that many cyclists in the colder climates of the country ride often when the temperature is 0 degrees or even below. As this was not expected, no provision was made for coding sub-zero temperatures. Consequently, all responses of zero degrees or below were coded as 01 in the appropriate columns. Therefore, the mean temperatures for some northern states discussed in this report are somewhat higher than what was actually reported.

CHAPTER IV

ANALYSIS OF DATA ON AGGREGATE BASIS

This chapter analyzes data from all respondents on an aggregate basis. That is, data from all returned questionnaires are used to arrive at figures for average annual miles traveled, average trip length, overall accident experience, and similar items. The following chapter analyzes the data by examining similar variables but characterized by the respondent's bicycling experience, geographic location of residence, age, sex, and similar categories.

GEOGRAPHIC AND POPULATION GROUP DISTRIBUTION

A total of 3,270 usable questionnaires were received with responses from all 50 states and the District of Columbia. It should be noted that all subjects did not provide responses to every inquiry. For this reason, the total response in the following analyses usually will not be equal to 3,270. A question was asked of respondents as to the population size of the metropolitan area where they lived. Five choices were provided, ranging from greater than one million to less than 5,000, which was classified as rural. Table 2 shows the distribution that resulted from this question.

TABLE 2

DISTRIBUTION OF RESPONDENTS BY METROPOLITAN AREA SIZE

Metropolitan Area Size	Number of Responses	Percent of Total	U.S. Population Percentage
Greater than 1 Million	1,057	32.4	33.4
250,000 to 1 Million	482	14.8	13.5
50,000 to 250,000	702	21.5	11.7
5,000 to 50,000	791	24.2	41.4
Less than 5,000--Rural	232	7.1	
Total	3,264	100.0	100.0

Although not intended, the returns showed an almost even split between areas greater than 250,000 population and those less than 250,000. This particular split corresponds closely to that of the United States as a whole (41). However, a goodness of fit test (p=.05) showed that a significant difference exists between the overall distributions.

Bicycling ease is dependent on both the gearing of the bicycle and the topography of the land. Table 3 shows the response to the questions regarding the topography of the area where the respondent lives, and the topography of the area where the respondent does most of his bicycling.

Upon examining the responses, two interesting items are noticed. First, it appears that rolling terrain does not inhibit bicycling. While 49.7 percent of the respondents stated that they lived in areas that they considered rolling,

TABLE 3

DISTRIBUTION OF RESPONDENTS WITH RESPECT TO TOPOGRAPHY

Character of Topography	Respondents Living in This Type Area	Percent of Total	Respondents Riding in This Type Area	Percent of Total
Mostly Flat	1,398	42.8	1,091	33.4
Mostly Rolling	1,623	49.7	1,975	60.5
Mostly Steep Hills or Mountainous	242	7.5	197	6.1
TOTAL	3,263	100.0	3,263	100.0

60.5 percent of the respondents reported that they bicycled in rolling terrain. It may be presumed that with the tremendous increase in sales of the 10-geared bicycle many cyclists actually seek out rolling topography in order to use the gears. The second item that is seen in the Table is that there are almost 20 percent less respondents who live in steep or mountainous terrain reporting that they also bicycle in that type terrain. This may show that even bicycles with 10 gears cannot be used very easily in very steep areas. However, the small sample responding in this category (less than 7 percent of the total usable data) may not be representative of the larger population.

AGE AND SEX DISTRIBUTION

Of the respondents who provided information on their age and sex, 2,873 were males (88 percent) while 391 were females (12 percent). This large male sample was expected, and due, in part, to the fact that the majority of members in L.A.W. were males. The researcher still felt that comparisons between the sexes could be made with a fair degree of reliability, because almost 400 responses from women were received.

The mean age of all respondents to the questionnaire was 37.7 years, with only a minor difference between the sexes. Figure 2 shows the age distribution of the respondents. It is somewhat surprising to see the large number of persons older than 46 (28.7 percent) that were

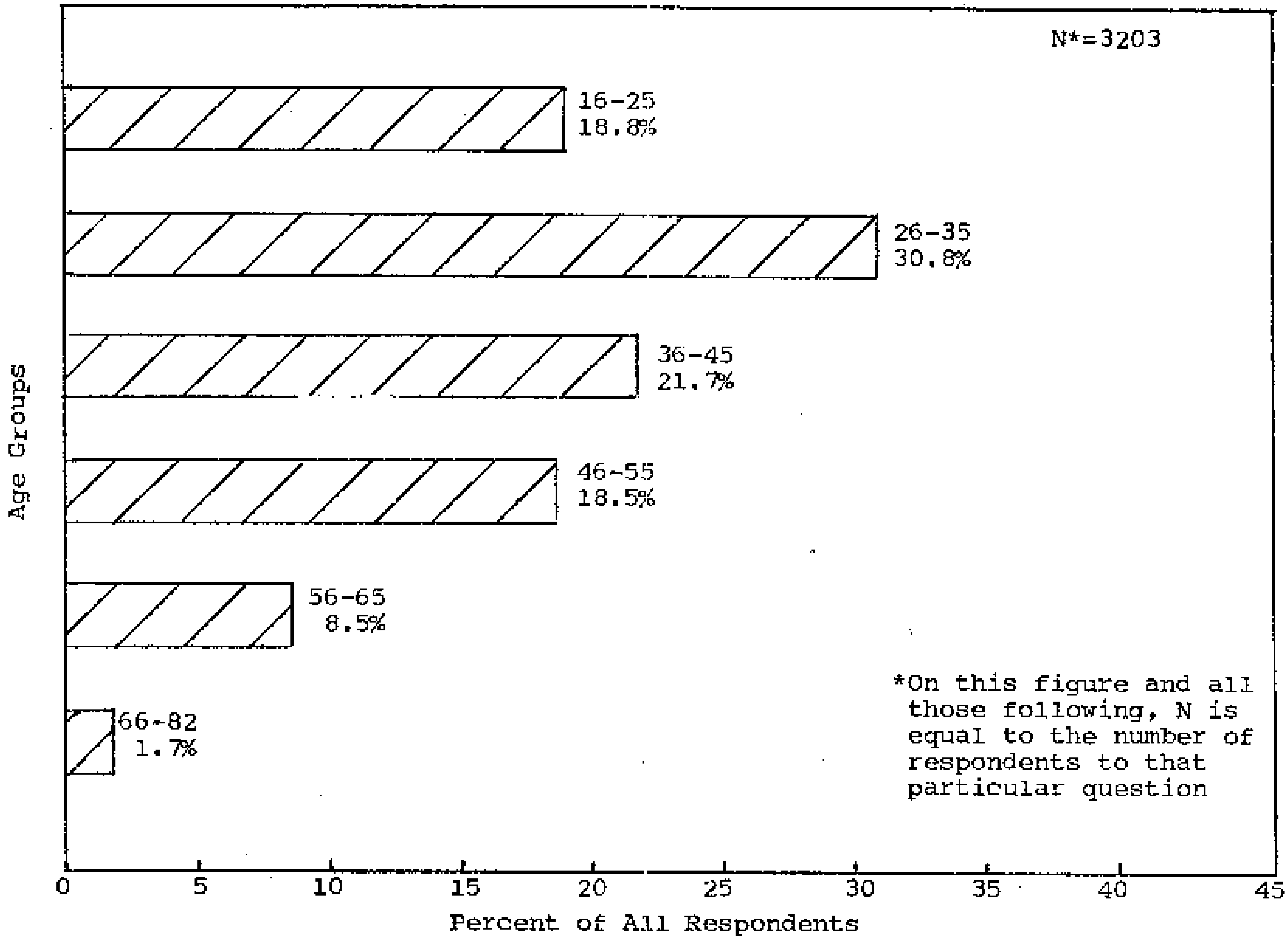


FIGURE 2 - AGE DISTRIBUTION OF L.A.W. RESPONDENTS

active cyclists. The oldest respondent was an 82 year old man, and there were 54 persons above the age of 66 who were considered regular riders for the purposes of the survey. It is also interesting to note that the latter age group--above 66 years of age--averaged more miles riding per year than any other age group. (This is discussed in more detail later.)

AUTOMOBILE AVAILABILITY

Respondents were asked how many automobiles were available for their use. Table 4 shows the distribution of the respondents with respect to the number of automobiles available.

TABLE 4

DISTRIBUTION OF RESPONDENTS WITH RESPECT TO AUTOMOBILE AVAILABILITY

Number of Automobiles Available for Use	Number of Respondents	Percent of Total
0	177	5.4
1	1,379	42.4
2	1,400	43.1
3	236	7.2
4 or more	60	1.9
	3,252	100.0

It can be seen that only 5.4 percent of the respondents do not have any available autos. The age distribution showed that there are an appreciable number of respondents who are 60 years of age or older who may not need a car. Also, some of the younger respondents are probably college students who do not own a car. There were more respondents with two cars (43.1 percent) than one car (42.4) available. Multiple car respondents account for 52.2 percent of the total and there are on the average 1.6 automobiles available for each respondent. It is difficult to relate these figures to any national data because the L.A.W. survey was addressed to individuals whereas national sampling is usually made on a "per dwelling unit" basis.

A study completed in 1971 in Reston, Virginia, a "new town" type suburb of Washington, D.C., showed a very similar distribution of auto availability, based on dwelling units (30). It is likely that the respondent in the bicycle user survey was, in fact, providing information on automobile availability for the household, because the respondent appears to be the household head. If that is the case, the socio-economic status of the L.A.W. membership would be comparable to that of Reston, that is, of higher middle class suburban characteristics.

BICYCLE TYPE AND EQUIPMENT

There was an overwhelming majority of respondents (96.8 percent) who stated that most of their riding was on bicycles that had five speeds or more. Table 5 shows the distribution with regard to bicycle type.

TABLE 5

DISTRIBUTION OF RESPONDENTS WITH RESPECT TO BICYCLE TYPE

Bicycle Type	Number of Respondents	Percent of Total
One Speed	25	0.8
Three Speed	80	2.5
Five or More	3,150	96.8
	3,255	100.0

Although all types of bicycles are being sold today, the multi-speed bicycle (3, 5, or 10 speed) has taken over as today's popular model. It is estimated that some 85 percent of bicycle production today is of the multi-speed variety (14). This trend is evident in the responses received, for less than 1 percent reported that they commonly used a one-speed bicycle.

Respondents were asked whether or not their bicycles (and themselves) used certain types of equipment. The equipment ranged from rear view mirrors, lights, and helmets (safety equipment), to registration of the bicycle. Whether or not the bicycle was equipped with an odometer or other device to measure distances was also noted. This latter item played an important role in determining the accuracy of the trip lengths and overall mileage figures reported in other sections of the questionnaire. Results of these inquiries as to equipment usage are displayed in Figure 3.

Over one-third (35 percent) of the sampled members reported that they did have odometers or used some other measuring device. In order to discover if any significant differences existed in reporting mileage between those who did have odometers and those that did not, a statistical T-test was performed on the data. Respondents who stated that they did not have a measuring device actually reported mileage figures 4.3 percent higher than those who did have an odometer. However, there was no statistical difference between the two groups at the .01 level of significance. (The T-test analysis is shown in Appendix D.)

BICYCLING EXPERIENCE

The length of time that the respondent had been bicycling prior to filling out the survey form was important to know in order to discover any differences that might exist in accident or riding characteristics between different groups. Table 6 shows the distribution of respondents with respect to their years of continuous bicycling experience.

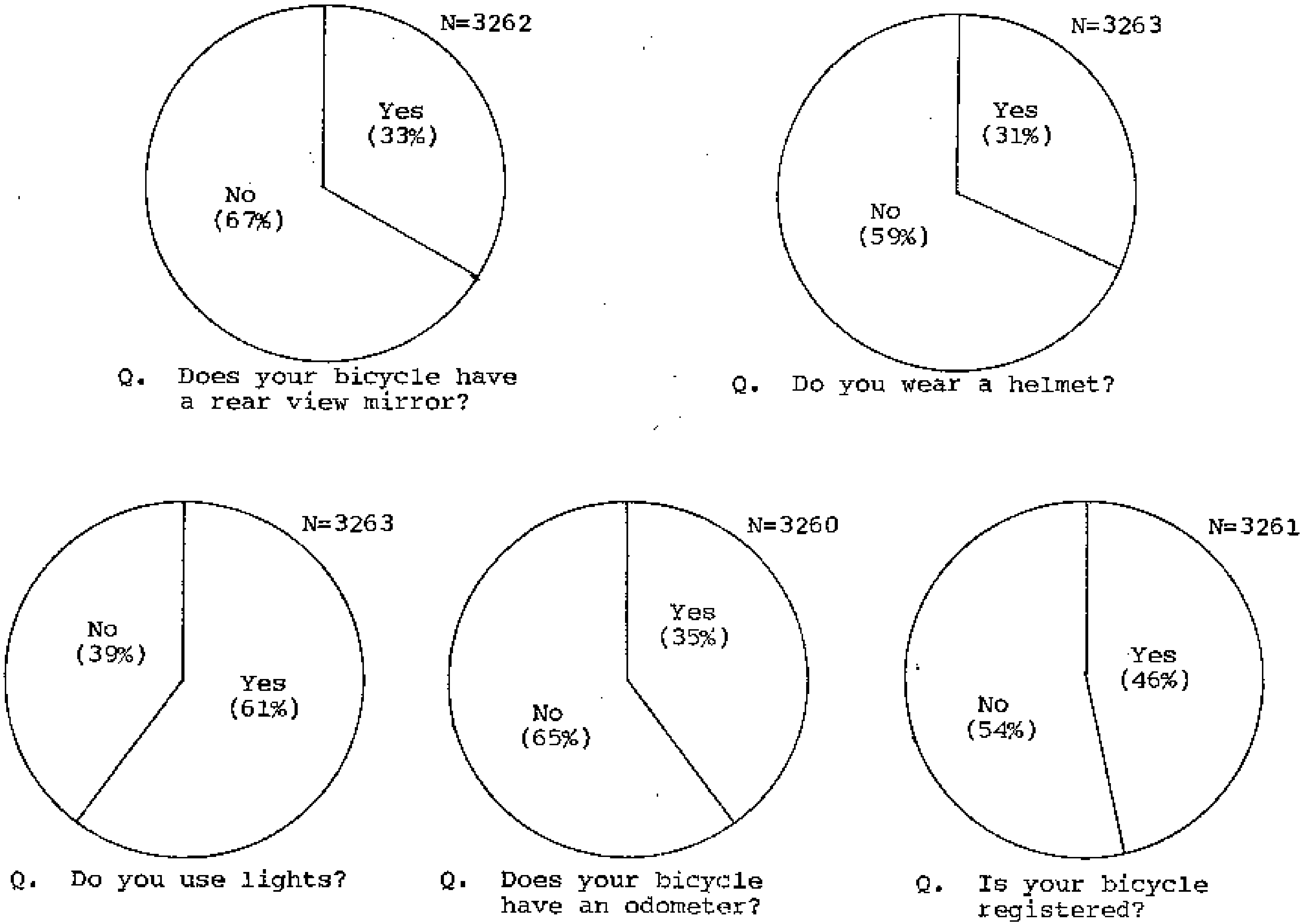


FIGURE 3 - RESPONSES TO EQUIPMENT USED - L.A.W. SAMPLE

TABLE 6

DISTRIBUTION OF RESPONDENTS WITH RESPECT TO BICYCLING EXPERIENCE

Experience	Number of Respondents	Percent of Total
Less than One Year	116	3.6
One to Four Years	1,566	48.1
Five to Ten Years	916	28.1
More than Ten Years	657	20.2
TOTAL	3,255	100.0

The word "continuous" was used in the bicycling experience question in order to prevent persons from counting childhood bicycling in the total years they use as past experience. The researcher felt that many older adults who might include these years, bicycled under different conditions than those of today, and therefore it should not be considered comparible experience.

The small response received to the choice "less than one year" was probably because the questionnaire was directed at those members who could provide trip figures and mileage data for the year 1974. Since the form was mailed in March, 1975, some potential respondents could not provide 1974 information if they had begun to bicycle within the last 11 months.

Over half (51.7 percent) of the respondents stated that they had been bicycling regularly for four years or less. This time period corresponds very closely to the bicycle boom that started in the early 70's. Apparently, much of the League of American Wheelmen's membership growth in the last two or three years is made up of persons just beginning to bicycle.

TOTAL MILES RIDDEN IN 1974

The average miles ridden during the year 1974 for all respondents was 2,332 miles. This is based on an average of 8.9 months of the year that respondents rode, or about 260 miles in every month that the respondents stated were suitable for cycling. The distribution of respondents with regard to the number of miles traveled is shown in Figure 4. There are 315 respondents (9.8 percent of total) stating that they rode over 5,000 miles during 1974, and of these, 44 returns showed mileages in excess of 10,000 miles. Many of these were from persons who had done extensive touring during the year.

It should not be considered common for mileages greater than 4,000 or 5,000 miles a year to be traveled on a bicycle. However, these latter annual mileages are definitely within reason, because a regular bicycle commuter traveling 15 to 20 miles a day, or a recreation bicyclist riding 50 to 75 miles each weekend (not too uncommon), will come close to totaling this many miles. Still, over a third of the respondents (34.8 percent) reported that they traveled less than 1,000 miles during 1974. For comparison purposes, it

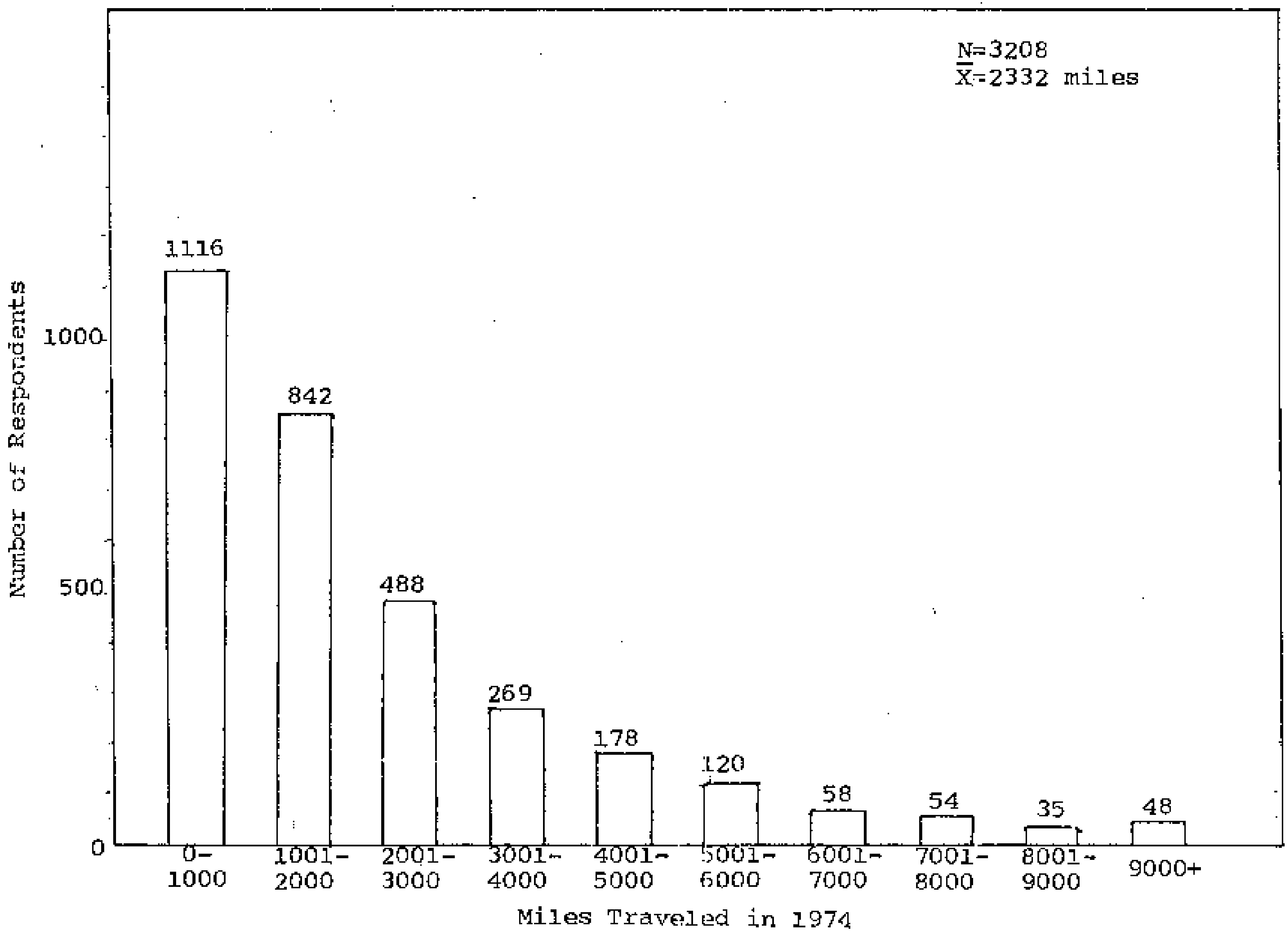


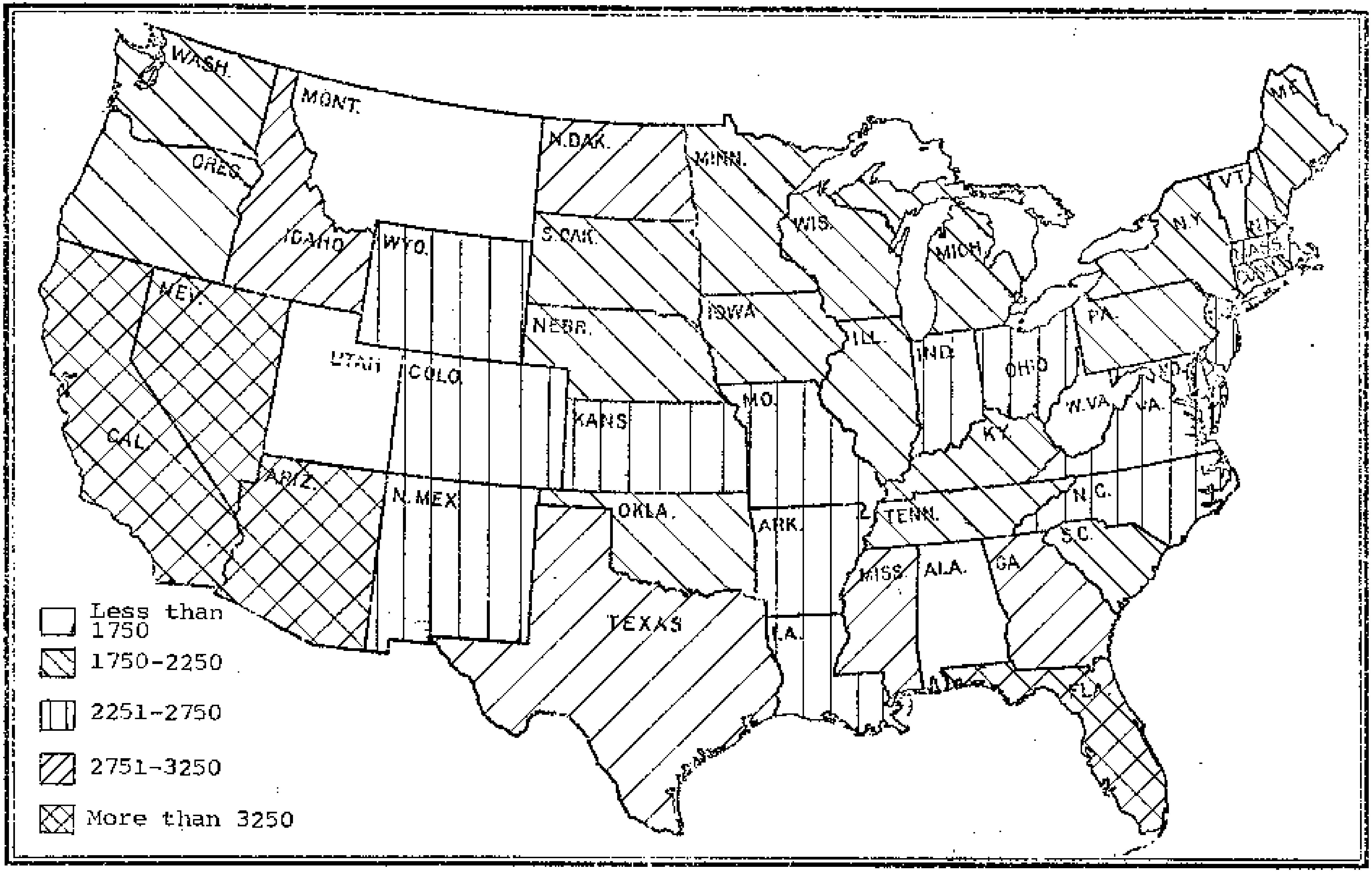
FIGURE 4 - DISTRIBUTION OF RESPONDENTS WITH RESPECT TO ANNUAL MILES TRAVELED

should be noted that the average passenger car traveled 9,992 miles in 1973, and the average motorcycle traveled 4,498 miles (23). Map 2 shows the average miles traveled in each state. Map 3 shows the average months ridden in each state. As expected, those states with milder winters experienced both more miles traveled and more average months in which riding took place.

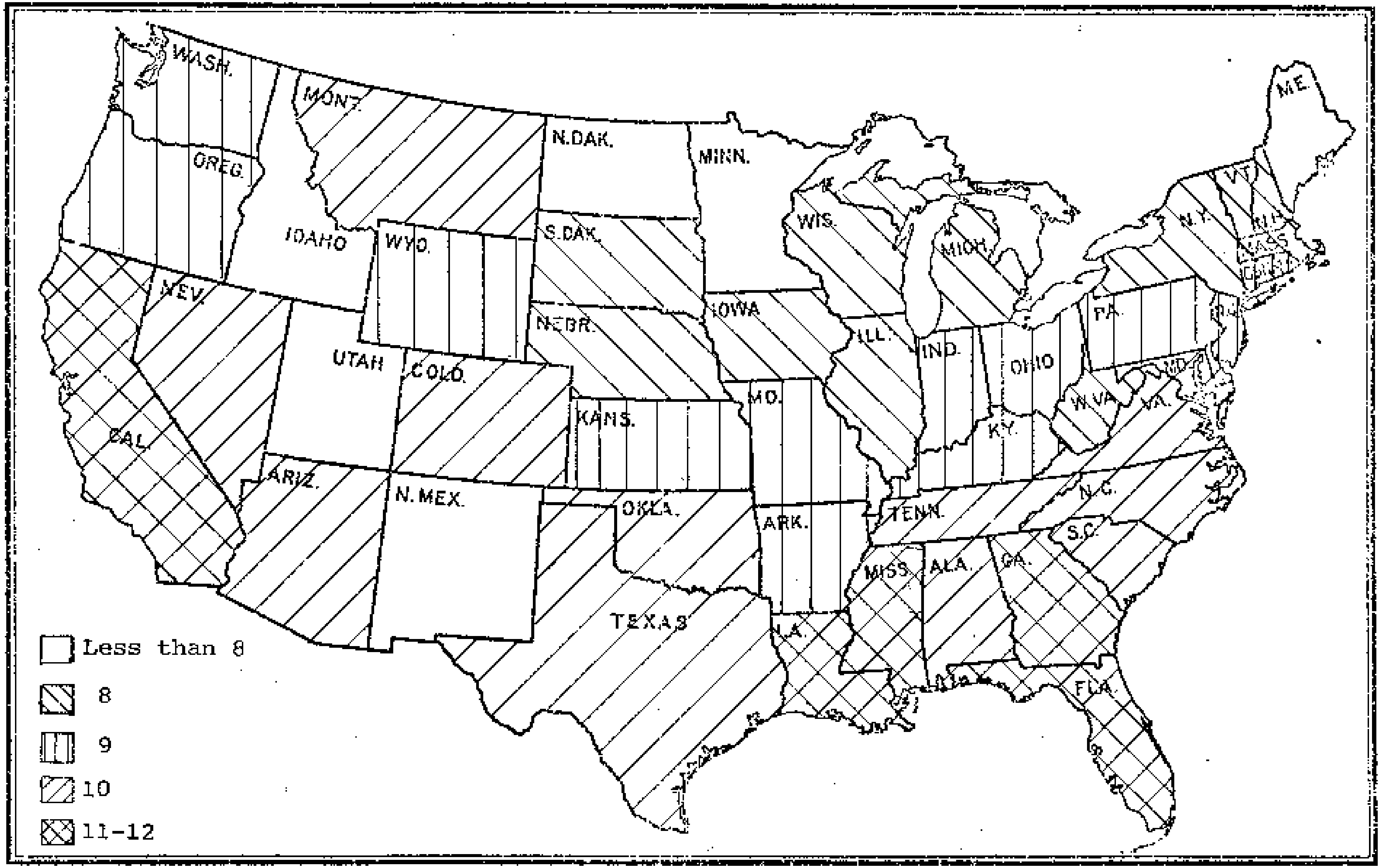
As mentioned previously, over one-third of all respondents stated that their bicycles were equipped with odometers. The student's T-test, at the 99 percent level of confidence, showed no significant difference in mileages reported by those who had odometers and those who didn't (Appendix D). The test is based on over 3,000 respondents with combined bicycle riding of more than 7 million miles.

Table 7 shows the distribution of responses to the question that asked "How much bicycling do you think you will do in the current year as compared to the past year?" Only 176 responses (5.4 percent) stated that they would ride less or much less. Over 1,800 respondents (almost 60 percent) reported that they will ride more or much more. There were many comments on this question with a number of persons stating that they planned to begin riding to work by bicycle. Also, a few respondents mentioned plans for riding on the Bike Centennial Route this summer from coast to coast.

Respondents were also asked where most of their riding occurred. They were provided with four facility types to



MAP 2 - AVERAGE MILES RIDDEN DURING 1974



MAP 3 - AVERAGE MONTHS RIDDEN DURING 1974

TABLE 7

DISTRIBUTION OF RESPONDENTS WITH RESPECT TO PROJECTED BICYCLING

Projected Bicycling	Number of Respondents	Percent of Total
Much Less	25	0.8
Less	151	4.6
About the Same	1,232	37.8
More	1,281	39.3
Much More	574	17.5
TOTAL	3,263	100.0

choose from and asked to provide the percentage of miles they rode on each facility. The results are shown in Figure 5.

It should be noted that less than 25 percent of the respondents (N=705, N=663) reported any travel at all on special bicycle facilities including bicycle routes, lanes, or separate pathways. This travel amounted to less than 7 percent of the total miles traveled by all respondents. This may be due to the relative scarcity of special facilities (although almost every city has made an attempt at installing some type of bikeway), or the fact that most respondents did not find any advantage to using a bikeway, and therefore did not.

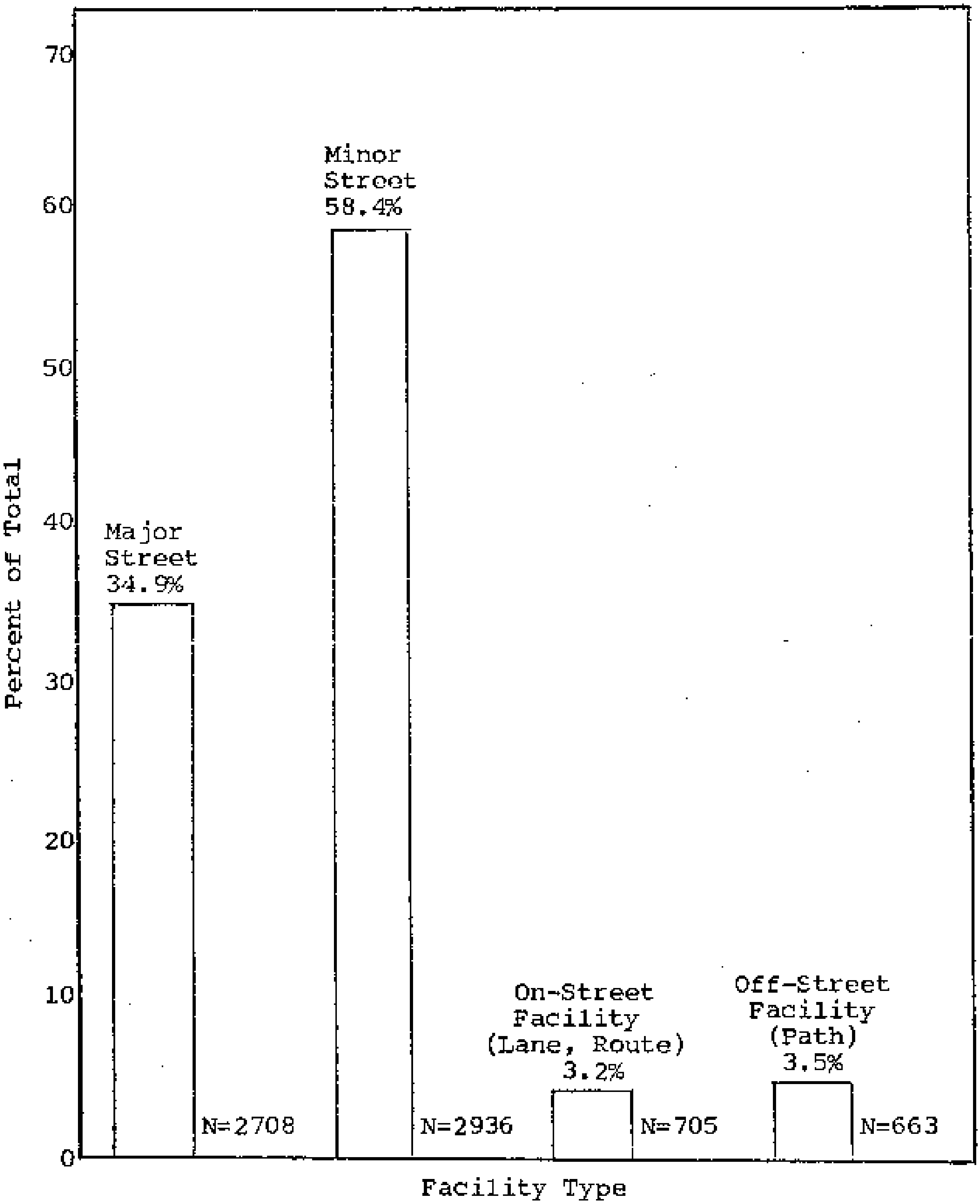


FIGURE 5 - PERCENT OF TOTAL MILES RIDDEN
ON EACH TYPE FACILITY

TRIP PURPOSE AND LENGTH

A section was provided on the survey form that requested each respondent to provide information on the total average number of trips taken and the average miles traveled per month for each of five distinct trip purposes. Figure 6 shows the distribution of respondents who rode for each trip purpose.

Almost 85 percent of all responsents reported using a bicycle for recreation riding and/or touring, and almost half reported using a bicycle for either work/school commute trips or utility trips. More than a third of the respondents stated they made trips for the sole purpose of exercising. Less than 10 percent reported that they raced. The League of American Wheelmen had acquired a reputation as being primarily a touring organization. Apparently, many new members are using bicycles for commute-type trips and other utility purposes in addition to recreation and touring.

Table 8 provides details on the characteristics of each trip type including the average round trip length. It is seen that although the recreation and touring trip accounts for over 50 percent of the total miles traveled each month, the work or school commute trip accounts for almost a third of the total trips reported each month. This, of course, is because the commute trip is made much more frequently than other types. The utility trip category accounted for a surprising 17.6 percent of all trips but only 6.4 percent of the total miles. The low round trip distance of 4.5 miles accounts for

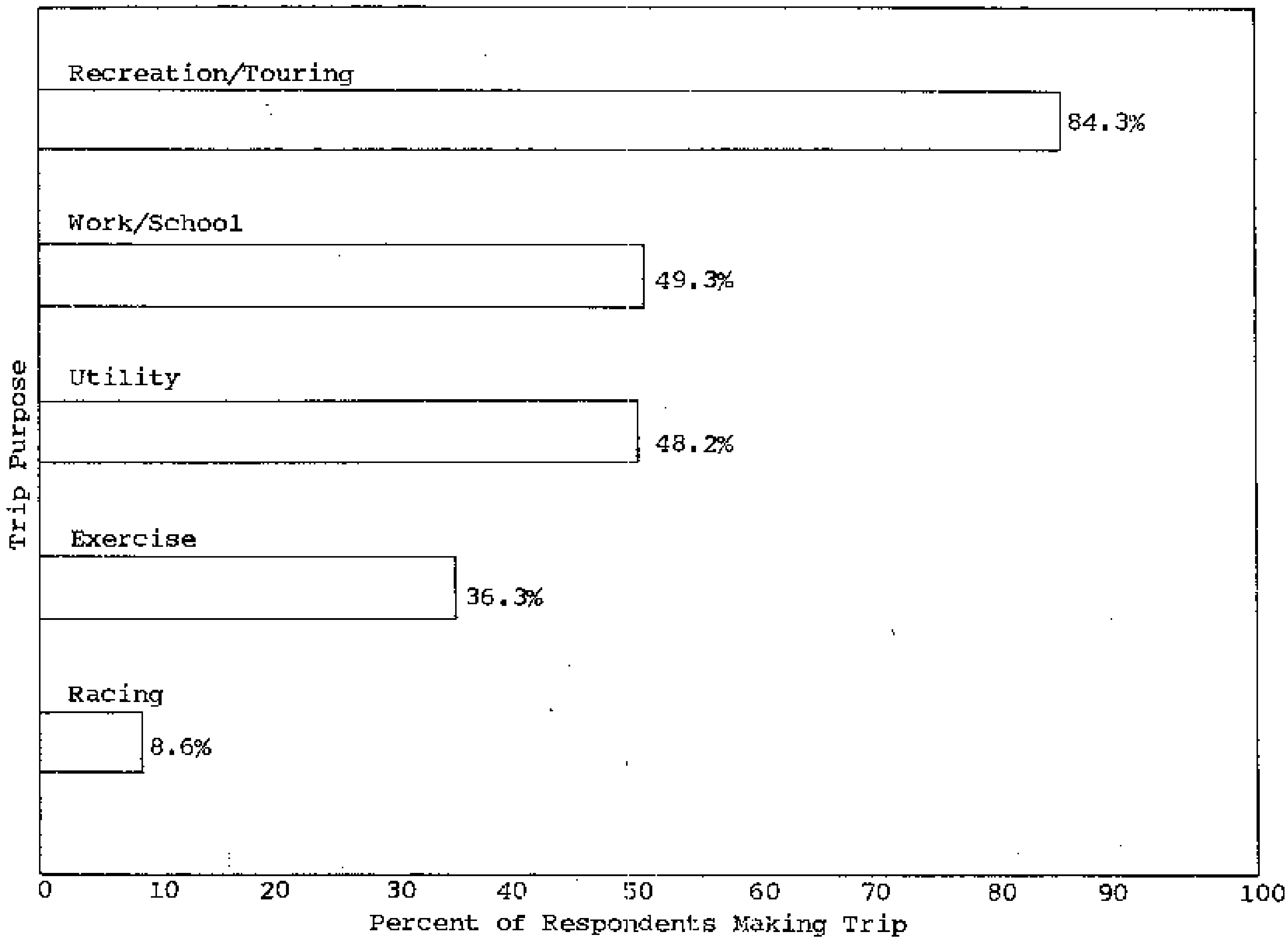


FIGURE 6 - DISTRIBUTION OF RESPONDENTS WITH RESPECT TO TRIP PURPOSE - L.A.W.

TABLE 8

TRIP CHARACTERISTICS BY PURPOSE - L.A.W.

Trip Purpose	All Respondents				Average Trips Per Month Per Respondent	Average Miles Per Month Per Rospondent	Average Round Trip Distance Per Respondent
	Total Trips Reported Per Month	Percent of Total Trips	Total Miles Reported Per Month	Percent of Total Miles			
Work/School	22,283	33.1	179,675	21.7	13.8	111.5	8.1
Recreation/ Touring	19,665	29.3	433,991	52.4	7.1	157.4	22.2
Utility	11,843	17.6	53,236	6.4	7.5	33.7	4.5
Exercise	10,821	16.1	110,175	13.3	9.1	92.8	10.2
Racing	2,607	3.9	51,779	6.2	9.3	184.9	19.9
TOTAL	67,219	100.0	828,856	100.0	-	-	-
Average for All Purposes	-	-	-	-	9.8	132.6	13.5

this difference. The overall average number of trips and average number of miles traveled by all respondents each month are 9.8 and 132.6, respectively. This reduces to an average round trip length of 13.5 miles for all trips.

Total trip percentages by purpose were tested against those of total miles to note if a significant overall difference exists between the variables. The goodness of fit test (p=.05) showed the results were significantly different; the one variable could not be used as an indicator of the other.

When asked "What percentage of the total miles you traveled in 1974 was on weekdays?", respondents reported that 46.4 percent of their riding occurred on Monday through Friday, and the remainder (53.6 percent) on weekends. When these figures are studied in conjunction with the trip characteristics table, it appears that some recreation and exercise trips are being made during the week, because utility and commute trips (assumed to be made on Monday through Friday only) account for less than 25 percent of the total miles.

An attempt was made to obtain a "snapshot" of bicycling activity during a one-week period. The questionnaire asked the respondent the number of trips taken in the week immediately prior to the time the form was completed. In most cases, the seven-day period fell during the last weeks of winter or the early weeks of spring, not ideal bicycling weather. Throughout the country, the weather was cold, snowy, or rainy with the possible exception of a few mild winter states. Even under these conditions, over 67 percent (2,188 of the 3,256 responding) stated that they had made at least one trip by bicycle during the week. Of these, almost one-third (31.2 percent) reported making 5 or more trips which suggests commuting to work or school. Many of the respondents living in states that have harsh winters with season-long snow cover reported that their bicycles were undergoing winter "tune-ups". One man from Alaska who reported no trips made in the week commented, "There's four feet of snow on the bike path!"

ACCIDENT EXPERIENCE

There were 3,249 responses to the question, "Did you have a collision or serious fall on your bicycle last year?" Of these, 694 (or 21.4 percent) answered "yes" and 2,555 (78.6 percent) responded "no". Upon examination, the actual number of collisions or serious falls experienced by these 694 individuals showed that 126 persons, or 18.2 percent, were involved in more than one incident. Table 9 shows this distribution.

The terminology "collision or serious fall" was used in place of "accident" in order to allow some judgment on the part of the respondent as to what he considered a serious mishap. Based on the grand total of 7,546,287 miles reported by all respondents in 1974, the accident rate is 113 per

TABLE 9

DISTRIBUTION OF RESPONDENTS
REPORTING ACCIDENTS

Number of Accidents Reported	Number of Respondents	Total Number of Accidents During 1974
None	2,555	0
One	568	568
Two	103	206
Three or More	23	80
TOTAL	3,249	854

million bicycle miles traveled. Appendix E contains a complete state-by-state breakdown of accident rates based on the total mileage and accidents reported by all respondents living in that state. It should be noted that this rate reflects collisions and falls that resulted in both bicycle damage and minor scrapes and bruises, as well as those accidents that required professional medical treatment.

In order to stratify the accident data, four categories, each describing a certain seriousness of injury, were provided for the respondent to select. Table 10 shows this distribution of injury severity for all accidents reported.

As explained earlier, some respondents provided information in this and the following sections on incidents that occurred in other years in addition to 1974. However,

TABLE 10

DISTRIBUTION OF RESPONDENTS WITH RESPECT TO SERIOUSNESS OF INJURY

Seriousness of Injury	Number Reported	Percent of Total
No Injury (Bicycle Damage Only)	148	17.0
Minor Scrapes and Bruises	479	55.1
Moderate Injury (Required Emergency Room Treatment)	184	21.2
Major Injury (Required Hospitalization)	58	6.7
	869	100.0

in the determination of all collision rates on a per mile basis, adjusted values that reflect 1974 mileage traveled are shown in the tables and figures.

Less than 30 percent of the collisions and falls resulted in injuries where professional medical treatment was needed. A total of 193 respondents (1974 adjusted figure), or 27.8 percent of the total persons reporting at least one fall or collision, required at least an emergency room or doctor visit. This total expands to 237 actual incidents when adjusted for those reporting more than one collision or fall, or a rate of 31.4 serious accidents per million bicycle miles. This incident rate (31.4) is equivalent to an injury requiring some type of medical treatment every 31,800 miles, or one injury approximately every 14 years of riding for a L.A.W. member. When only the very serious injuries are examined (those requiring extended medical treatment), the rate is 7.6 per one million miles, or one such accident every 132,000 miles. This means that an L.A.W. member might experience this type of injury once in 57 years. Of course, other factors, such as the sex of the rider, years experience, city size, and other variables will enter into this estimate. They are examined in more detail in the next chapter.

It is also important that one does not attempt to apply these accident rate values to the general bicycling public. As shown later, cycling experience tends to play an important role in accident involvement (along with age and other factors). L.A.W. members are probably more experienced cyclists than the average rider, and probably travel 5 to 10 times as many miles as the average cyclist does.

The cause of the collision or fall is, of course, important to determine. However, the researcher felt that since official accident records were not studied for the incidents that the respondents discussed, certain information was not available to make a fair determination of cause. Also, many incidents were not reported. Therefore, information on only the other vehicle, or object collided with, was requested along with where the accident occurred and what trip purpose was underway at the time of the crash. Table 11 shows the 7 distinct classifications of crash occurrences

TABLE 11

RATIO OF SERIOUS ACCIDENTS TO ALL ACCIDENTS BY CRASH TYPE

Crash Occurrence	All Collisions		Serious Collisions		Seriousness Ratio
	Number Reported	Percent of Total	Number Reported	Percent of Total	
Fall	354	40.6	84	35.6	0.9
Moving Motor Vehicle	159	18.2	61	25.9	1.4
Another Bicycle	149	17.1	30	12.7	0.7
Dog, Animal	67	7.7	23	9.8	1.3
Stationary Motor Vehicle	37	4.2	5	2.1	0.5
Railroad Crossing[a]	27	3.1	6	2.5	0.8
Pedestrian	11	1.3	2	0.8	0.6
All others	68	7.8	25	10.6	1.4
TOTAL	872[b]	100.0	236	100.0	-

[a] Railroad crossing is part of "Fall" category but is shown separately for closer study.

[b] This table is for all accidents reported, not 1974 only.

NOTE: The goodness of fit test ($p = .05$) showed the percent of "serious collisions" by crash type was not significantly different than those percentages for "all collisions." Therefore, if data of only one type is known, the other may be reasonably estimated.

and the total number of all incidents reported by collision type. Also shown are those incidents that required professional medical treatment, classified as "serious" collisions.

The "seriousness ratio" shown is calculated by comparing the percent of serious crashes to the percent of all crashes reported for each type of collision. The higher the ratio, the more serious that type of collision. As seen in the Table, collisions with moving motor vehicles had the highest ratio and collisions with dogs or other animals also ranked high. The "all other" category included many incidents of being forced off the road by a motor vehicle and falling or striking an object. This probably accounts for the high seriousness ratio of 1.4 in this category.

The most frequent crash type, listed simply as "fall", contains incidents where the bicyclist did not actually collide with another object other than the pavement or riding surface. The comments received from respondents indicated that about 60 percent of the accidents in this category can be classified as bicyclist error. A bicyclist turning too sharply going around a corner and subsequently falling would be an example of this. In the remaining 40 percent of the incidents classified as a fall, a poorly-maintained road surface containing large pot holes or longitudinal cracks, rocks, gravel, or other debris caused the bicyclist to fall.

All other reported collisions or falls which did not fit in one of the first seven categories were grouped together. These included a few cases of the bicyclist being forced off the road by an auto or truck and perhaps then hitting a tree or other object. Also included were a few cases of mechanical failure of a bicycle component that led to an accident. Only 26 respondents reported involvement in this latter accident type which seems very low when it is realized that over 7 million miles of bicycle travel were studied. It may be that the respondents maintain their bicycles very well and, if a component does break, they may handle the situation well enough to prevent an accident from occurring.

It is surprising to note from Table 11 that crashes classified as falls and including those involving railroad crossings accounted for over 43 percent of all accidents and over 38 percent of serious injuries. These crash types could be considered as single-vehicle incidents. On the other hand, collisions with motor vehicles showed a lower than expected percentage (28 percent) of the total accidents requiring medical treatment. There were a very small number of pedestrians struck by bicycles, but dogs and other animals represented over 10 percent of the serious accident cases reported. In addition, there were numerous comments from respondents on the many "near misses" due to dogs.

A large number of bicycle-bicycle collisions also were reported (149 out of the total 872 accidents). The separation of motor vehicle and bicycle traffic is usually suggested as the inherent solution to reduce the number of bicyclist injuries and deaths. This is probably quite true for fatality cases. However, the results as displayed in Table 11 show that almost 60 percent of all serious injuries reported could just as well have occurred on a bicycle path completely separated from automobile traffic. This is a fact worth considering when evaluating the safety benefits of a separate bikeway.

Additional information requested regarding accident experience included the location of the collision or fall, and the trip purpose engaged in when it happened. These results are shown in Table 12. A comparison of accidents by location and activity as related to miles traveled in each category is discussed in Chapter V.

It should be remembered in looking at Table 12 that although over 88 percent of the collisions occurred on major and minor streets having no bicycle facilities, the vast majority of the miles traveled by respondents were on these facilities. This relationship is discussed further in the following chapter.

A last item directly involving accident experience on the questionnaire asked those respondents who reported having one or more accidents in 1974 how many of these were officially reported to police authorities. Only 124 falls or collisions (less than 18 percent of the total experienced) were reported. This number represents a little over 64 percent of all the incidents requiring professional treatment.

TABLE 12

DISTRIBUTION OF RESPONDENTS WITH RESPECT TO
LOCATION AND TRIP PURPOSE AT TIME OF ACCIDENT

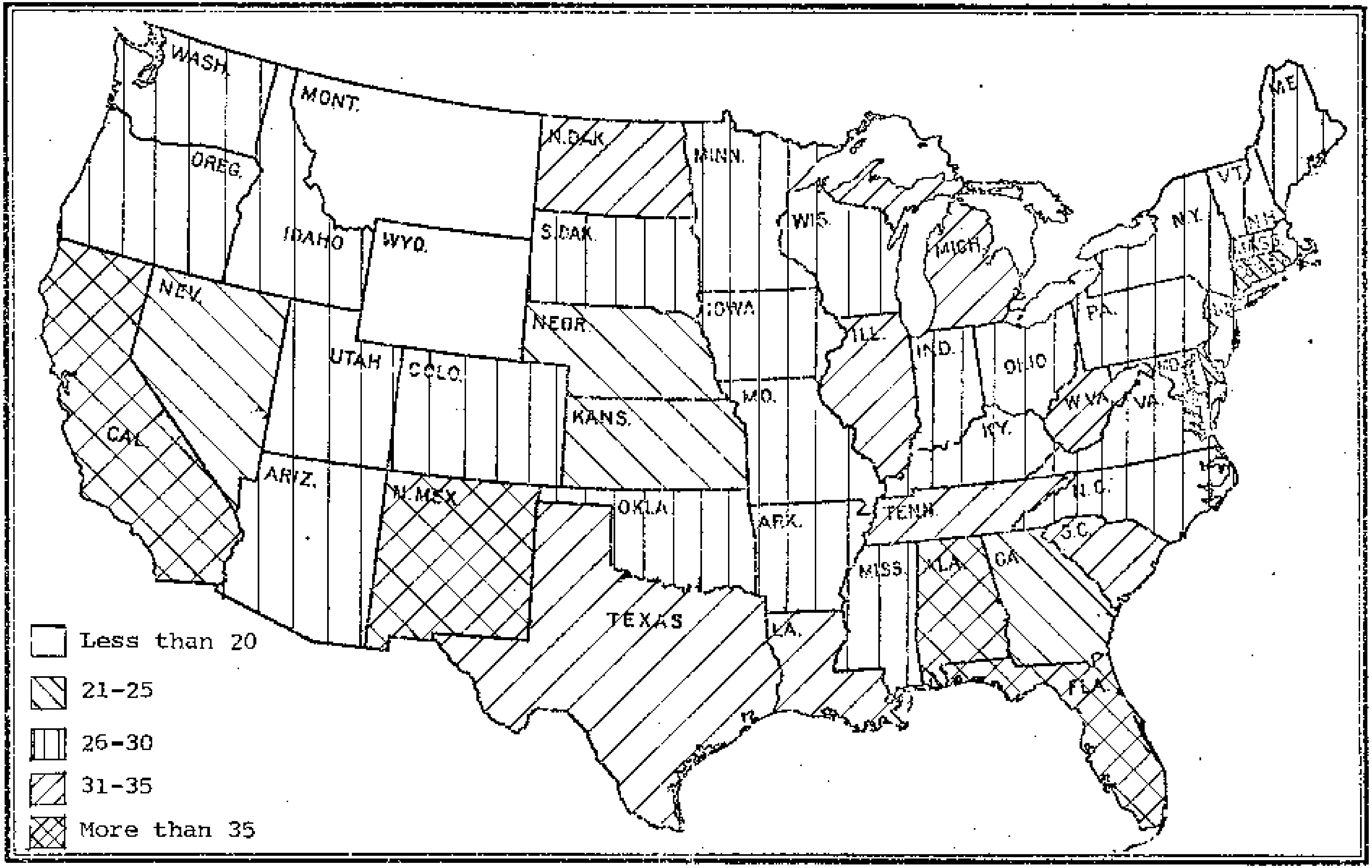
Location of Accident	Number Reported	Percent of Total	Trip Purpose at Time of Accident	Number Reported	Percent of Total
Major Street	291	34.8	Work/School	160	18.4
Minor Street	451	54.0	Recreation/Touring	450	51.8
On-Street Bicycle Facility (Lanes, Routes)	14	1.7	Utility	90	10.4
			Exercise	103	11.8
Off-Street Bicycle Facility (Paths)	79	9.5	Racing	57	6.6
TOTAL	835	100.0	TOTAL	860	100.0

This would appear to substantiate many claims that bicycle accidents are under-reported. There was evidence in the comments of attempts at reporting some of the incidents mentioned but, in most cases, the respondent stated that the police refused to file an official written report.

ATTITUDINAL QUESTIONS

Recipients of the questionnaire were also asked a question relating to the minimum air temperature at which they usually would still ride a bicycle. Interestingly, although the average minimum temperature of the 3,073 respondents who answered this question was 29.6 degrees Fahrenheit, there was quite a range noted when each individual state was studied. Persons in colder states, such as Wyoming and Montana, stated that they usually rode until the temperature was below 15 degrees. Warmer state residents, such as Florida and California, showed a minimum over 35 degrees. The several respondents from Alaska stated a temperature of 36 degrees was necessary for them to ride a bicycle, possibly due to long periods of time when snow is on the ground. Map 4 shows these minimum temperatures for each state. Of interest is the fact that there were 199 respondents (6.7 percent of the total) that stated that they still rode their bicycle when the temperature was zero degrees or below.

Other attitudinal questions asked the frequency of riding done after dark and in the rain. The distribution of



MAP 4 - MINIMUM TEMPERATURE BELOW WHICH RESPONDENT
WOULD NOT USUALLY RIDE A BICYCLE
(DEGREES FAHRENHEIT)

the responses to these queries along with those to a question asked concerning obeying the vehicle laws is shown on Figure 7.

It is seen that only 64.8 percent of the respondents ride after dark either occasionally or frequently. This is surprising since the League of American Wheelmen members probably represent the most active riders in the country. A close relationship exists between the number of respondents who use lights (60.5 percent) and those that do ride at night. It appears from this that about 4 percent of the respondents ride at least occasionally at night with no lights.

Over 75 percent of the respondents stated that they rode in the rain; many commented that they also rode in snow. Apparently, many bicyclists feel that darkness is more of an inhibitor to riding than weather and temperature conditions. Accident rates for riders who do ride in the rain and after dark are discussed in the next chapter.

With regard to the question of obeying vehicle laws, only 50.2 percent stated that they "always" obeyed the laws that applied to them as a bicyclist. However, there were many comments that the applicable laws were unknown or vague in the respondent's mind. This problem is presently being studied by the U.S. Department of Transportation (32). A special report on bicycle laws in the United States was published in September 1974 specifically discussing many of the contradictory and confusing laws now in existence (6). The National Committee in Uniform Traffic Laws and Ordinances

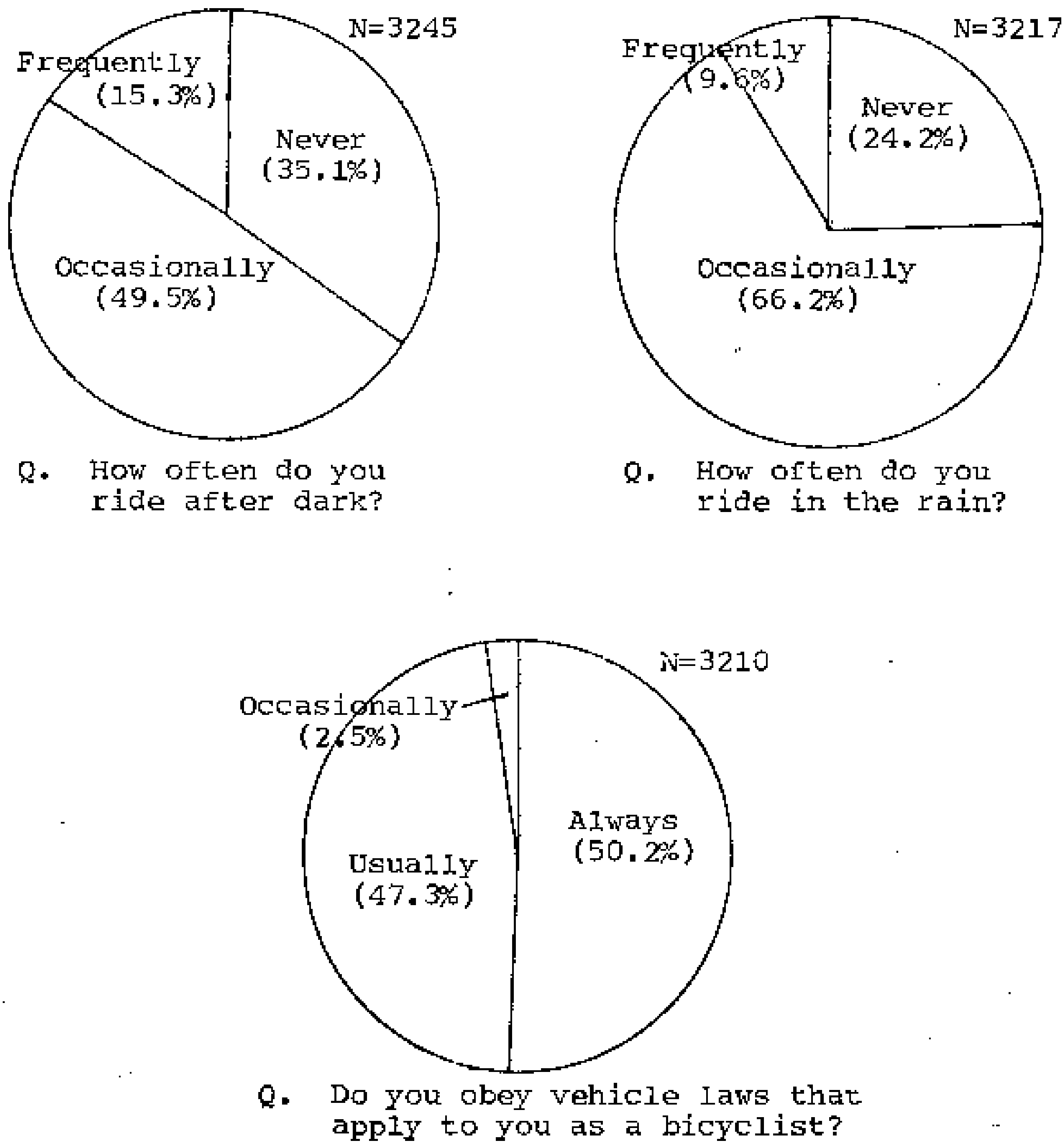


FIGURE 7 - RESPONSES TO ATTITUDINAL QUESTIONS - L.A.W.

(NCUTLO) will meet in 1975 to discuss updating the bicycle section of the Uniform Vehicle Code. This latter document is a guide that most states adopt as their vehicle laws with minor alterations (40).

Returning to the question concerning law obeyance on the questionnaire, a large number of the 47.3 percent who checked that they "usually" obeyed laws stated that they obeyed all laws, except they usually "slid by" STOP signs if no traffic was coming. This treatment of the STOP sign as if it were a yield symbol is commonly practiced by many cyclists, including the author, at deserted intersections. Many times, a bicyclist can come to an almost complete stop while still on the bicycle and continue on without actually having his foot hit the ground. The definition of "stop" for bicyclists has undergone considerable discussion in law enforcement circles and was considered as a possible change to the Uniform Vehicle Code. A special panel on bicycle laws (as part of NCUTLO) recommended that no changes be made, and that bicyclists continue to come to a full stop at all STOP signs. They did note that the bicycle is most unstable while being started and stopped, and increases the bicyclist's danger, but they felt that it would be confusing to have different meanings for a STOP sign (35). It may be that many L.A.W. members realize this danger and therefore commonly do not make a complete stop at all STOP signs. Accident experience analysis categorized by the different responses to the question of law obeyance is discussed in Chapter V.

CHAPTER V

ANALYSIS OF DATA BY SPECIFIC VARIABLES

This chapter analyzes both mileage data and accident data from a standpoint of what effect independent variables, such as age, sex, experience, and similar items, have on the number of miles ridden or the possibility of accident involvement.

ANALYSIS OF MILES RIDDEN

Age and Sex

As Figure 8 shows, on the average the male respondents traveled almost 900 miles more by bicycle over a year's period than the female respondents. This difference of almost 40 percent more mileage by males may reflect the tendency for males to ride on longer trips than females and also that the work or utility trip may not be as easily made by the female due to dress or other restrictions, including harassment by motorists. This latter action was reported by several female respondents. It should be remembered also that the questionnaire was directed at the most active rider in the family. In many cases, a women who did travel a great many miles by bicycle could not respond because a male in the household might have traveled even further.

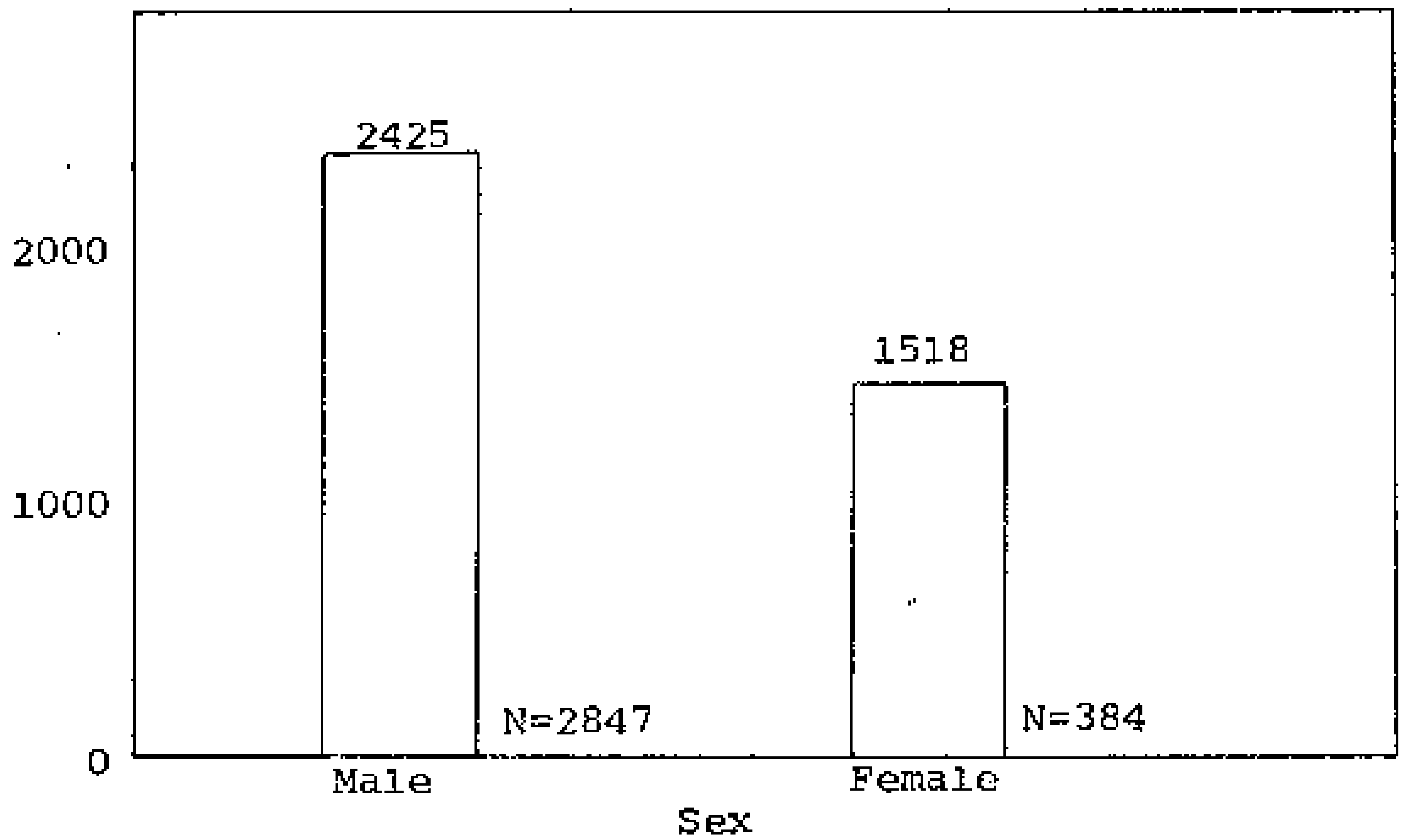


FIGURE 8 - MILES RIDDEN IN 1974 BY SEX

The age of the respondent does not appear to have had an influence on the number of miles ridden. Figure 9 shows the average annual miles traveled for each age group studied.

The oldest age group (those 66 to 82) averaged over 3,200 miles a year, over 1,000 miles more than the youngest group and almost 900 miles more than all other age groups. Many older respondents stated that they were retired and rode almost on a daily basis. This may account for the very

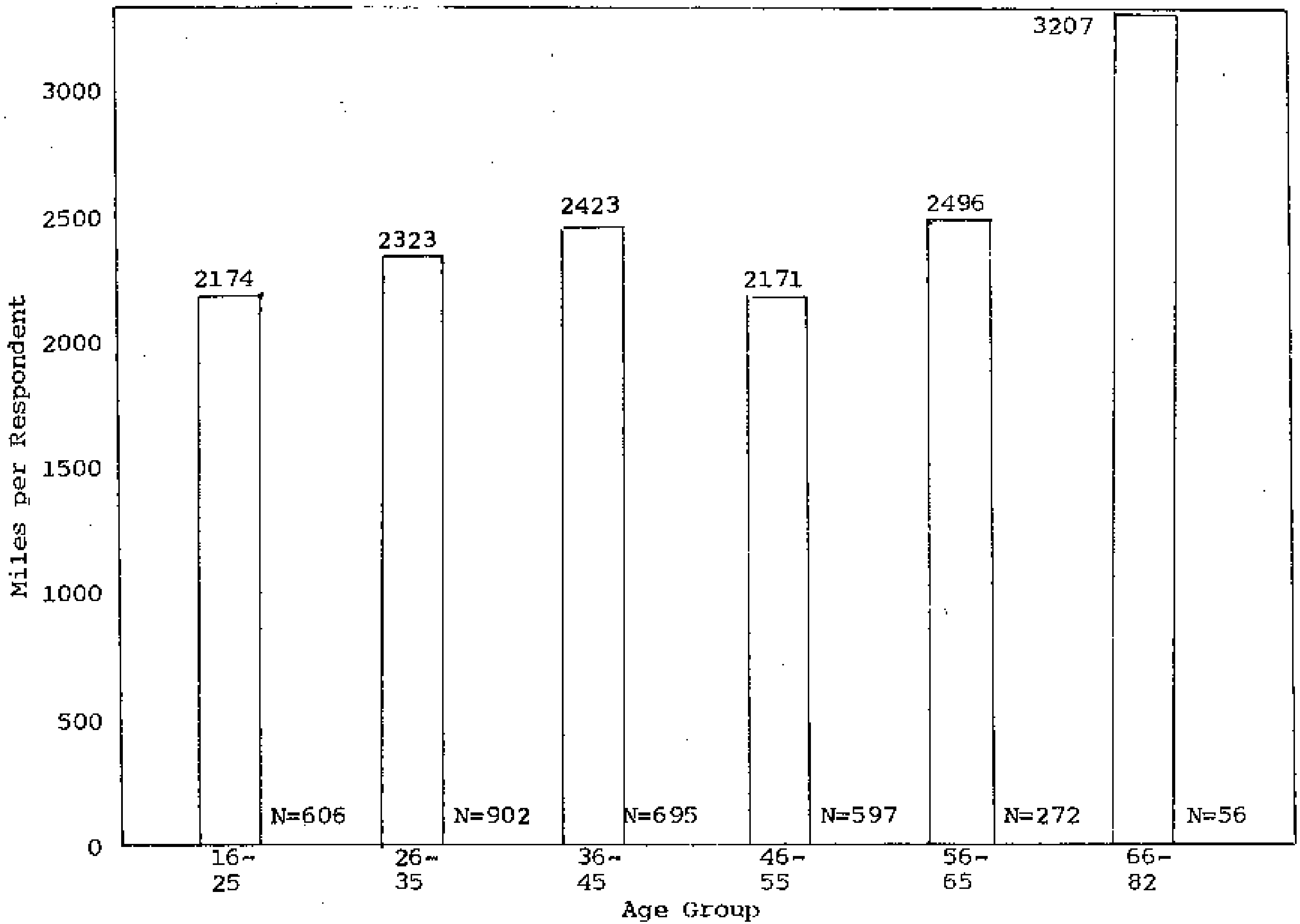


FIGURE 9 - MILES RIDDEN IN 1974 BY AGE GROUPS

high average in this age group, but it should be noted that there were only 56 responses in this age group.

Topography and City Size

Figures 10 and 11 show how the average annual miles traveled by the respondents differed according to the topography and the size of the metropolitan area where they live. From Figure 10, it appears that L.A.W. members traveled further in areas that could be classified as steep hills or mountainous than those who rode mostly where it was flat or rolling. However, this difference is based on only 6 percent of the respondents riding in steep terrain. Statistical testing showed that there was no significant difference between those riding in flat land and those in rolling terrain.

Upon examining Figure 11, it appears that persons living in smaller cities (those under 50,000) and in rural areas travel less distance in a year than those in larger cities. This may be due, in part, to the fact that many destinations are closer in a smaller size city, and therefore trip lengths would be less.

Years Experience

Figure 12 shows the average miles ridden in a year stratified by the number of years that the respondent had been continuously riding a bicycle. As a respondent continues to ride a bicycle over a period of years, it appears that he travels further each year. The very low average of 807 annual

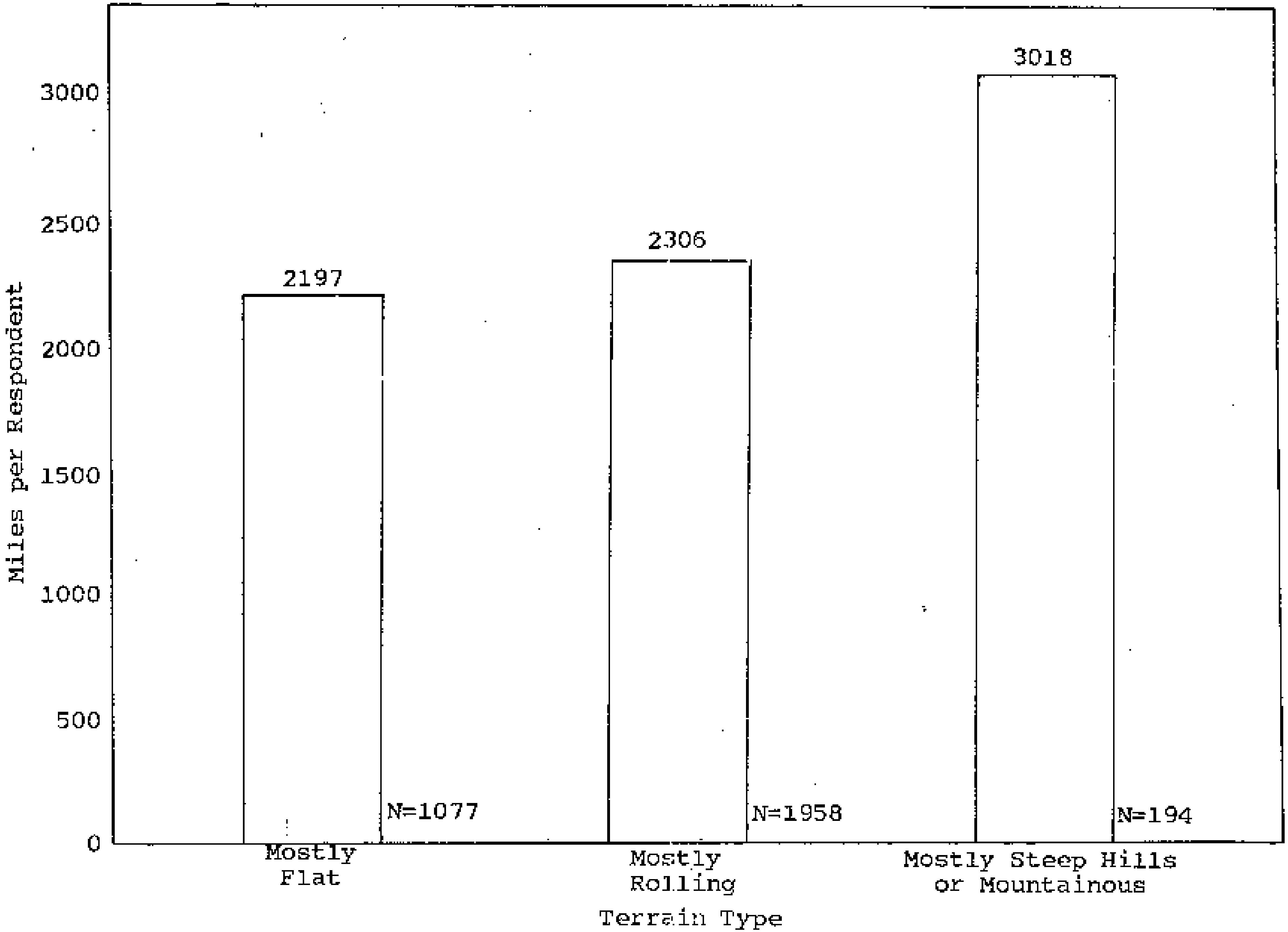


FIGURE 10 - MILES RIDDEN IN 1974 BY TOPOGRAPHY

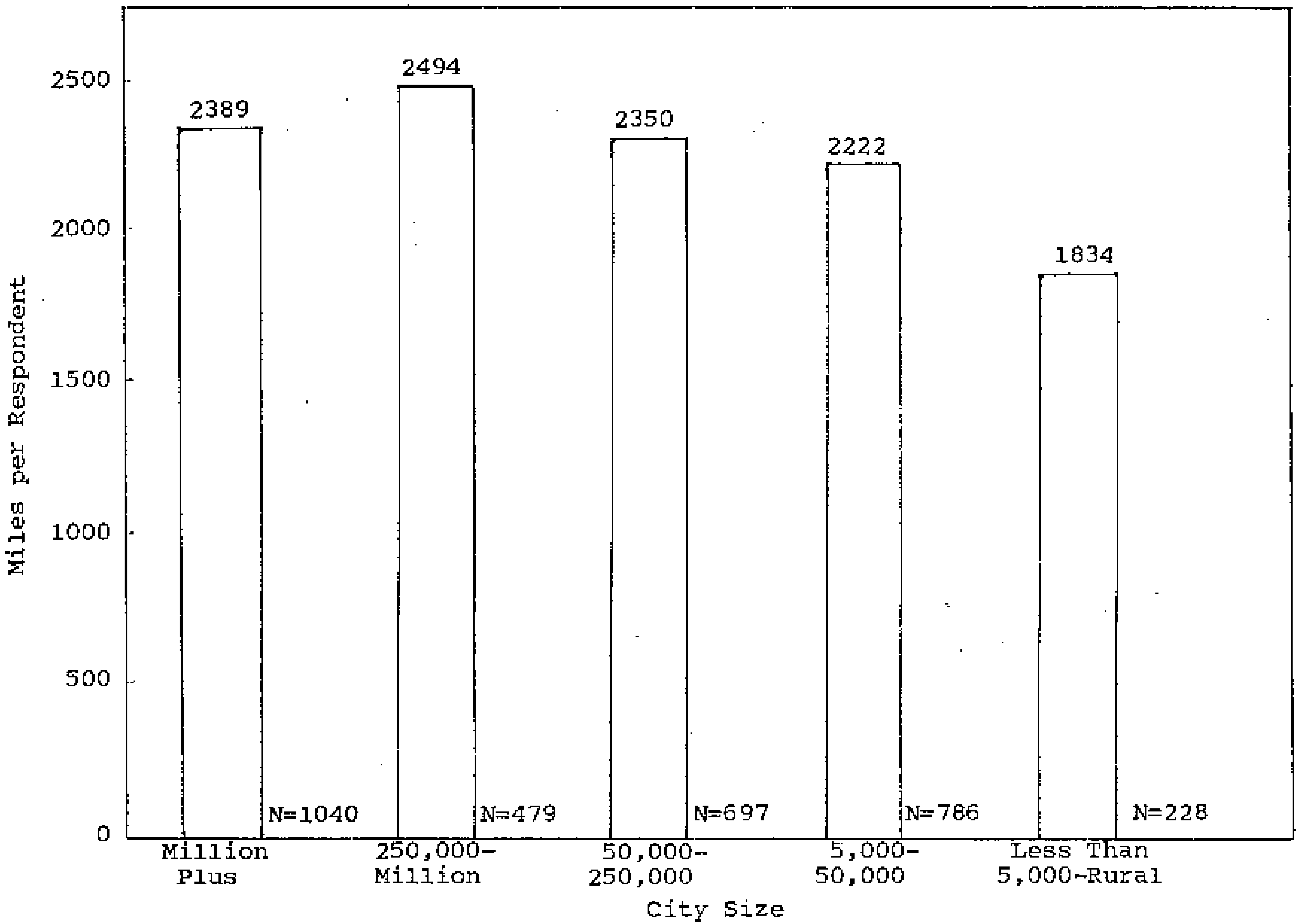


FIGURE 11 - MILES RIDDEN IN 1974 BY CITY SIZE

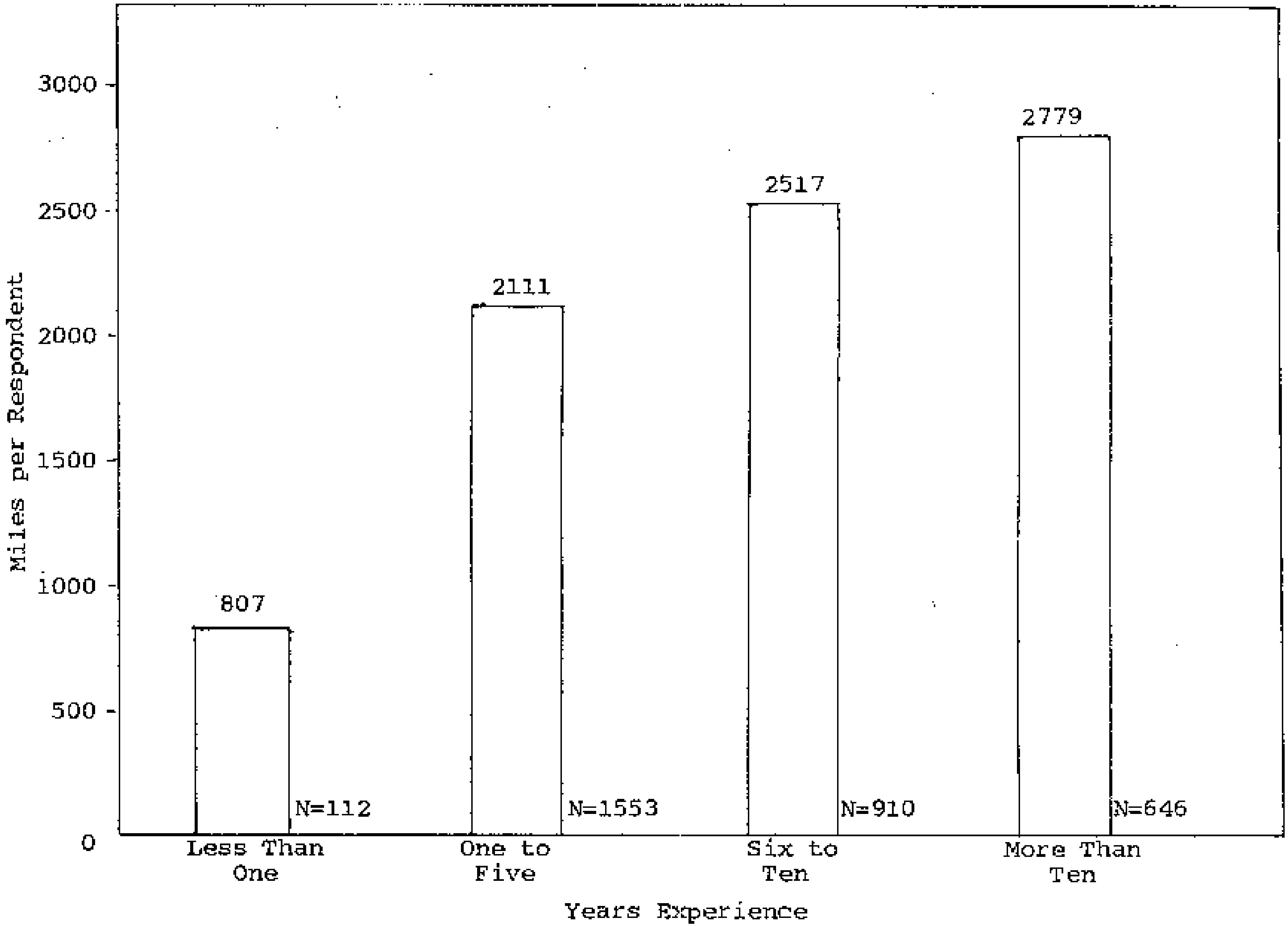


FIGURE 12 - MILES RIDDEN IN 1974 BY YEARS EXPERIENCE

miles traveled for those respondents with less than one year's experience is probably not representative because these respondents could not provide a full year's mileage figures if they had been riding for less than a year. This was an oversight in the design of the questionnaire and that mileage figure is shown for illustration only.

Auto Availability

If it is to be believed that many cyclists are using bicycles to complete trips that would otherwise have been by other modes, then the miles traveled by bicycle should increase if the respondents have less cars available. As can be seen in Figure 13, this is exactly what happened.

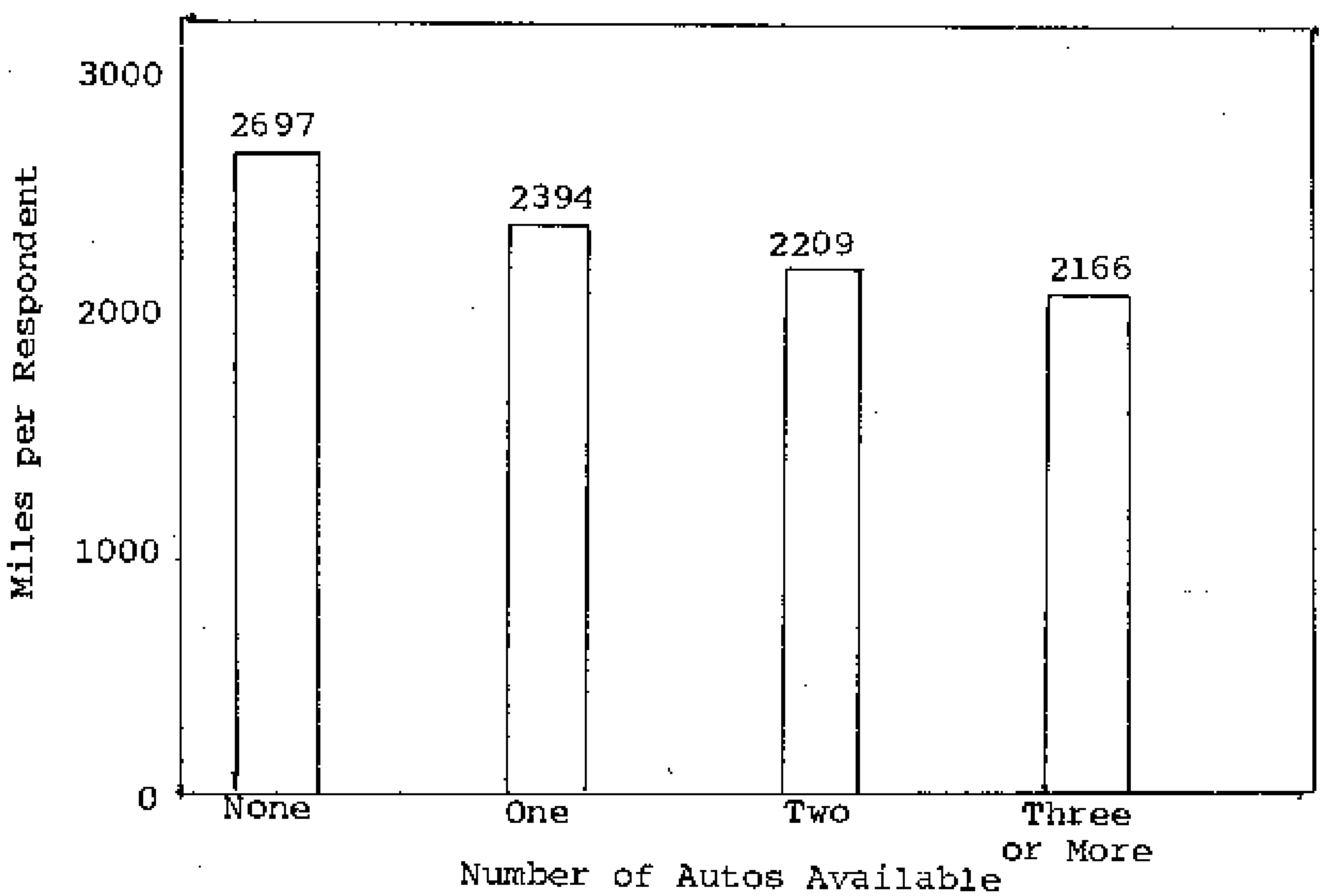


FIGURE 13 - MILES RIDDEN IN 1974 BY AUTO AVAILABILITY

Those respondents with no cars available traveled almost 11 percent more miles by bicycle than those with one automobile available, and almost 20 percent more than those with three or more cars. These are findings that transportation planners might take note of; it appears that the bicycle is being used as a substitute mode for some trips, at least in the case of the respondents to this questionnaire.

ANALYSIS OF ACCIDENT EXPERIENCE

Age and Sex

While bicycles are becoming more and more of a common sight on streets and highways today, so are reports of injuries and deaths to the cyclist (12). Therefore, it is important to note what influence different variables appear to have on the rate of such incidents. Figures 14 and 15 show the accident involvement rate per one million miles traveled by bicycle for both male and female and for differing age groups.

Females appear to have a much higher incident rate, in both the category of all accidents reported and those requiring medical treatment, classified as serious. This may be due in part to the female having less riding experience than the male. However, analysis showed that there were only minor differences between the two sexes in this respect. It may also be that females do not consider bicycling as dangerous as male riders. This premise was investigated by examining the percentage of male and female riders who use

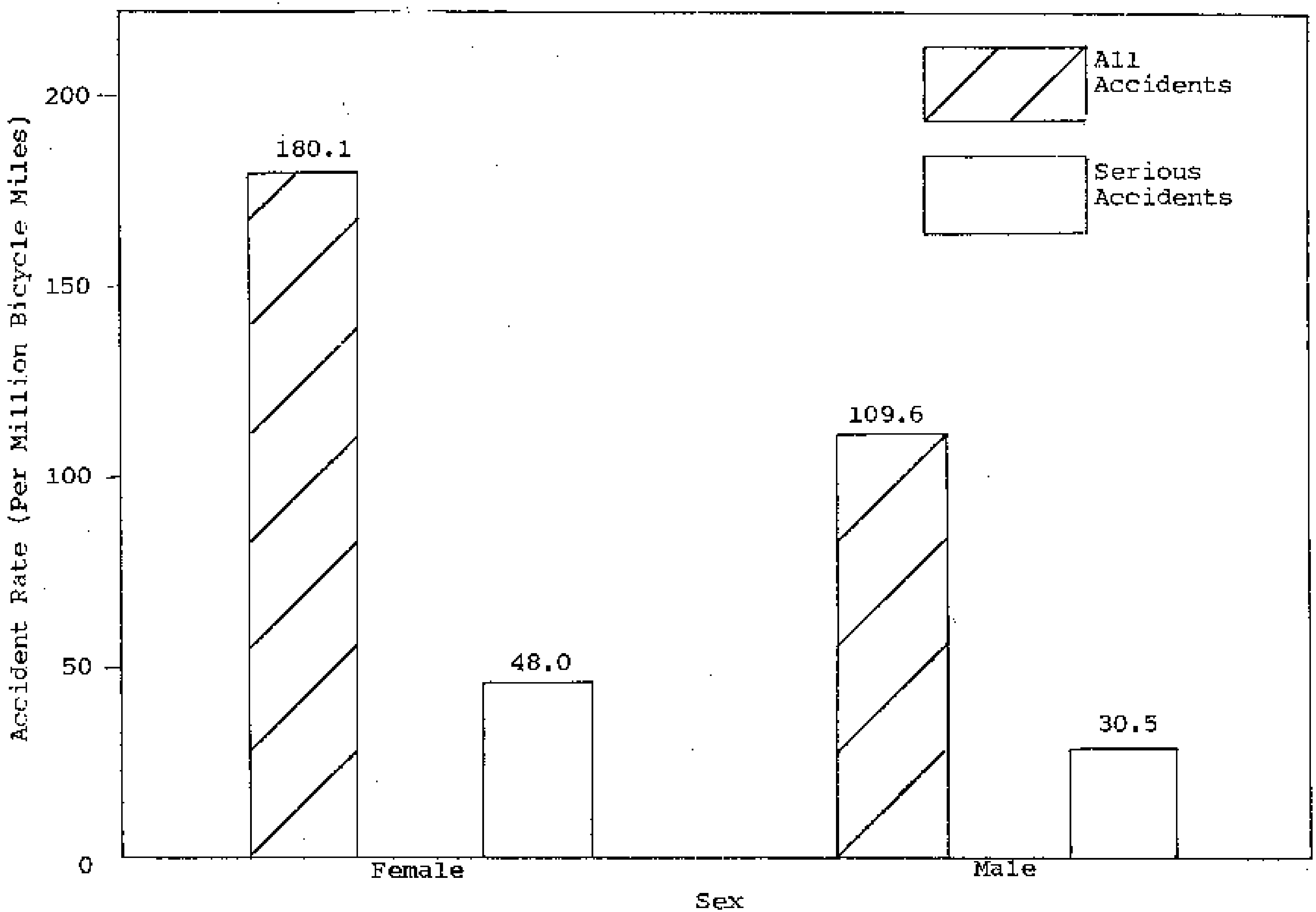


FIGURE 14 - ACCIDENT RATE BY SEX

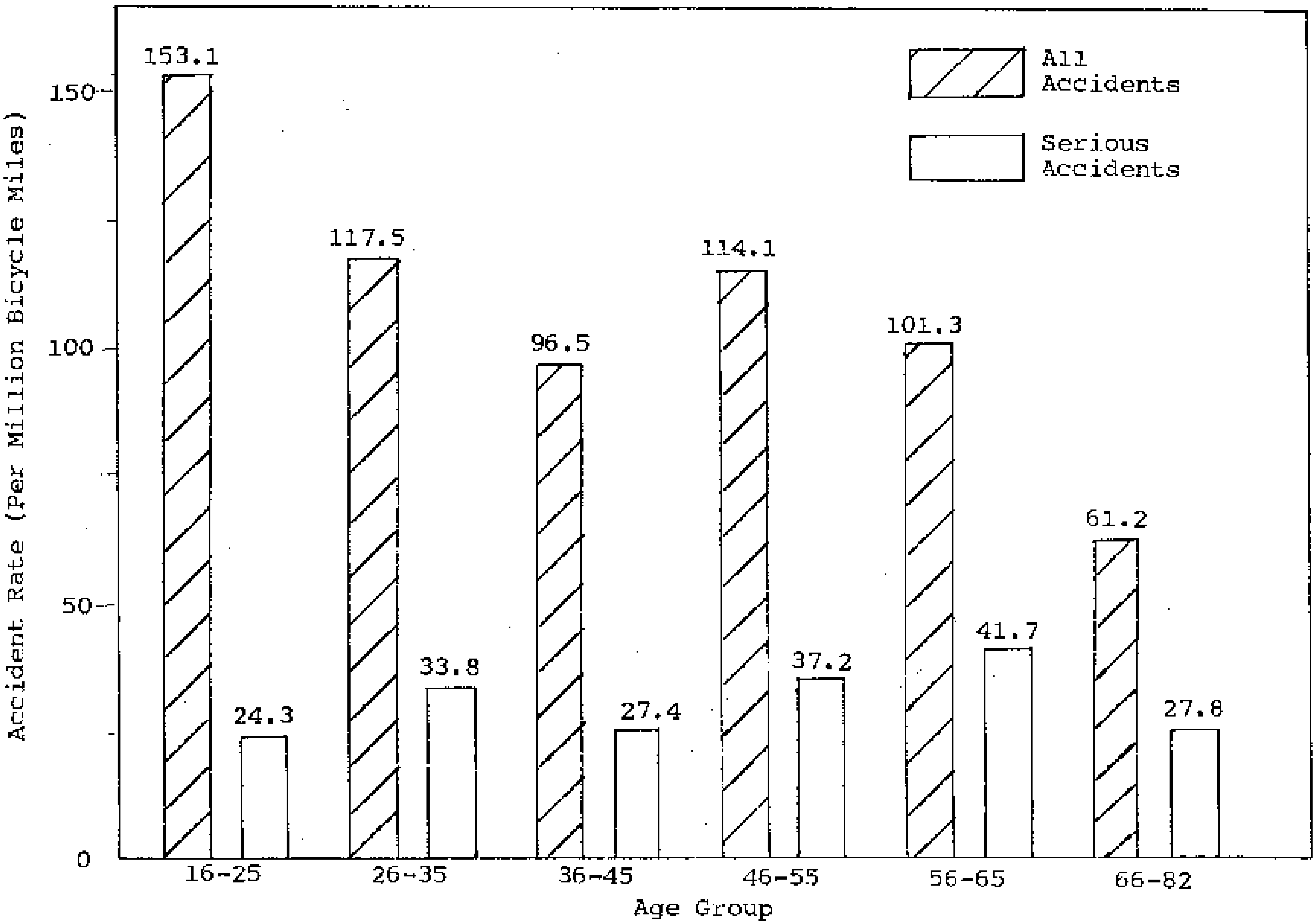


FIGURE 15 - ACCIDENT RATE BY AGE GROUP

helmets and mirrors, safety-related items. Males did show a 12 percent higher usage of helmets, and a 3 percent higher use of mirrors than females. One factor that might be influencing the finding in this study is that only 12 percent of the respondents were female. Although this provided 391 individual cases of female riders to examine, this disproportionate sex division may not provide a good basis for comparison. Incidently, motor vehicle accident studies show females experiencing an accident rate about 20 percent lower than males (2).

When different age groups are examined in relation to their accident rate, it appears that older groups have less overall accidents while the youngest group (ages 16-25) showed the highest rate of 153.1 collisions or serious falls per million bicycle miles. However, when only those accidents requiring medical treatment are examined, the trend is somewhat reversed. The youngest group showed the lowest rate (24.3) while the groups aged 46 to 55 and 56 to 65 experienced serious accidents at the rates of 37.2 and 41.7, respectively. The oldest group (ages 66-82) had a considerably lower rate of 27.8.

These diverse findings are difficult to explain, although it might be reasonable to assume that younger riders might experience a higher overall accident rate due to having less experience and possibly the tendency of the young to take more chances.

Cycling Experience

Figure 16 shows the accident rate for all incidents and also those classified as serious categorized by the years of bicycling experience for the respondents.

Similar to the rates when stratified by age, it appears that those cyclists with more experience have a lower accident rate. In fact, the rate is almost 50 percent less for those with more than 10 years of riding experience when compared to those with less than one year's experience. When only serious incidents are examined and the small sample in the first category ignored (less than one and one-half percent of total miles traveled fell in this category), there is an obvious decrease in this rate of incidence.

City Size and Topography

Figures 17 and 18 show what the accident rates were for respondents living in different size cities and also riding in different types of terrain. There appears to be no major differences for accident occurrence in different size cities, although there is a slightly lower rate for both the cases of all accidents and serious accidents in smaller cities than larger cities.

When topography is looked at as a possible factor in influencing accident rates, there is a noticeable decrease in the accident rate as the topography changes from flat to rolling to steep. This is the reverse of what would be assumed to occur. However, it may be that cyclists exercise

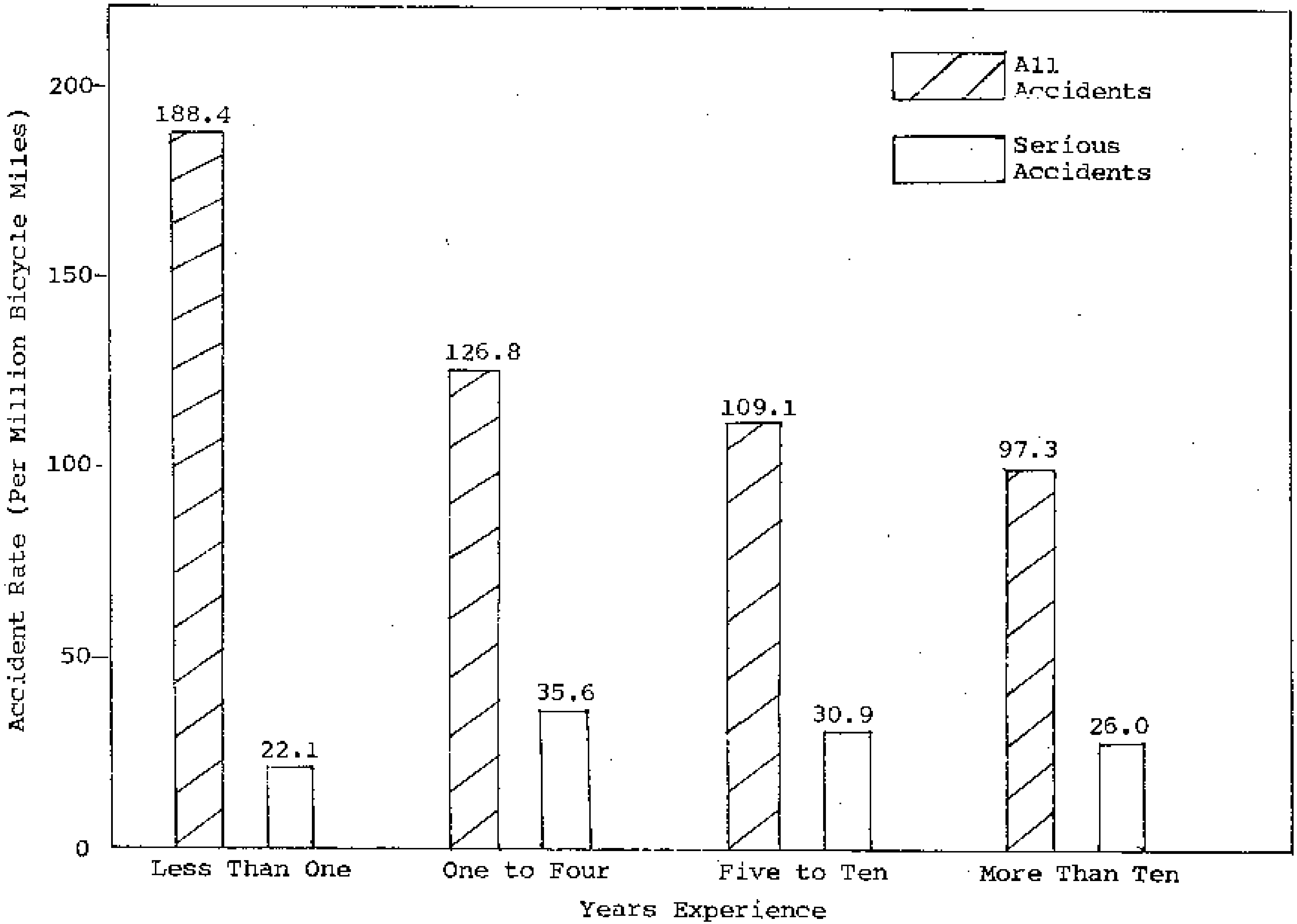


FIGURE 16 - ACCIDENT RATE BY YEARS EXPERIENCE

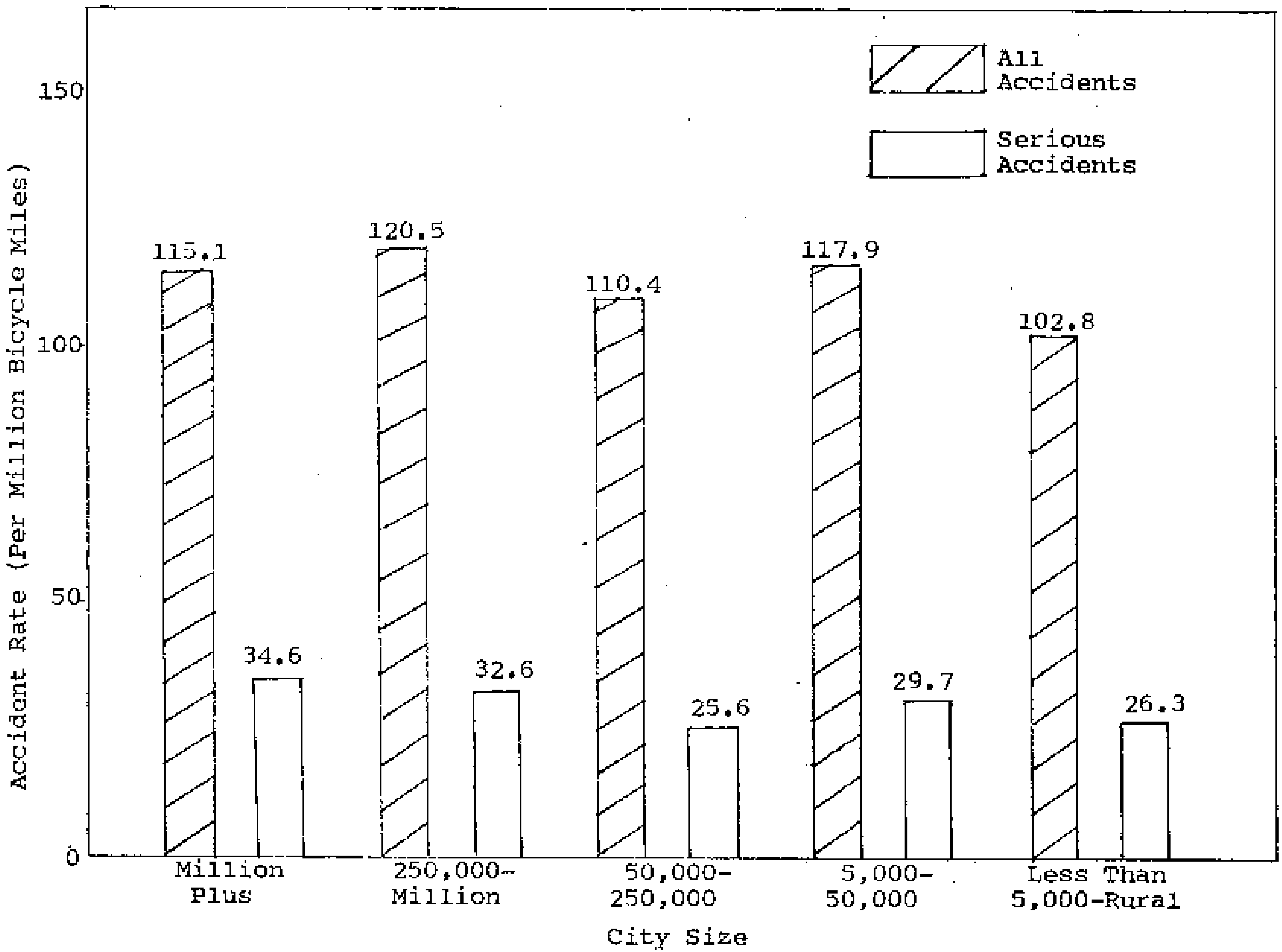


FIGURE 17 - ACCIDENT RATE BY CITY SIZE

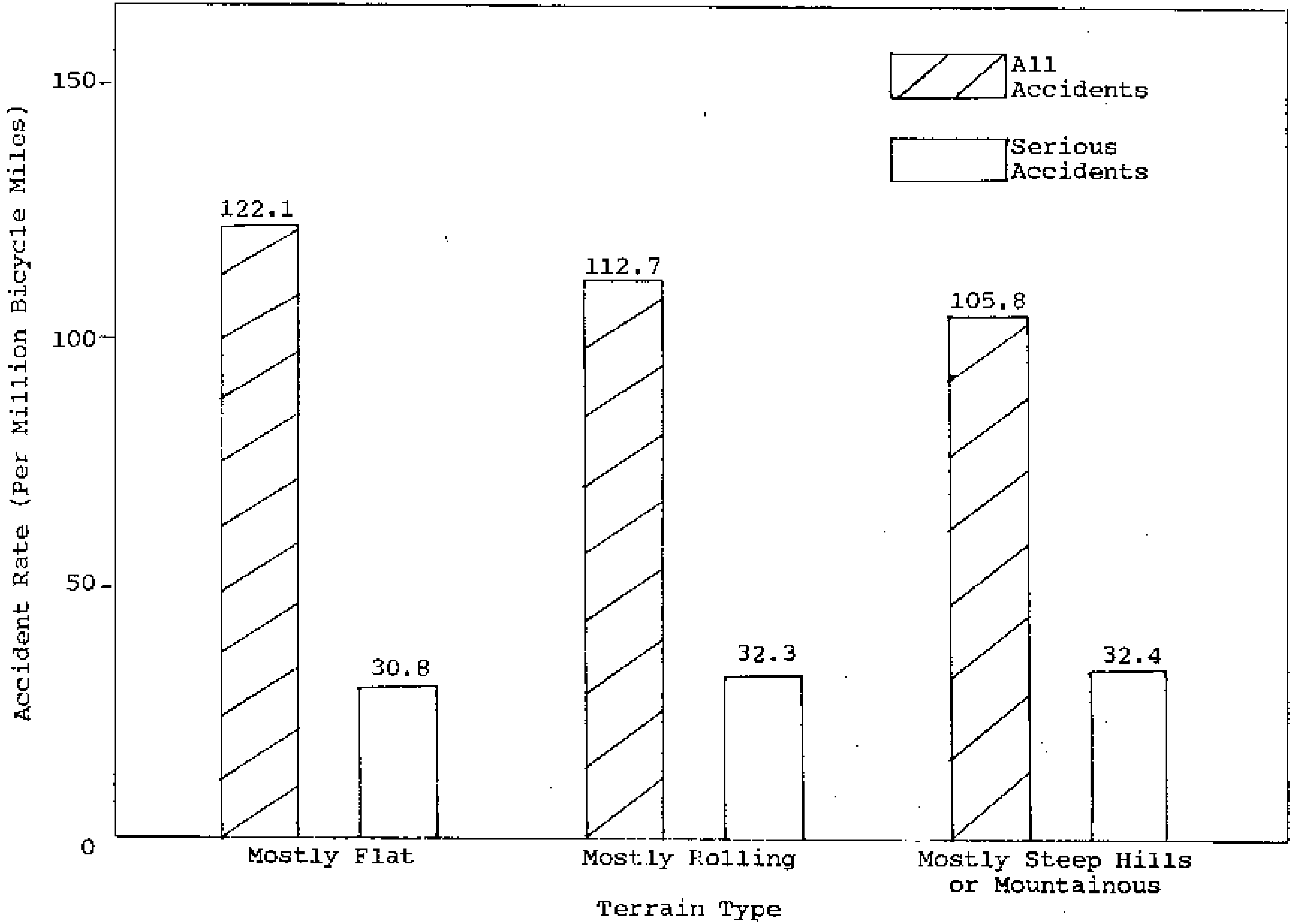


FIGURE 18 - ACCIDENT RATE BY TOPOGRAPHY

more caution on steep hills than when riding in flat areas. These differences are not noticeable when only serious collisions or falls are examined.

Location of Crash and Trip Purpose

Table 13 permits comparisons to be made for accidents that occurred on different type facilities, ranging from major streets to separate bicycle paths. Similarly, Table 14 provides information as to the trip purpose or activity under way at the time of the crash. Off-street bicycle facilities (that do not allow motor vehicle traffic) showed the highest overall accident rate, and also an extremely high serious accident rate. In fact, the serious accident rate of 79.6 incidents per million bicycle miles traveled was the highest calculated rate for any analysis done in the study. On an accident frequency basis, a L.A.W. bicyclist riding on off-street bikeways would likely be involved in a serious collision or fall requiring professional medical treatment once every 12,600 miles, or every five and one-half years, a much higher frequency than any other facility studied. No explanation is known for this finding. A guess might be that cyclists use less caution on this type facility, feeling it is free of the menacing motor vehicle only to collide with a tree or fall on some slippery gravel. Coincidentally, the lowest accident rate existed for both the categories of all accidents and serious accidents when those incidents that occurred on bikelanes and bike routes were

TABLE 13

ACCIDENT RATE BY LOCATION OF CRASH

Facility Type	Total Miles Traveled by All Respondents	All Accidents		Serious Accidents	
		Number Reported	Rate Per Million Miles	Number Reported	Rate Per Million Miles
Major Street	2,634,000	298	114.2	92	34.9
Minor Street	4,407,000	461	104.8	118	26.7
On-Street Bicycle Facility (Lane, Route)	241,000	14	58.1	6	24.8
Off-Street Bicycle Facility (Path)	264,000	81	291.6	21	79.6

TABLE 14

ACCIDENT RATE BY TRIP PURPOSE

Trip Purpose	Total Miles Traveled by All Respondents	All Accidents		Serious Accidents	
		Number Reported	Rate Per Million Miles	Number Reported	Rate Per Million Miles
Work/School	1,637,000	160	97.7	40	24.4
Recreation/Touring	3,954,000	451	114.1	135	34.1
Utility	483,000	89	184.3	21	43.5
Exercise	1,004,000	100	100.6	29	28.9
Racing	468,000	54	115.4	12	25.6

examined. As expected, the rate for accidents occurring on minor streets was somewhat lower than those incidents occurring on major streets. This is probably due to less exposure to high speed and/or high volume traffic for the bicyclist when using minor streets compared to travel on major streets.

When the relationship between trip purpose and accidents is examined, the utility trip stands out as having the highest rate of incidents, both for serious accidents and also when all accidents are studied. The commute trip (work or school) had the lowest rate in both categories of accidents. This latter finding may have occurred because a person making regular trips over the same route on an almost daily basis learns the "feel" of the route, and its bad sections and good sections. Similar to a truck driver using precautions when he is on a certain section of a familiar road, this acquired skill in "reading" the road from repetitious use allows the cyclist to travel safer, and thereby reduce his accident potential.

Responses to Safety-Related Questions

An attempt was made to determine if the respondent's attitude toward safety and obeyance of the law had any effect on his accident involvement.

Figure 19 shows the accident rate of those respondents who stated that they wore a helmet and used a rear view mirror while riding a bicycle, and those that did not.

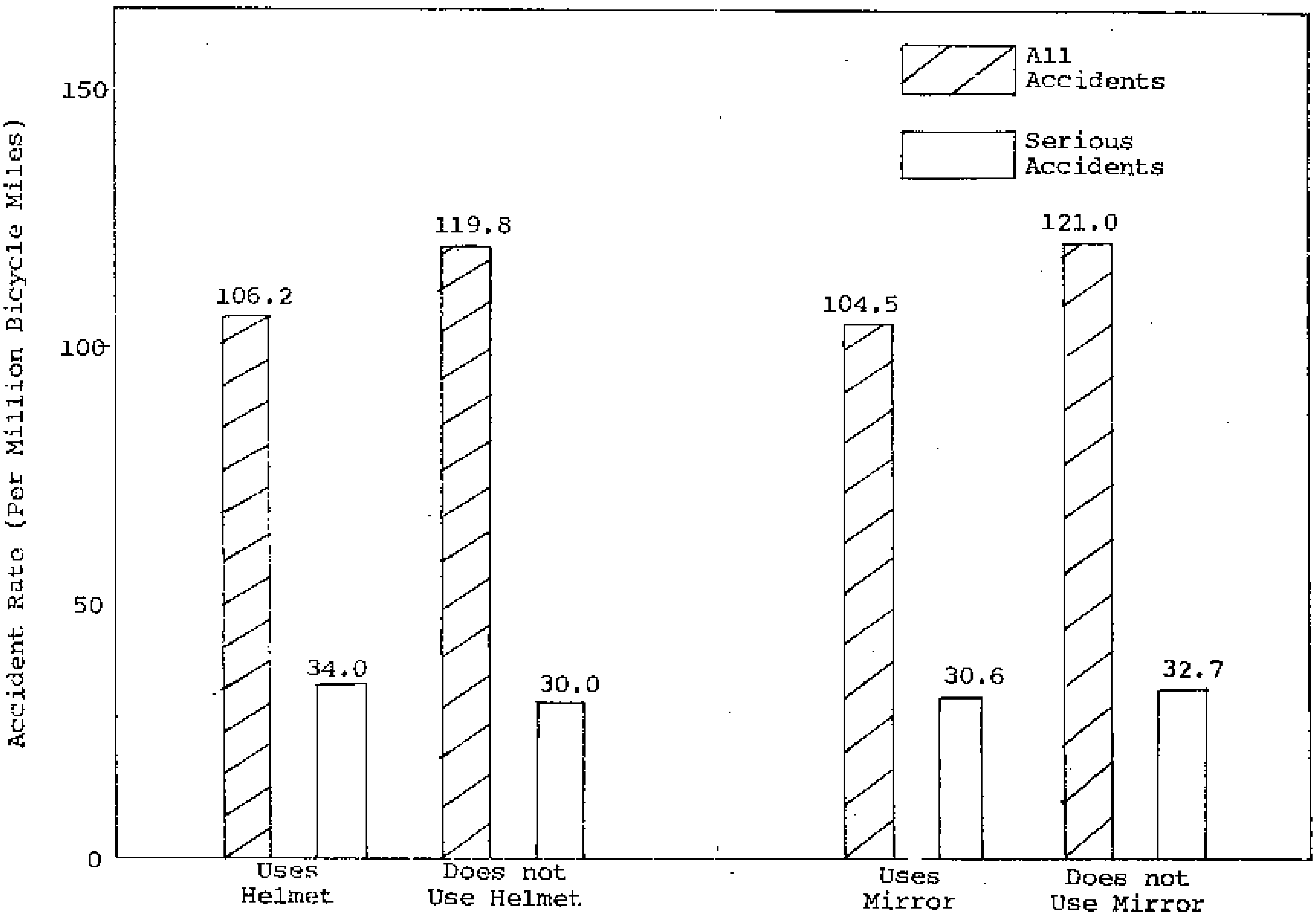


FIGURE 19 - ACCIDENT RATE BY USE OF SAFETY EQUIPMENT

Figure 20 shows the rate of accident involvement categorized by the respondent's answer to how strictly he obeyed the vehicle laws while operating his bicycle.

The respondents who stated that they did wear helmets and used a rear view mirror displayed an accident rate 11 and 14 percent lower than those who did not, respectively. A quirk does appear when the serious accident rate is examined for helmet users and non-users. The analysis shows that non-users experienced accidents that could be classified as serious at a lower rate than helmet wearers (30.0 versus 34.0). It would seem that helmeted bicyclists might have a lower serious accident injury rate than others; however, data based on over 800 reported accident cases do not bear this out.

Respondents who answered that they "occasionally" obeyed vehicle laws while riding their bicycles had an accident rate 38 percent higher than those that "usually" and "always" obeyed the laws. Also, the serious accident rate was higher for these individuals. This subjective question was added to the questionnaire with the intent of obtaining a general idea of what regular bicycle users felt toward the vehicle laws as they applied to bicycles. (More discussion on this subject can be found in the section "Attitudinal Questions" in Chapter IV.) However, some very interesting findings have also appeared with regard to the relationship between accident involvement and how the respondent feels toward obeyance of the law.

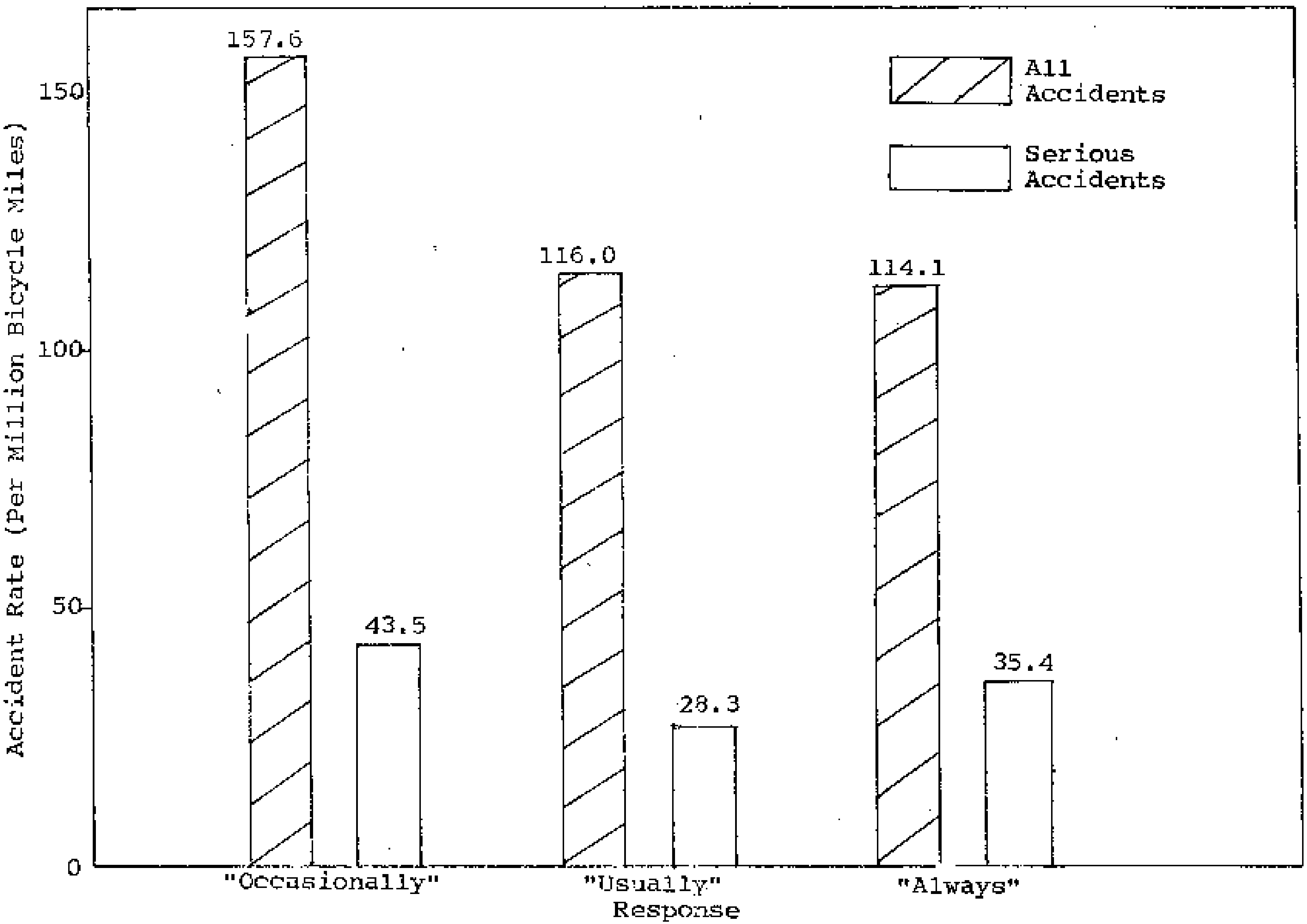


FIGURE 20 - ACCIDENT RATE BY RESPONSE TO "OBEY LAW" QUESTION

Responses to Ride in Rain
and in the Dark Questions

Table 15 shows the results when accident rates are computed for both categories of all accidents and serious incidents only, stratified by how often the respondent rode a bicycle after dark or in the rain. Interestingly, in both cases, the rider who stated he bicycled in what seemingly would be considered more accident producing conditions, showed lower accident involvement rates. This relationship appears to hold true for both the rates involving all accidents and the more serious incidents requiring professional medical treatment. A possible explanation may be that the respondents who ride at night and in the rain realize the more dangerous conditions and bicycle accordingly.

TABLE 15

ACCIDENT RATE BY RESPONSE TO RIDE IN RAIN
AND DARK QUESTIONS PER MILLION BICYCLE MILES TRAVELED

Ride in Rain	Rate for All Accidents	Rate for Serious Accidents
Never	125.8	33.6
Occasionally	112.9	31.9
Frequently	110.2	31.6
Ride when Dark		
Never	113.1	30.4
Occasionally	121.2	33.8
Frequently	104.0	29.8

Comparison with Auto
Accident Rate

In order to put into perspective the bicycle accident rates that have been discussed in this report, motor vehicle accident rates available from the Federal Highway Administration are presented for comparison (17). For the year 1973 (the latest year data are available), the overall non-fatal injury rate shows that about 2.4 such injuries occur in one million miles of driving on all non-Interstate highways. This rate rises to 2.9 when only urban rates are examined. These injuries are defined as any bodily harm received by any person in a motor vehicle traffic accident, including pedestrians and bicyclists. It is assumed, however, that only injuries resulting from a serious enough accident requiring police to file a report would be the type entered into these rate calculations.

Assuming that any bicycle injury requiring at least a doctor visit or emergency room treatment would be an equivalent type injury, the bicycle rate of 31.4 accidents per million bicycle miles traveled is the comparable rate. It should be remembered that an automobile is driven an average of 9,992 miles a year (23), while the bicyclists in this survey averaged 2,232 miles a year, only about one-fifth as much. Even with this adjustment, the bicycle accident injury rate in this study was about twice as high as the motor vehicle traffic accident injury rate.

To put these accident rates in perspective, it should be remembered that these rates are equivalent to a moderate or serious incident once every 14 years for a bicyclist, and approximately once every 28 years for a motorist, or anyone involved in a motor vehicle traffic accident.

CHAPTER VI

COMPARISON OF NATIONAL DATA WITH LOCAL DATA

All the information up to this point is based on returns from 3,270 respondents in the national bicycling organization, the League of American Wheelmen. In order to compare responses from regular bicycle users who belonged only to a local bicycle club, approximately 900 members of the Washington Area Bicyclist Association (WABA), located in the District of Columbia, were asked to fill out the same questionnaire.

Because the respondent from WABA had to provide his own return envelope and stamp, and no election was occurring at the same time, a much lower response rate than the 46.7 percent from L.A.W. was anticipated. A total of 101 (or 11.2 percent) questionnaires were returned, but of these, only 70 (7.8 percent of the total membership) were usable because only data from WABA members who were not also L.A.W. members were desired. With this small return, the following comparisons should be considered as approximate. In some instances, many of the analyses carried out on the national results with 3,270 responses could not be duplicated with enough reliability for only 70 respondents. Thus, in many cases, only aggregate data are examined.

AGE AND SEX DISTRIBUTION

Of the 70 respondents that provided usable data, 62 or 88.6 percent of the total were male, while only 8 were female. This high percentage of males matched very closely the respondents from the national organization. This disproportionate distribution was most likely caused by directing the questionnaire at the most active rider. It was also known in advance that the local club's membership was estimated to be at least two-thirds male.

The average age of the WABA respondents was 32.2, considerably lower than the 37.7 average age of the L.A.W. membership that responded. The distribution of respondent's ages of the Washington bicycle club (Figure 21) shows that the majority (75 percent) are less than 36 years of age. This compares with only 49.5 percent in this age group for the national sample. The goodness of fit test ($p = .05$) showed the age distribution of WABA respondents to be significantly different than L.A.W. respondents.

AUTOMOBILE AVAILABILITY

With respect to the availability of automobiles reported by WABA members, the findings were quite different than those reported from L.A.W. Table 16 shows the difference between the two samples.

While approximately only one of every 20 L.A.W. respondents did not have a car available for their use, almost one out of every seven WABA respondents fell into this

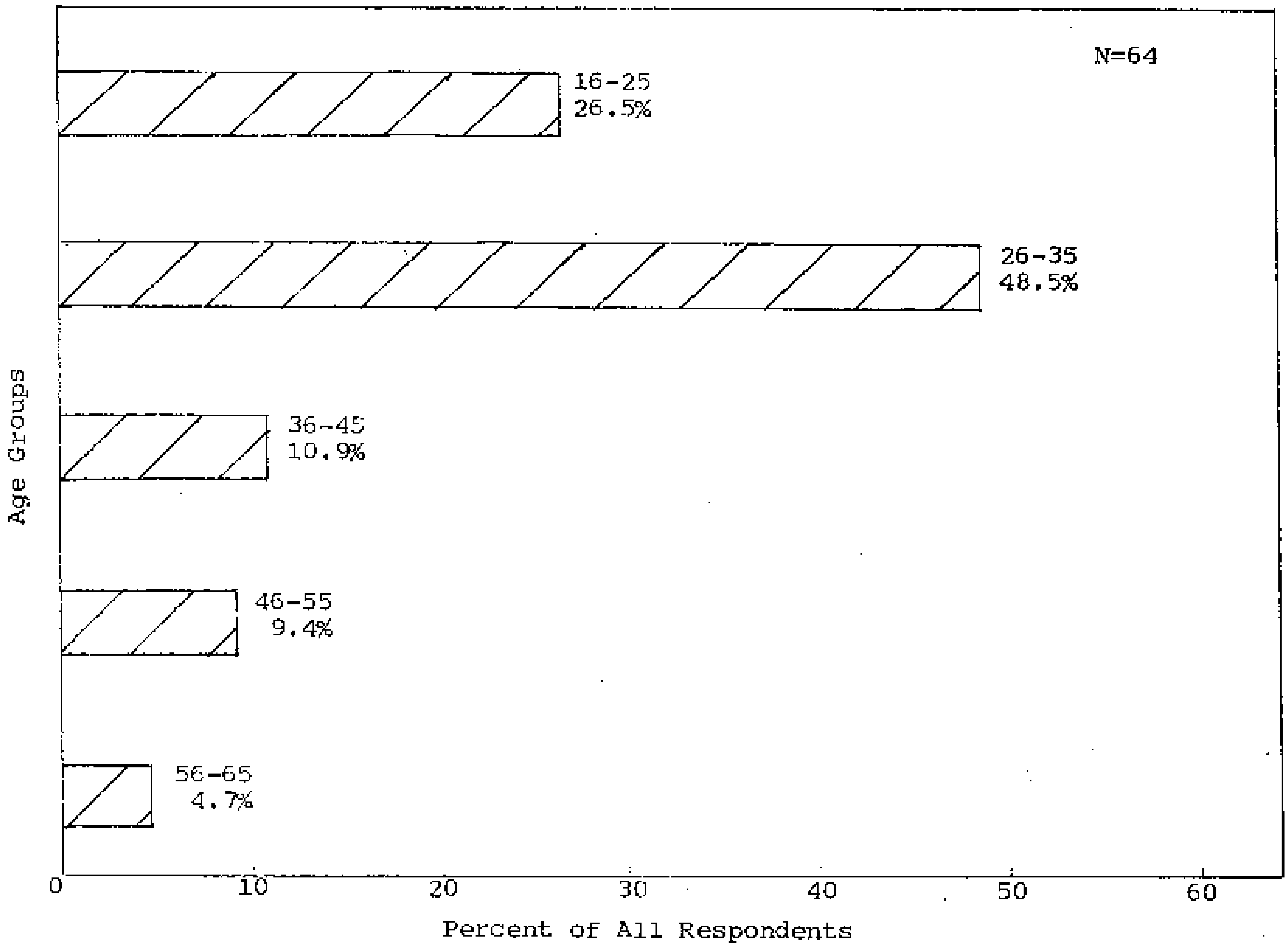


FIGURE 21 - AGE DISTRIBUTION OF WABA RESPONDENTS

TABLE 16

COMPARISONS BETWEEN L.A.W. AND WABA WITH RESPECT TO AUTOMOBILE AVAILABILITY

Automobiles Available	L.A.W. (3,270 Samples) Percent of Total	WABA (70 Samples) Percent of Total
0	5.4	14.3
1	42.4	52.9
2	43.1	31.4
3	7.2	1.4
4 or More	1.9	0.0
	100.0	100.0

category. It would seem likely to follow that WABA members might be bicycling more and farther, due to this lower response to automobile availability. This, however, was not the case, as is explained later. Washington, D.C., is a fairly dense city with a public transportation system that adequately serves the city proper. This may partly explain the large difference in auto availability that exists between the samples.

BICYCLE TYPE AND EQUIPMENT

Although the majority (83 percent) of WABA respondents stated that they used a bicycle with 5 or more speeds for most of their riding, this percentage is almost 14 percentage points less than L.A.W. respondents, who reported almost a unanimous 96.8 percent respondents riding a 5- or 10-speed bicycle. There were no WABA respondents stating that they used a single speed bicycle.

Figure 22 shows the responses to the 5 questions regarding equipment usage. Major differences existed between the national and local samples here also, expecially in the use of mirrors (only 8.6 percent for WABA, 33 percent for L.A.W.) and lights (77 percent for WABA members, 61 percent for L.A.W. respondents). Only 20 percent of the local organization's respondents stated that they possessed an odometer to measure distance. This percentage compares with 35 percent of L.A.W. members. As in the national sample, statistical testing showed no significant difference for the mileages reported between those with odometers and those without such devices. Interestingly, helmet wearing appears to have become a common occurrence among regular bicycle users; in both cases, almost 30 percent of the respondents used head protection while riding. This may be partly responsible in the lowering of the number of serious injuries. The last item in the question on equipment usage, registration, showed that 83 percent of WABA members had their bicycles registered. This high figure, compared to only 46 percent in the national survey, is most likely accounted for because the District of Columbia is now requiring all bicycles ridden in the District to be registered.

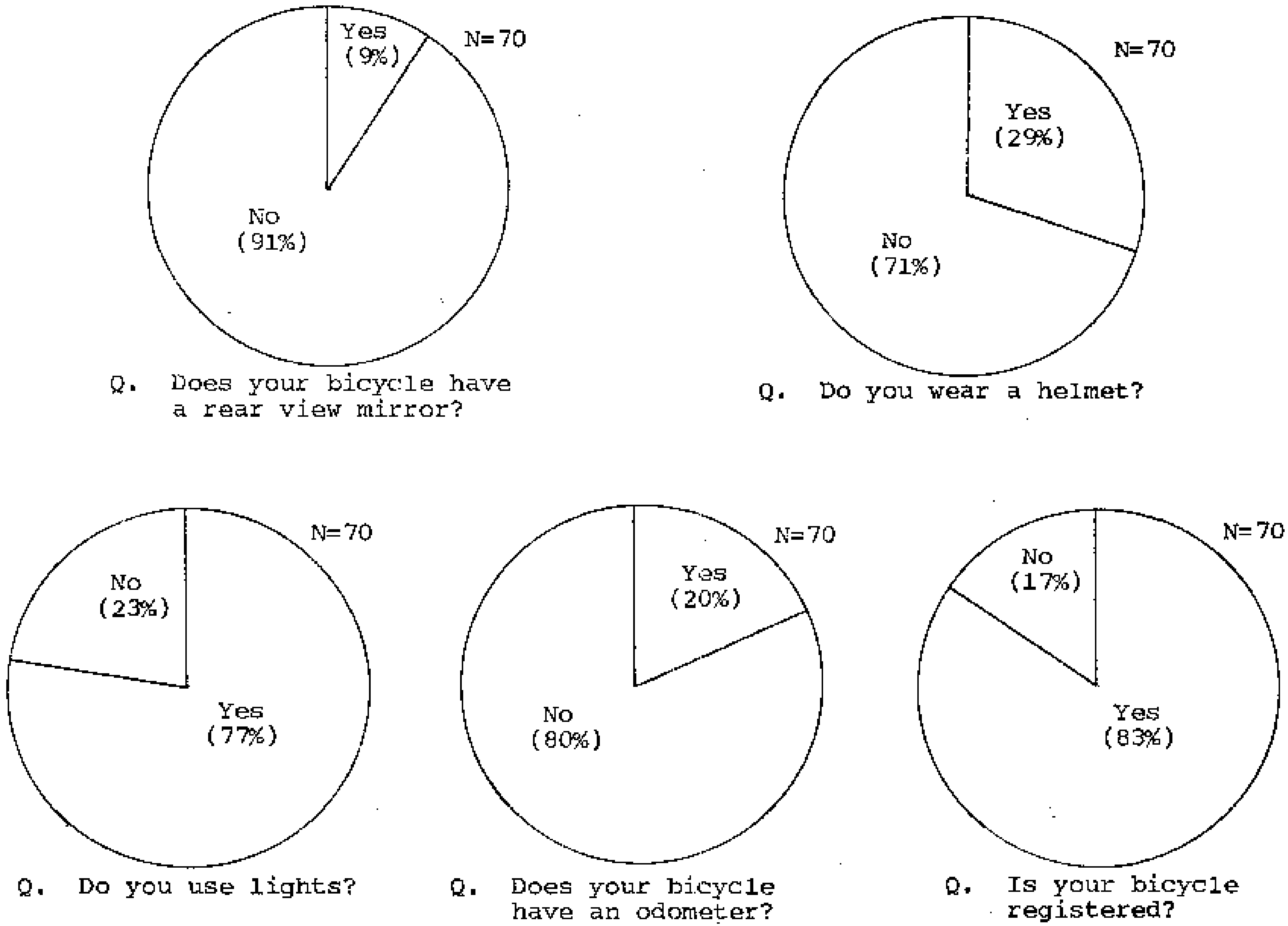


FIGURE 22 - RESPONSES TO EQUIPMENT USED - WABA SAMPLE

BICYCLING EXPERIENCE

Over two-thirds of the Washington area bicyclists (67.1 percent) have bicycled less than 4 years. This corresponds to 51.7 percent for the national League of American Wheelmen. A substantial number (14.3 percent) of the WABA respondents have been cycling continuously for a period longer than 10 years. This corresponds to 20.2 percent in this category for L.A.W. respondents.

1974 TOTAL MILES RIDDEN

The WABA respondents reported traveling 1,536 miles a year during an average 9.3 months that they stated as being suitable for cycling. This is almost 35 percent less than the mileage reported in the national sample based on only 8.9 months riding. The mileage figure reported by WABA was compared with the mileage by city size breakdown established from the national sample. In cities over one million, as Washington is, the miles traveled actually increased slightly above the overall average of the national survey. Part of the explanation for this difference in miles traveled may be that WABA members have been shown to be younger and less experienced than the L.A.W. respondents. Both of these variables were important when increases in miles traveled were studied. It may also be that major differences not discovered exist in riding characteristics between the two samples.

The difference also carries over into the question regarding future riding. Almost 60 percent of the L.A.W. members reported that they would ride more or much more this year than last year. WABA members, on the other hand, responded that only 37 percent will be riding more or much more.

Whereas L.A.W. respondents reported riding 93.3 percent of all their miles on major or minor streets and highways, only 82.4 percent of the Washington bicyclists' miles were reported ridden on these type of streets. However, major street riding for the national sample accounted for only 35 percent of all riding, while this figure climbed to 49 percent for the bicyclist in Washington. This difference may be partly responsible for the higher accident rate experienced by the Washington bicyclists, discussed shortly.

TRIP PURPOSE AND LENGTH

Figure 23 shows the distribution of WABA respondents riding for each trip purpose. When compared with the L.A.W. data shown in Figure 6 (page 42), it can be seen that the work and/or school trip is the most common trip made by Washington cyclists, replacing the recreation/touring trip, the most common trip made by L.A.W. members. It should also be noted that WABA respondents made 17 percent more utility trips than those in the national survey reported making. The goodness of fit test ($p = .05$) showed the trip purpose distribution of WABA respondents to be significantly different than the national sample.

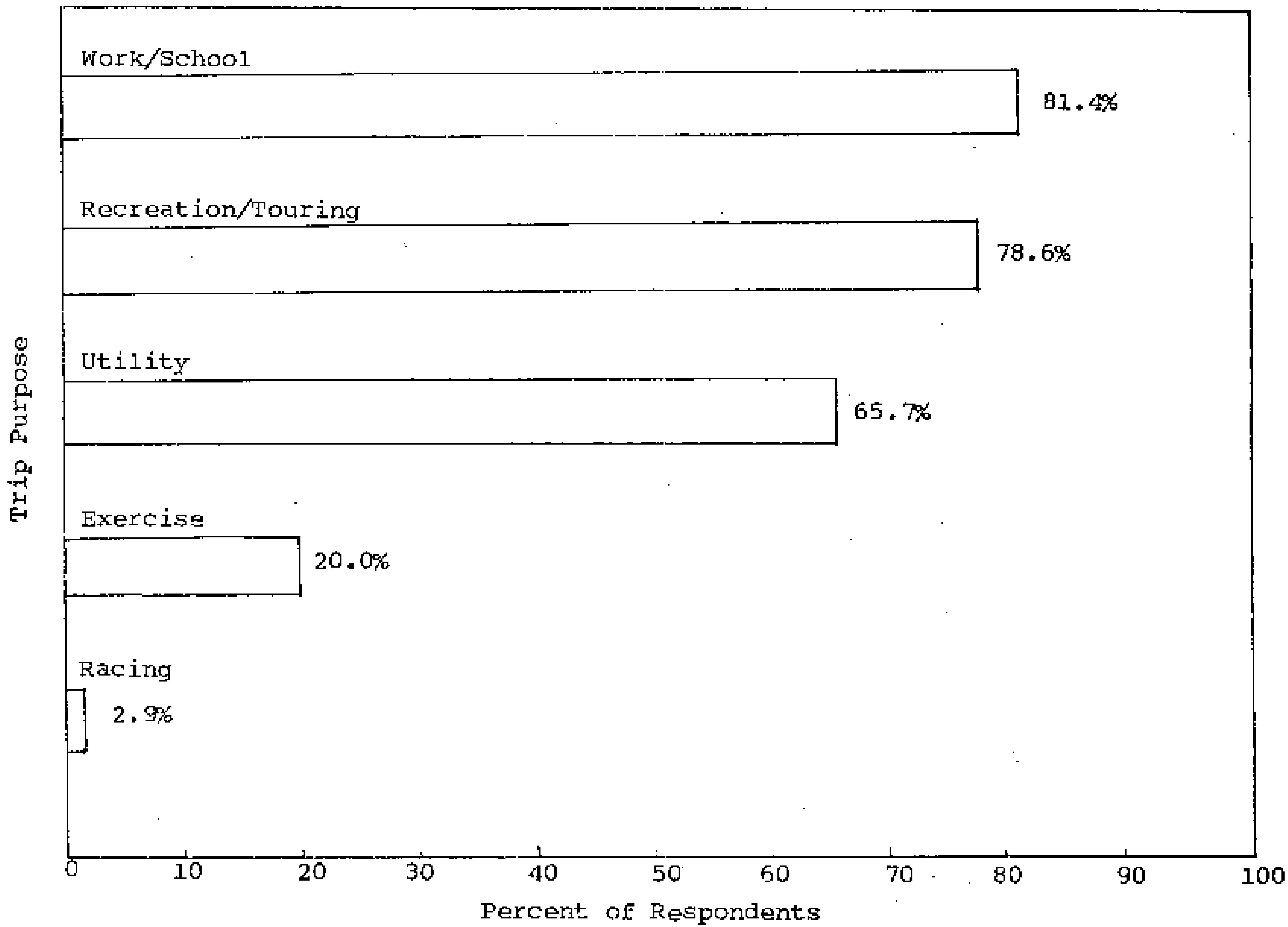


FIGURE 23 - DISTRIBUTION OF RESPONDENTS WITH RESPECT TO TRIP PURPOSE - WABA

Table 17 further analyzes the WABA response by stratifying the trip purpose by the number of trips made and the average length of each trip.

The major difference between the two samples becomes readily apparent when Table 17 is compared with Table 8 on page 43, which presents similar information on the L.A.W. respondents. It appears that the work and school commute trip along with the utility trip is much more heavily represented both in the percentage of all trips reported and the percentage of total miles reported for the Washington cyclists. Over 80 percent of all trips taken by WABA respondents were for these purposes compared to about 50 percent for the L.A.W. respondents. The recreation or touring trip that accounted for over half of all the miles ridden by L.A.W. members represented only 22.7 percent of all miles ridden by WABA members. The trip length for this purpose is also considerably different. However the goodness of fit test ($p = .05$) showed that overall the average round trip distances for each purpose was not significantly different between the national and local samples.

The "snapshot" of WABA activity showed that 81.4 percent of the respondents rode their bicycles the week before they filled out the survey. This compared to 67 percent of the L.A.W. respondents. However, WABA members received the questionnaire in late April or May, almost 6 weeks after L.A.W. members. This later date in better cycling weather probably accounts for the higher response. Almost 43 percent

TABLE 17

TRIP CHARACTERISTICS BY PURPOSE - WABA

Trip Purpose	All Respondents				Average Trips Per Month Per Respondent	Average Miles Per Month Per Respondent	Average Round Trip Distance Per Respondent
	Total Trips Reported Per Month	Percent of Total Trips	Total Miles Reported Per Month	Percent of Total Miles			
Work/School	917	61.0	7,473	62.2	16.1	131.1	8.1
Recreation/ Touring	204	13.5	2,719	22.7	3.7	48.5	13.1
Utility	315	20.9	1,088	9.1	6.8	23.7	3.5
Exercise	59	3.9	376	3.2	4.2	27.0	6.4
Racing	11	0.7	331	2.8	5.5	132.5	24.1
TOTAL	1,506	100.0	11,989	100.0	-	-	-
Average for All Purposes	-	-	-	-	11.9	99.4	8.3

reported making 5 or more trips during the week, suggesting commuting trips to work or school. This is almost 28 percent more than L.A.W. respondents reported. As previously mentioned, WABA members appear to use their bicycles more for work and school trips than those in the national sample.

ACCIDENT EXPERIENCE

There were 15 WABA respondents of the 70 who stated that they had experienced a serious fall or collision in the last year. This percentage of the total (21.4 percent) is the same as reported for L.A.W. members. Three persons reported more than one incident for a total of 18 accidents experienced in 1974 for the 70 respondents. Calculations show that the rate of incidents is 167 per million miles traveled, compared to a rate of 113 for the national sample. This rather large difference existing between the samples is hard to explain, although the small sample size in the case of the local organization may not be a true representation of the almost 1,000 members in WABA. Since the Washington Area Bicyclist Association members reside in a metropolitan area greater than one million in population, the accident rate calculated for this size city based on the national sampling was examined. It showed a rate of 115 accidents per million bicycle miles traveled, only slightly larger than the overall rate of 113 accidents per million bicycle miles traveled for the entire national sample.

Only one injury occurred that required professional medical attention; the accident rate for those more serious accidents is 9.2 per million bicycle miles. However, since such a small sample is being investigated and only one incident in this category was reported, these accident rates should be only looked at as general indicators.

Because of the small sample, it is not profitable to investigate accident occurrences and calculate rates beyond the analysis done so far. It might provide misleading findings and, therefore, any comparisons with the larger national sample results would most likely be meaningless.

ATTITUDINAL QUESTIONS

The local respondents reported a temperature of 28.9 degrees as the minimum at which they would still usually ride a bicycle. This compares to 29.6 degrees for the overall national average and very close to the 29.9 degrees reported from national respondents living in Washington, D.C., Maryland, and Virginia.

Eighty percent of the WABA members responding stated that they usually rode in the dark, higher than the 64.8 percent which was the national result on this question. This response may be due to the high intensity lighting in many parts of the District of Columbia. Also, 77 percent of the WABA members said that they used a light, which shows a pattern similar to the national results when light usage and riding at night are compared.

Over 73 percent of the respondents stated that they also rode in the rain either "occasionally" or "frequently". The national sample showed a 75 percent response in these same categories.

With regard to the question of obeying vehicle laws, only 30 percent stated that they "always" obey the laws that applied to them as bicyclists. There were 65 percent who stated they "usually" obeyed laws, with the remaining 5 percent reporting that they only "occasionally" obeyed laws. The 30 percent figure is even less than the 50.2 percent result from the national club sample. This may be because of a general lack of enforcement in the particular city under study (Washington, in this case), or it may be that safety and observance of laws is stressed to a higher degree in the League of American Wheelmen than in the Washington cycling organization.

It is difficult to analyze further much of the local data due to the small sample size. Nonetheless, from the comparisons that were made, it appears that differences do exist between the two groups of bicyclists studied. How great these differences are, though, is difficult to quantify. In some instances, it appears that the 70 respondents are similar in riding characteristics to a subgroup of the national sample that is close in age, experience, or other variable. At other times, there seems to be no similarities between the groups. A larger response might have provided better insight into these differences and similarities.

CHAPTER VII

FINDINGS AND RECOMMENDATIONS

The primary objective of this research was to investigate the habits of the adult bicycle rider (16 or over), who uses his bicycle on a regular basis, in order to identify characteristics of the bicyclist and his trips.

To accomplish this, in March of 1975, a mailback questionnaire was sent to all 8,405 members of the League of American Wheelmen (L.A.W.), an organization composed of many avid bicyclists throughout the country. Questions relating to both personal information (age, sex, city size, auto availability) and bicycling experience, such as cycling experience, riding activity in 1974, and accident involvement, were included on the form.

An identical questionnaire was sent to about 900 members of the Washington Area Bicyclist Association (WABA), a bicycling organization in Washington, D.C. This was done in order to study any differences existing between the two samples.

FINDINGS

Analysis of the L.A.W. sample (38.9 percent return) showed that:

- The average L.A.W. respondent rode 2,332 miles in 1974 during a period of 8.9 months. Almost 10 percent of the respondents pedaled over 5,000 miles in 1974. More than one-third traveled less than 1,000 miles.

- Almost all respondents (96.8 percent) rode a bicycle with 5 or more gears and had available an average of 1.6 cars for their use. This is an average typical of many suburban metropolitan locations.

- Most respondents (61 percent) reported that they used lights on their bicycles, and almost one-third use a rear view mirror and a helmet.

- Over half (51.7 percent) stated that they had been riding a bicycle regularly for less than 5 years. This coincides with the nationwide increase in the number of bicycles sold since the bicycle boom began in the early 70's.

- Over 60 percent of the respondents said they plan to ride "more" or "much more" in 1975 compared to 1974.

- The vast majority (93.3 percent) of the riding took place on regular streets. Less than one-fourth of the sampled individuals reported ever using a special bicycle facility, either a bike lane or separate path, for their riding. This riding amounted to less than 7 percent of the total miles traveled.

- The work or school commute trip was the trip most commonly made, but the recreation or touring trip accounted for over half of the miles ridden by all respondents due to the longer distances traveled on the latter trip type.

- The average round trip length for all trips was 13.5 miles, ranging from an average of 4.5 miles for utility trips to 22.2 miles for each recreation and touring trip.

- Accident involvement showed that 21.4 percent of all respondents experienced a serious fall or injury in 1974. Of these, 27.8 percent required professional medical treatment. A rate of 113 accidents per million bicycle miles of travel was calculated from the data. Serious accidents (only) showed a rate of 31.4 per million bicycle miles, or an injury requiring medical treatment once every 14 years for a L.A.W. member.

- The most common accident reported, representing 25 percent, was that of the rider falling without actually colliding with any object. After that, in descending order, were collisions with a moving motor vehicle, another bicycle, and a dog or other animal.

- As expected, the most serious accidents involved moving motor vehicles, while collisions with dogs, or caused by dogs, also were frequently noted in this category.

- The majority of accidents happened during recreation or touring trips and occurred on minor streets.

- Only 18 percent of all accidents (64 percent of those requiring medical treatment) were reported to police and a written report filed.

- Nationally, respondents stated that they would usually ride a bicycle when the temperature was above 29.6 degrees. This average varied from 15 degrees to almost 40 degrees for different states. About two-thirds of those surveyed stated that they at least occasionally rode a bicycle at night, while 75 percent, at times, ride in the rain.

- A little over half of the respondents reported "always" obeying the laws while 47.3 percent "usually" do. A frequent comment by the respondents on this question discussed the common practice of "sliding" by STOP signs if no traffic was present.

The analysis of the variables that affected the number of miles ridden or the accident involvement of the respondents in this study indicate that:

- The average male rode almost 40 percent more miles in 1974 than the average female.

- The average respondent in the oldest age group (66-82) rode about 900 miles more in 1974 than the average respondent in any other age group.

- The miles rode seemed to increase with years of experience but decreased for those respondents reported having a large number of cars available for use.

- Females had an accident rate almost 60 percent higher than males. Interestingly, females show a 12 percent lower usage of helmets and a 3 percent lower use of mirrors, both safety-related items.

- Older groups appear to have the lowest overall accident rate, while the youngest group appears to have the highest.

- As cycling experience increased, accident involvement decreased dramatically.

- The safest trips made appeared to be the work or school commute trip while the utility trip showed the highest accident rate.

- Surprisingly, bicycle facilities where no motor vehicles are allowed showed the highest accident rate of any variable examined. On-street facilities, such as bicycle lanes or routes, showed a very low accident rate. The rates for both major and minor streets fell in between.

- Persons wearing helmets and using mirrors showed an accident rate at least 10 percent lower than those who reported that they did not use them.

- Respondents who "always" obeyed the law had an accident rate 38 percent lower than those who "usually" obey vehicle laws.

- Bicyclists who ride in the rain and at night may be exercising more caution because these individuals had lower rates than others who never ride in those conditions.

The serious injury accident rates established for the regular cyclists were compared to motor vehicle injury accident rates. Bicyclists in this study showed a rate about twice that of an average motorist. Relatively speaking, a L.A.W. bicyclist would be involved in an injury-producing crash once every 14 years while for a motorist this would be once every 28 years.

Data obtained from the Washington Area Bicyclist Association (WABA) showed differences when compared to the national sample. However, only 70 responses of the 101 received were usable. Therefore, some analyses could not be performed on the data due to the insufficient sample size, especially when stratification was attempted.

The aggregate data representing 70 bicyclists in a local area showed:

- The average WABA respondent rode 1,536 miles in 1974 in a period of 9.3 months, almost 35 percent less miles than the national sample.

- The WABA respondents were on the average 5 years younger than the L.A.W. sample, which might account for some of the difference in miles ridden. However, WABA members showed a much lower number of automobiles available than L.A.W. respondents, 1.1 to 1.6. Previous analysis of the national data showed that bicycle travel increased if less autos were reported available, but this relationship does not appear to be the case in comparing the two groups surveyed.

- Only 33 percent of WABA respondents have bicycled for over 5 years. Almost half of the L.A.W. sample was in this category. Analysis of this variable also showed that bicycle riding appears to increase with experience. Consequently, this difference in experience between the samples might also help to explain the difference in miles traveled.

- WABA members are more oriented toward using the bicycle as a purposeful means of transportation;

82 percent of all trips reported were for work, school, or utility purposes. This compares to only 51 percent of the same trips made by the national respondents.

- The average round trip length for a work or school trip was 8.1 miles for both WABA and L.A.W. respondents.

- The percentage of WABA respondents who experienced an accident in 1974 was very similar to the national sample. However, the Washington bicyclists showed a rate per million bicycle miles traveled almost 50 percent higher than L.A.W. members, 167 versus 113.

RECOMMENDATIONS

Bicyclists are making themselves seen and heard throughout the country. They are using bicycles for everyday trips to school and work, and for quiet weekend rides in a park. Planners and engineers are having a trying time keeping up with the demand for more and better bicycle facilities. This report provides information to those individuals and others concerned with the bicycle mode of transportation. The now known characteristics of a regular bicyclist and his trips will hopefully assist persons who are planning and designing for the bicycle's return to the streets and highways.

To further the study of bicycling habits, both of the regular user and the "Sunday cyclist", the following recommendations are made:

1. Local bicycling organizations in different parts of the country should be sampled in order to compare riding characteristics with the national data presented in this report.

2. Questions similar to those asked in this study should be directed at other segments of the bicycling population, such as the casual weekend rider, the people who strictly use bicycles as a means of exercise, and senior citizens who may use three-wheeled bicycles.

3. Since certain states did not have a large number of respondents to this study, bicyclists in these states should be investigated further to determine if differences do exist between those states and others.

APPENDIX A

MAILBACK QUESTIONNAIRE
FOR REGULAR BICYCLE USER STUDY

REGULAR BICYCLE USER QUESTIONNAIRE

Dear Cyclist:
The League of American Wheelmen, along with the Department of Civil Engineering of the University of Maryland, is actively working with Federal, State, and local officials to improve the transportation picture for bicyclists. Transportation planners, traffic engineers, and many local agencies need to know the riding habits of regular bicycle users in order to help provide for safe and efficient bicycling. We ask you to help by taking a few minutes to fill out the following questionnaire and return it with your ballot in the envelope provided. All responses to the items in the questionnaire will be tabulated such that individual replies will not be identified and only summaries of all responses received will be employed in the results to be reported. Results will be published in the BULLETIN as soon as possible.

INSTRUCTIONS: Only members of L.A.W. are to respond, and they must be 16 years of age or older. If family membership, the most active rider over 16 should respond.
Please indicate the following by blackening circle or filling in blank:

1. AGE:_____ 2. SEX: MALE ○ FEMALE ○ 3. ZIP CODE: ____________ CITY & STATE: ____________

4. What is the size of the metropolitan area where you live?
- Greater than 1,000,000 Pop. ○
- 250,000 to 1,000,000 Pop. ○
- 50,000 to 250,000 Pop. ○
- 5,000 to 50,000 Pop. ○
- Other- Rural ○

5. What is the TOPOGRAPHY like in the area where you live?
- Mostly flat ○
- Mostly rolling ○
- Mostly steep hills or mountainous ○

6. What is the TOPOGRAPHY like where you do most of your riding?
- Mostly flat ○
- Mostly rolling ○
- Mostly steep hills or mountainous ○

7. What type of bicycle do you ride the most?
- 1 speed ○
- 3 speed ○
- 5 or more ○

8. Do you and/or your bicycle have the following equipment?

	YES	NO
Rear view mirror	○	○
Helmet	○	○
Odometer	○	○
Lights	○	○
Bicycle registration	○	○

9. In your own estimation, how many months per year is the climate where you live suitable for cycling? _______ months

10. How many continuous years have YOU used a bicycle regularly? ("regularly" is defined as at least 3 times a month during suitable riding months)
- Less than 1 year ○
- 1 to 4 years ○
- 5 to 10 years ○
- more than 10 years ○

11. In 1974, how many months did YOU ride regularly? _____ months

12. During the months that YOU rode in 1974, approximately how many roundtrips per month (average), and miles per month (average) did you ride for:

	AVERAGE ROUNDTRIPS/MO.	AVERAGE MILES/MO.
A. Work and/or School Trips..........................	______	______
B. Shopping, personal business, etc.................	______	______
C. Recreation, Touring...............................	______	______
D. Non-track Racing (include training)..............	______	______
E. Exercise only.....................................	______	______

13. For the one activity in question #12 that you listed as having the greatest number of roundtrips, show approximately what percentage of riding was done on:

A. Major streets/highways (moderate or heavy traffic) EXCLUDING SIGNED BICYCLE FACILITIES.................. ____%
B. Minor streets/roads (light traffic, e.g:residential streets, county roads) EXCLUDING SIGNED BICYCLE FACILITIES............ ____%
C. Special ON-street bicycle facilities (bike lanes, routes, etc.)....... ____%
D. OFF-street (sidewalks, bike paths, NO MOTOR VEHICLES ALLOWED)......... ____%

100 % TOTAL

14. Have you had a collision or serious fall in the last year on your bicycle?
YES ○ How many? ______ How many reported to police? ______
NO ○ (SKIP TO QUESTION #18)

15. How serious was your most recent collision or fall?
Bicycle damage only, no personal injury ○
Minor scrapes and bruises ○
Required emergency room treatment or doctor visit ○
Overnight hospital stay or continual doctor visits ○

16. At the time of your most recent collision or fall, in what activity were you participating, and on what type facility?

ACTIVITY:		FACILITY:	
Work and/or School	○	Major streets	○
Shop,Pers. Bus.,etc.	○	Minor streets	○
Recreation	○	Spec. ON-street facil.	○
Racing	○	Not on street	○
Exercise	○		

17. In your most recent collision or fall, did you collide with:
A moving motor vehicle? ○
A stationary motor vehicle? ○
Another bicycle? ○
A pedestrian? ○
Other (explain) ____________________ ○

18. How many total miles did you ride in 1974? (best estimate) ______

19. What percentage of this was on weekdays? ____% weekends? ____%

20. Do you ride:

	Never	Occasionally	Frequently
After dark?	○	○	○
In the rain?	○	○	○

21. At what temperature is it usually too cold for YOU to ride your bicycle? ____degrees

22. Do you obey the vehicle traffic laws that apply to you as a bicycle rider?
Occasionally ○ Usually ○ Always ○

23. Do you belong to both a local and a national bicycle club? YES ○ NO ○

24. How much bicycling do you think you will do in the current year as compared to the past year?
Much less ○
Less ○
About the same ○
More ○
Much more ○

25. How many automobiles do you have available for your use? ______

26. Did you ride your bicycle last week? YES ○ How many round trips? ______
NO ○ Why not? ____________

27. Any comments? ________________________________

THANK YOU VERY MUCH

APPENDIX B

NUMBERS OF QUESTIONNAIRES RETURNED FROM EACH STATE

RESPONSE BY L.A.W. REGION

REGION	NUMBER OF QUESTIONNAIRES SENT	USABLE FORMS RETURNED
ONE		
Maine		7
New Hampshire		11
Vermont		6
Massachusetts		153
Rhode Island		14
Connecticut		29
Regional Total	727	220 (30.3%)
TWO		
New York		158
New Jersey		93
Puerto Rico		0
Regional Total	767	251 (32.7%)
THREE		
Pennsylvania		153
Delaware		14
Regional Total	443	167 (37.7%)
FOUR		
Maryland		106
District of Columbia		14
Virginia		97
West Virginia		6
North Carolina		27
Regional Total	593	250 (42.2%)
FIVE		
South Carolina		11
Mississippi		8
Alabama		19
Georgia		11
Florida		103
Regional Total	479	152 (31.7%)

SIX		
Ohio		278
Kentucky		22
Tennessee		27
Regional Total	783	327 (41.8%)
SEVEN		
Michigan		192
Indiana		120
Regional Total	667	312 (46.8%)
EIGHT		
Illinois		505
Regional Total	1,351	505 (37.4%)
NINE		
Wisconsin		192
Minnesota		40
Iowa		53
Missouri		57
Regional Total	728	342 (47.0%)
TEN		
Oklahoma		27
Arkansas		11
Louisiana		25
Texas		107
Regional Total	450	170 (37.8%)
ELEVEN		
North Dakota		5
South Dakota		10
Nebraska		8
Kansas		26
Regional Total	163	49 (30.1%)
TWELVE		
Montana		4
Wyoming		7
Colorado		43
Regional Total	129	54 (41.9%)

THIRTEEN			
Utah		3	
Arizona		11	
New Mexico		6	
Nevada		8	
Regional Total	94	28	(29.8%)
FOURTEEN			
California		313	
Hawaii		2	
Regional Total	799	315	(39.4%)
FIFTEEN			
Idaho		3	
Oregon		38	
Washington		79	
Alaska		8	
Regional Total	232	128	(55.2%)
GRAND TOTAL	8,405	3,270	(38.9%)

APPENDIX C

FORM USED TO CODE INFORMATION FROM QUESTIONNAIRE

CODING FORM

IDENTIFICATION NUMBER	1, 2, 3, 4
AGE	5, 6
MALE=1 FEM	7
ZIP CODE (1st 3 no's.)	8, 9, 10
METRO SIZE	11
TOPO/LIVE	12
TOPO/RIDE	13
BIKE TYPE	14
EQUIPMENT YES=1,NO=2: MIRROR	15
HELMET	16
ODOM.	17
LIGHTS	18
REGIST	19
MO./Year SUITABLE for bike	20, 21
YEARS EXPER.	22
MO. RODE IN 1974	23, 24
# TRIPS/MO. & MILES/MO. BY TRIP PURPOSE — WORK/SCHOOL: # OF TRIPS	25, 26
WORK/SCHOOL: # OF MILES	27, 28, 29
UTILITY: # OF TRIPS	30, 31
UTILITY: # OF MILES	32, 33, 34
REC/TOURING: # OF TRIPS	35, 36
REC/TOURING: # OF MILES	37, 38, 39
RACING: # OF TRIPS	40, 41
RACING: # OF MILES	42, 43, 44
EXERCISE: # OF TRIPS	45, 46
EXERCISE: # OF MILES	47, 48, 49

FACILITY TYPE-%RIDING: MAJOR STREETS	50, 51
MINOR STREETS	52, 53
ON-STR'T. FACIL.	54, 55
OFF-STR'T. FACIL.	56, 57
COLLIDI: Y=1,N=2	58
NUMBER	59
# REP'T	60
SERIOUSNESS	61
WHAT ACTIV.	62
WHERE	63
COLLIDE WITH	64
1974 TOTAL MILES RIDDEN	65, 66, 67, 68
% OF WEEKDAYS	69, 70
RIDE WHEN: DARK	71
RAIN	72
MIN. TEMP	73, 74
OBEY LAWS	75
CLUBS	76
1975 BIKING	77
# AUTOS	78
RIDE L. WK.	79
# TRIPS	80

APPENDIX D

STATISTICAL ANALYSIS OF RESPONSES TO ODOMETER QUESTION

STATISTICAL ANALYSIS OF MILEAGE REPORTED

A statistical test, known as the Student's T-test, may be used to determine if two sample means taken from the same universe are significantly different (38).

In the cases analyzed, average annual miles traveled by bicyclists are studied. One group of the respondents stated that their bicycles were equipped with odometers or other measuring devices. The other group stated that they did not use an odometer, and therefore the mileage figures provided were estimates.

The results of each sample are as follows:

Those with Odometers

Average Miles = 2,254 ($\bar{X}_1$)
Standard Deviation = 2,027* (S_1)
Sample Size = 1,120 (N_1)

Those without Odometers

Average Miles = 2,350 ($\bar{X}_2$)
Standard Deviation = 2,116 (S_2)
Sample Size = 2,105 (N_2)

The two mileages reported come from the same universe having the respective means μ_1 and μ_2. The hypotheses are:

H_0: $\mu_1 = \mu_2$, and the difference is merely due to chance.

H_1: $\mu_1 \neq \mu_2$, and there is a significant difference between the groups.

*The standard deviation is large due to the number of respondents (almost 10 percent) who reported traveling over 5,000 miles.

Under the hypothesis H_0, both groups come from the same population. The mean and standard deviation of the difference in means are given by

$$\mu_{\bar{X}_1-\bar{X}_2} = 0$$

and $$\sigma_{\bar{X}_1-\bar{X}_2} = \sqrt{S_1{}^2/N_1+S_2{}^2/N_2} =$$

$$\sqrt{(2,027)^2/1,120+(2,116)^2/2,105} = 76.1$$

where we have used the sample standard deviations as estimates of σ_1 and σ_2. Then, Z, the test statistic, is calculated

$$Z = \frac{\bar{X}_1-\bar{X}_2}{\sigma_{\bar{X}_1-\bar{X}_2}} = \frac{2,254-2,350}{76.1} = -1.26$$

For a two-tailed test, the results are significant at a .01 level if Z lies outside the range -2.58 to +2.58. Hence, we conclude, with 99 percent confidence, that there is no significant difference between the groups with regard to the reported mileages.

APPENDIX E

BICYCLE ACCIDENT RATES FOR EACH STATE

ACCIDENT RATE (PER MILLION BICYCLE MILES)*

State	Total Miles Reported	Total Accidents	Rate	Serious Accidents/Rate
Oregon	90,445	15	166	(2/22)
Illinois	893,159	123	138	(22/25)
New Jersey	218,831	30	137	(11/50)
New York	317,880	43	136	(12/38)
Ohio	626,017	85	135	(19/32)
Indiana	274,233	37	135	(12/44)
Connecticut	61,575	8	130	(2/32)
Maryland	239,004	31	130	(12/50)
Michigan	390,318	50	128	(9/23)
District of Columbia	48,744	6	125	(2/41)
Colorado	104,954	13	124	(5/48)
Pennsylvania	310,467	38	122	(12/39)
North Carolina	61,610	7	113	(2/32)
Louisiana	64,589	7	109	(4/62)
Massachusetts	345,278	37	107	(13/38)
Virginia	223,891	24	107	(9/40)
Iowa	107,876	11	102	(1/ 9)
Wisconsin	385,563	39	101	(11/29)
Texas	360,957	38	105	(11/32)
Kansas	61,073	6	98	(3/49)
Florida	338,441	32	95	(12/36)
Washington	168,449	16	95	(7/42)
Missouri	129,158	12	93	(7/54)
California	1,006,859	87	87	(24/24)

*Only those states in which respondents rode a total of 50,000 miles or more are shown.

APPENDIX F

METRIC CONVERSION UNITS

METRIC CONVERSION UNITS

To Convert	To	Multiply by
inches (in.)	millimeters (mm)	25.40
inches (in.)	centimeters (cm)	2.540
inches (in.)	meters (m)	0.0254
feet (ft)	meters (m)	0.305
miles (miles)	kilometers (km)	1.61
yards (yd)	meters (m)	0.91
square inches (sq in.)	square centimeters (cm^2)	6.45
square feet (sq ft)	square meters (m^2)	0.093
square yards (sq yd)	square meters (m^2)	0.836
acres (acre)	square meters (m^2)	4047.
square miles (sq miles)	square kilometers (km^2)	2.59
cubic inches (cu in.)	cubic centimeters (cm^3)	16.4
cubic feet (cu ft)	cubic meters (m^3)	0.028
cubic yards (cu yd)	cubic meters (m^3)	0.765
pounds (lb)	kilograms (kg)	0.453
tons (ton)	kilograms (kg)	907.2
one pound force (lbf)	newtons (N)	4.45
one kilogram force (kgf)	newtons (N)	9.81
pounds per square foot (psf)	newtons per square meter (N/m^2)	47.9
pounds per square inch (psi)	kilonewtons per square meter (kN/m^2)	6.9
gallons (gal)	cubic meters (m^3)	0.0038
gallons (gal)	liter (dm^3)	3.8
acre-feet (acre-ft)	cubic meters (m^3)	1233.
gallons per minute (gpm)	cubic meters/minute (m^3/min)	0.0038
newtons per square meter (N/m^2)	pascals (Pa)	1.00

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CURRICULUM VITAE

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Collegiate institutions attended	Dates	Degree	Date of Degree
Northridge State University	9/63-1/67	-	-
San Jose State University	1/67-1/69	B.S.	1/69
University of Maryland	8/72-8/75	M.S.	8/75

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Minor: Traffic and Transportation Engineering

Professional publications: "Results of SIGOP-TRANSYT Comparison Studies," Traffic Engineering, Vol. 43, No. 12, September, 1973.

"A Highway Safety Standard for Bicycle Facilities," TRB Record Report (soon to be published).

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