

THE RURAL HEALTH STUDY:
A COMPARISON OF HOSPITAL
EXPERIENCE BETWEEN
FARMERS AND NONFORMERS
IN A RURAL AREA OF
MINNESOTA (1976-1977)

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The Rural Health Study: A Comparison of
Hospital Experience between Farmers and Nonfarmers in a
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Utah Biomedical Test Lab., Salt Lake City

Prepared for

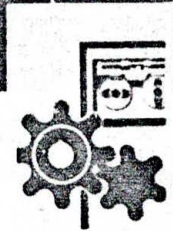
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**The Rural Health Study: A Comparison
of Hospital Experience between Farmers
and Nonfarmers in a Rural Area of Minnesota**

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Abstract

The Rural Health Study was undertaken to use hospital records and brief occupational histories as a means of identifying problem health areas for agricultural workers and residents in a selected area of the Midwest. A population-based analysis by place of residence for two rural counties and a larger case-control analysis by years of agricultural exposure with data from six rural hospitals were utilized.

Overall, patients with an agricultural background seem to be as healthy or slightly healthier than patients with no agricultural history. Nevertheless, the following possible problem areas were identified: Males and females both showed increased risks for diseases of the blood and blood-forming organs, osteoarthritis, gall bladder disease, hernia of the abdominal cavity, diseases of the veins and lymphatics, and eye conditions. In addition, farm males showed increased risks for benign prostatic hypertrophy and farm females had increased risks for uterovaginal prolapse, acute myocardial infarctions, diseases of the skin and subcutaneous tissue, and neoplasms. Females over 65 years of age with 20 years or more of agricultural exposure were the only farm group whose overall health was worse than the corresponding nonfarm group.

Data on smoking histories, collected for adjustment purposes, corroborated national findings by giving evidence of relationships between cigarette smoking and lung cancer, ulcers, and several circulatory and respiratory problems.

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INTRODUCTION *

The Utah Biomedical Test Laboratory (UBTL) recently completed a survey of the existence and availability of occupationally related injury and illness data in agriculture in the United States [1]. Case data were available primarily from two sources: the Workmen's Compensation System and the National Safety Council's Farm Accident Survey. Workmen's Compensation agricultural data were available from six states, with only California providing a substantial amount of data. The other state provided little or no data due to the exclusion of coverage to farm workers or due to the small number of hired farm workers covered. A Farm Accident Survey had been completed in twenty-one states at the time of this report. Additional injury and illness data that may be occupationally related to agriculture are collected by the Bureau of Labor Statistics, the National Center for Health Statistics, the Public Health Service, and individual state health agencies; however, detail is lacking and specific problem areas are difficult to identify.

Several deficiencies in available agricultural health statistics were obvious from the survey. Most data do not contain illness information, especially of long-term etiology; the large agricultural areas of the midwest are under represented; and accurate estimates of the number of workers at risk are difficult to obtain to use with the available accident statistics.

The Rural Health Study was designed to investigate alternate data sources which did not contain the deficiencies described above; namely, a study to obtain illness information in the midwest, from which rates could be calculated, was the primary goal. A secondary purpose was to develop and test a method which has utility as a screening technique to identify possible occupational health problems in a population, as an alternative to a much more costly cohort study.

The data source chosen to be investigated was hospital records. Houten, Bross, and Viadana [2,3] successfully used hospital records and occupational histories in a retrospective survey of the relationships between

*A study based on data from a total of 16,598 discharge cases collected from six hospitals for the period from April 1, 1976, through March 31, 1977.

occupation and cancer. The Rural Health Study attempts to look at illnesses other than cancer and to pair hospital records and occupational histories with population estimates, where possible.

METHODOLOGY

Initial Project Plans

The original plan for designing a study which met the desired criteria was to select a rural midwestern county which contained one centrally located, well-equipped hospital such that practically all of the county's hospital experience would be captured by the one hospital. Using county census estimates of the farm and nonfarm populations and farm and nonfarm workers, rates could be calculated and relative risks computed of farm to nonfarm residents and workers for a variety of medical conditions. The county selected was to contain no large known hazardous occupational groups so as to provide a relatively clean non-farm comparison group.

The Commission on Professional and Hospital Activities (CPHA) in Ann Arbor, Michigan, was identified as an independent agency involved in the standardized abstracting and collection of hospital records through the Professional Activity Study (PAS). Over 40% of the short-term hospital discharges in the United States are included in CPHA programs. To eliminate costly and time-consuming abstracting of hospital records, it was deemed advantageous to enlist CPHA cooperation and limit the study to hospitals participating in the PAS system. Relevant data, routinely collected through the PAS system, include demographic characteristics of the patient plus dates of hospitalization, type of discharge, and diagnoses coded by the Hospital Adaptation of the International Classification of Diseases, II-ICDA [4].

Information concerning place of residence and occupation was not available in the PAS system but such data could be independently obtained at participating hospitals and coded into otherwise unused fields on the PAS form by hospital personnel without extensive training and without excessive burden to the patient. CPHA agreed to provide periodic data tapes of selected demographic and medical information plus the additional occupational information. This data set and census estimates could be used to compare the hospital experience of different occupational groups.

Several candidate hospitals in South Dakota, Iowa, and Minnesota met the initial criteria for study and were further evaluated as to their suitability for the Rural Health Study. Douglas County Hospital in Alexandria, Minnesota, was the final selection. Formal agreements were made with the hospital and CPHA for the collection of data over a one-year period.

Revised Project Plans

Prior to the initiation of data collection, a NIOSH review board suggested expansion of the study. This posed problems in that it was difficult to find a large, rural area where all of the hospitals belonged to PAS or a similar system and where the service area could be defined by estimable or county boundaries. An additional problem was that it would be imperative to have cooperation from all of the hospitals in the area.

A number of hospitals in rural west central Minnesota, near Alexandria, belonged to PAS. The largest hospital, in Willmar, Minnesota, basically met the requirements for being centralized, well equipped, and servicing the county population, but the smaller hospitals could not be tied to an estimable service area. It was decided to enroll as many of the hospitals as possible for in-hospital comparisons to complement the population-based comparisons from Willmar and Alexandria.

Preliminary estimates suggested that 20,000 total discharges would yield at least 2,000 males and 2,000 females who had spent most of their lives on farms. For in-hospital comparisons (case-control), these numbers were deemed sufficient to detect a relative risk of two of farmers to nonfarmers ($\alpha=.05$, $\beta=.50$) for any diagnosis accounting for roughly one-half of one percent of all diagnoses. Using data from the National Health Survey [5], most circulatory, respiratory, digestive, and genitourinary conditions and several prevalent cancers met this criterion.

Ten candidate hospitals (including Alexandria and Willmar) were identified and contacted regarding participation in the Rural Health

Study. Initial cooperation was received from nine of the hospitals; two of the larger hospitals later declined due to the magnitude of the work involved; and one of the smaller hospitals was terminated after the start of the study due to nonperformance of the required duties. The remaining six hospitals were expected to provide data on about 16,000 total discharges. Table 1 presents hospital characteristics of participating hospitals and Figure 1 shows the distribution of these hospitals in the study area. Table 2 provides a description of the population in the study area.

Study Variables

Pertinent data already collected by CPHA that was requested was patient number, age, sex, dates of hospitalization, height, weight, admission blood pressure, discharge status, final diagnosis explaining admission, and supplementary diagnoses (diagnoses coded by H-ICDA). Figure 2 shows the PAS data abstracting form. It was necessary to compose a questionnaire to be administered to all patients which would provide information on variables of interest not available in the CPHA data set. This information could then be merged with the medical and demographic data collected by CPHA.

Lacking from the CPHA data set was any occupational or residence information. Since farming is a lifestyle in addition to an occupation, it was decided to obtain information on whether a patient resided on a farm plus whether he worked on a farm. Since farm workers are spread over a large area, to obtain information on a large number of current farm workers would require a huge study in more hospitals than the scope of this study. Therefore, a patient's work history regarding agriculture was examined so that illnesses in retired farm workers could also be investigated in relationship to their farm exposure. This would also provide data on people leaving agriculture due to health problems.

Type of farm was originally thought to be an important variable for comparison, but after studying the agricultural characteristics of the area, most farmers were engaged in similar but multiple activities such that meaningful discrimination would be difficult. Type of farm was included on an earlier draft of the questionnaire and caused problems in

Table 1. Study Hospital Characteristics

Hospital	Location	County	# of Beds	Admissions/Year	# Physicians	Physician Specialties
Albany Community	Albany	Stearns	26	1000	2	Family Practice
Douglas County	Alexandria	Douglas	101	4600	25	Family Practice, Internal Medicine, General Surgery, Pediatrics, Orthopedics, Ophthalmology, Urology
Glacial Ridge	Glenwood	Pope	34	900	2	Family Practice
Melrose	Melrose	Stearns	28	1500	4	Family Practice
Paynesville Community	Paynesville	Stearns	43	1400	4	Family Practice
Rice Memorial	Willmar	Kandiyohi	175	7300	50	Family Practice, Internal Medicine, General Surgery, Pediatrics, Urology, Pathology, Radiology, Ophthalmology, Psychiatry, ENT

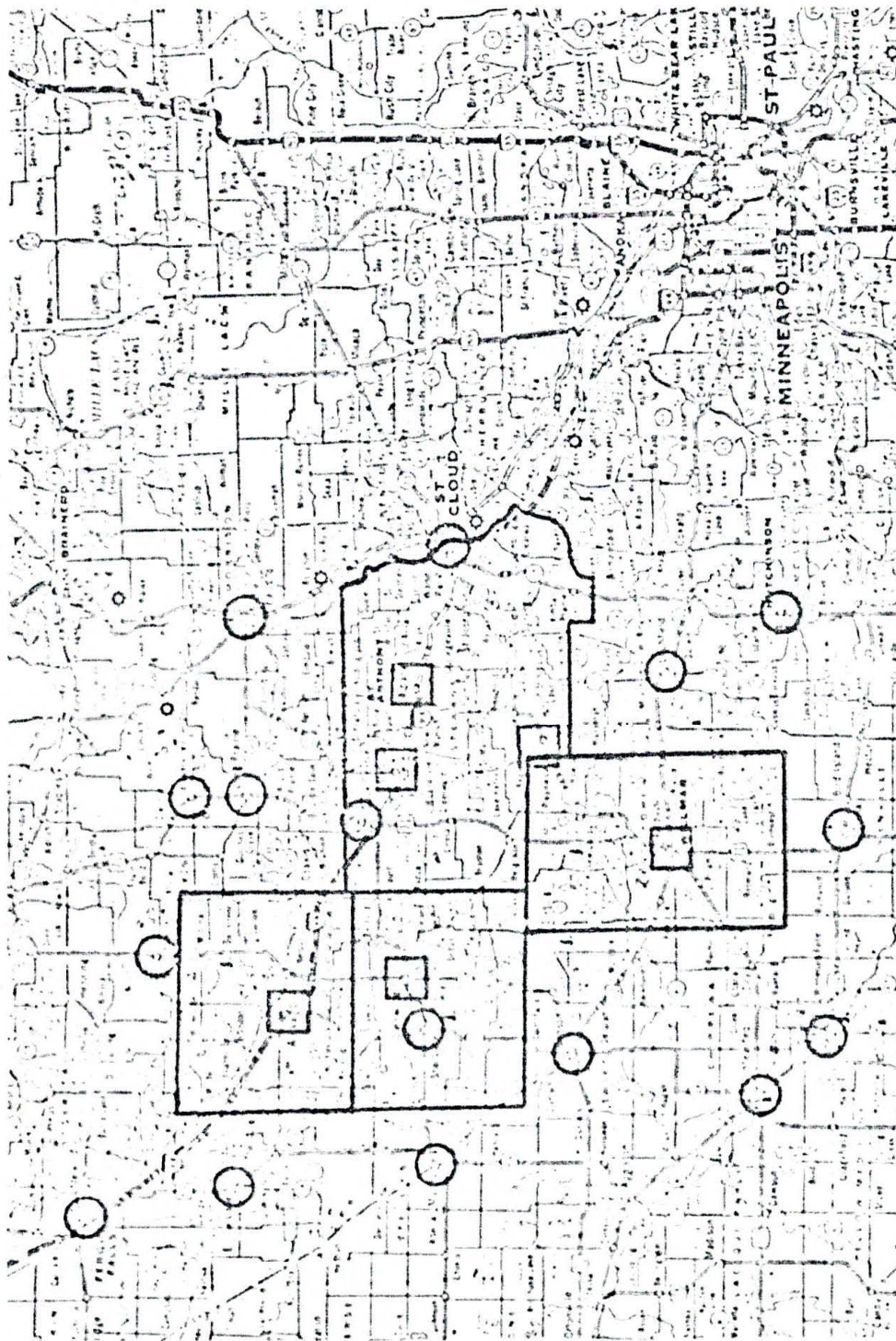


Figure 1. Distribution of Hospitals in the Study Area.

□ Study Hospital ○ Non-study Hospital

Table 2. Population Characteristics of Study Counties

County	Places With Study Hospitals	Places With Non-study Hospitals	1970 County Population	1970 Census Statistics				% Population Distribution		
				% Males	% Non-white	% 18-64 Years Old	% of Those Over 16 Employed in Agriculture	Rural Farm	Rural Nonfarm	Urban
Douglas	Alexandria	None	25,000	50	0.1	50 (Median Age = 31)	23	28	42	30
Kandiyohi	William	None	33,000	50	0.2	52 (Median Age = 31)	17	25	33	42
Pope	Glenwood	Starbuck	12,000	51	0.2	48 (Median Age = 36)	29	43	34	23
Stearns	Albany Melrose Paynesville	St. Cloud Sisk Center	104,000	50	0.4	51 (Median Age = 22)	12	20	40	40

Detach club before moving back

11234567890

Figure 2.

a pretest. The biggest problems were the time involved to explain and define the types of farms and the patient's inability to choose a category since his farm consisted of multiple commodities. Table 3 summarizes agricultural characteristics of the area.

Since smoking is related to some of the diseases under investigation, it was decided to include smoking history on the questionnaire for the purpose of stratification, since farmers are generally regarded to smoke less than nonfarmers [6].

In addition to the above ideas, the questionnaire would have to be easily understood, should leave little room for indecision on the part of the interviewer or patient, should be short so as to minimize patient and interviewer burden, and should be precoded so the data could be added to the CPHIA forms with a minimum of errors. Figure 3 presents the questionnaire in its final form.

Study Design

The final study design attempted to obtain valid information on the health of agricultural workers via three different approaches. Hopefully, common problem areas would be evident through several of the comparisons.

By obtaining information on place of residence, data from the two population-based hospitals in Douglas and Kandiyohi Counties can be combined with census population estimates updated to the time of the study and diagnosis-specific hospital discharge rates can be calculated. From the rates, estimates of the relative risk of farm residents to nonfarm residents can be calculated. The rates will be underestimated because not all of the hospitalizations of county residents will be captured, but by looking at data from some of the hospitals in neighboring counties, it can be determined whether the people from the study counties going to hospitals outside the county possess the same characteristics as county residents admitted to the in-county hospitals. If this is true, then estimates of relative risk are valid; otherwise, adjustments should be made.

Table 3. Agricultural Characteristics of Study Counties

		<u>County</u>			
		<u>Douglas</u>	<u>Kandiyohi</u>	<u>Pope</u>	<u>Stearns</u>
Number of Farms	All Farms	1469	1575	1095	3383
	Class 1-5 Farms*	1266	1453	1019	3031
% Land in Farms	All Farms	77	81	80	81
	Class 1-5 Farms	73	78	78	77
Mean Farm Size (Acres)	All Farms	218	256	311	205
	Class 1-5 Farms	240	270	327	219
% Employing Hired Workers	All Farms	35	38	36	29
	Class 1-5 Farms	37	39	38	31
<u>Farm Ownership (Class 1-5 Farms)</u>					
Individual or Family		92%	92%	92%	94%
Partnership		7%	7%	7%	5%
Corporation or Other		1%	2%	1%	1%
<u>Farm Classification (Class 1-5 Farms)</u>					
Dairy		48%	28%	36%	61%
Livestock		16%	17%	17%	16%
Cash-grain		26%	45%	37%	13%
General		5%	5%	6%	3%
Poultry		1%	3%	1%	2%
Other		5%	3%	3%	5%

Table 3. Agricultural Characteristics of Study Counties (continued)

% Farms Raising (Class 1-5 Farms)	County			
	Douglas	Kandiyohi	Pope	Stearns
Livestock or Poultry	84	75	82	93
Cattle	78	63	73	84
Milk Cows	57	40	44	67
Hogs & Pigs	28	27	27	41
Poultry	19	13	12	18
Sheep & Lambs	4	5	3	2
Oats	55	59	75	79
Alfalfa	78	62	72	84
Corn	77	87	84	87
Wheat	50	43	57	8
Barley	21	2	10	1
Soybeans	19	66	42	13

Source: 1974 Census of Agriculture, U. S. Department of Commerce, Bureau of the Census, Volume 1. State Reports, Part 23, Minnesota, State and County Data, U. S. Government Printing Office, 1977.

*Class 1-5 farms are farms with sales over \$2500/year.

AGRICULTURAL OCCUPATION AND SMOKING QUESTIONNAIRE

Patient Number _____

Instructions & Definitions

1. What county do you live in? <input type="checkbox"/> Dodge <input type="checkbox"/> Kandiyohi <input type="checkbox"/> Morrison <input type="checkbox"/> Pope <input type="checkbox"/> Nicollet <input type="checkbox"/> Todd <input type="checkbox"/> Other Minnesota <input type="checkbox"/> Out of State 1 2 3 4 5 6 7 8 9	1. Current county of residence.
2. Do you live on a farm? (If patient is less than 18 years of age, questionnaire is completed.) <input type="checkbox"/> Yes <input type="checkbox"/> No 1 2	2. Farm: 10 or more acres and sales of \$50 or more per year or less than 10 acres and sales of \$250 or more per year.
3. Have you ever smoked cigarettes? If answer is NO skip to question 7. <input type="checkbox"/> Yes <input type="checkbox"/> No 1 2	3a. Smoking cigarettes should refer to anything other than an occasional cigarette, any regular smoking.
4. Do you smoke cigarettes now? <input type="checkbox"/> Yes <input type="checkbox"/> No 1 2	
5. For how many years have you or did you smoke regularly? <input type="checkbox"/> Less than 5 <input type="checkbox"/> 5-9 <input type="checkbox"/> 10-14 <input type="checkbox"/> 15-19 <input type="checkbox"/> 20 or more 1 2 3 4 5	
6. On the average, how many cigarettes per day do you smoke, or did you smoke when you were a smoker? <input type="checkbox"/> Less than 1 pack per day <input type="checkbox"/> 1 pack or more per day 1 2	
7. Has your principal occupation ever been a farmer, farm worker, farm manager, or farm housewife? If answer is NO, what is your current occupation? (Questionnaire is completed if answer is NO and occupation is given. If answer is YES, go on to question 8.) <input type="checkbox"/> Yes <input type="checkbox"/> No 1 2	7. Principal occupation is the one at which the most hours were worked during the year. For current occupation, unemployed persons should answer in reference to their usual occupation when working.
8. For how many years have you worked in agriculture? <input type="checkbox"/> Less than 5 <input type="checkbox"/> 5-9 <input type="checkbox"/> 10-14 <input type="checkbox"/> 15-19 <input type="checkbox"/> 20 or more 1 2 3 4 5	8. This is the number of years in which your principal occupation was a farmer, farm worker, farm manager or farm housewife.
9. Is your principal occupation now a farmer, farm worker, farm manager, or farm housewife? If answer is NO, what is your current occupation? (Questionnaire is completed if answer is NO and occupation is given. If answer is YES, go on to question 10.) <input type="checkbox"/> Yes <input type="checkbox"/> No 1 2	9. Principal occupation is the one at which the most hours were worked during the previous year. Unemployed persons should answer in reference to their usual occupation when working.
10. Are you a hired farm worker? <input type="checkbox"/> Yes <input type="checkbox"/> No 1 2	10. Persons working for relatives or owning or leasing their own farms should answer NO.

Figure 3.

By obtaining information on occupation, similar estimates of discharge rates and relative risks of farm workers to nonfarm workers can be made. The number of people evaluated in this manner will be substantially less since the primary group of interest would be males between 25 and 64 years of age.

To effectively use all of the data from participating hospitals, a case-control, inhospital comparison can be undertaken. This type of analysis makes use of data from small hospitals (reducing any bias due to hospital size, such as cost) and includes data on patients using the two population-based hospitals who reside in another county and who were not evaluated in the first two analyses. Evaluating years of agricultural exposure is more valid than previous analyses for retired or exfarmers, for farm workers not living on farms, and for farm residents not working on farms. By using all the data, a case-control study effectively doubles the number of cases from the population-based analysis.

Selection of an inhospital control group for the above analysis is an important but difficult task. Relative risks from the population-based analysis should give good information on the types of diagnoses for which farmers and nonfarmers are at equal risk and, hence, should be suitable for use as control diagnoses. Through the addition of smoking histories, it is possible to adjust for smoking habits, an adjustment not generally possible in the population-based analyses.

To complement the above analyses, a variety of inhospital statistics can be calculated for farmers and nonfarmers, such as diagnosis-specific lengths of stay, age and sex distributions, and admission blood pressures. Birth statistics such as percent of abnormalities or stillbirths, average age of mothers, complications, etc., may provide valuable information. Hospital mortality statistics are not necessarily valid in this study since mortality can be affected by distance to the hospital and since many patients dying in the hospital would have incomplete occupational and smoking histories.

It is hoped that by looking at data from a variety of hospitals in several different types of analyses, a reasonable picture of the relative health of farmers and nonfarmers in rural Minnesota can be provided.

Statistical Methods

For the population-based hospitals, sex-specific discharge rates, age adjusted by the direct method to the nonfarm population were calculated for the groups of interest. The ratios of farm to nonfarm rates were used to calculate relative risks. Data from the two counties and hospitals were combined to obtain sufficient numbers of cases for meaningful comparisons. For the case-control analysis, estimates of relative risk were calculated as given by the Cornfield [7] approximation. Relative risks of the farm exposure categories to the nonfarm group for the individual smoking and age categories were made for diagnoses of interest and then summarized over age and smoking categories using the estimator "R" of Mantel and Haenszel [8].

Since it was necessary to provide an assessment of the relative importance of each relative risk, tests of statistical significance were used as a means of identifying diagnoses whose increased relative risk for farmers exceeded chance fluctuations. One-sided significance tests were used since the purpose of this study was to identify possible problem health areas in agriculture.

For the population-based hospitals, differences in the age adjusted rates were compared by computing the standard errors of the rates as given by Keyfitz [9] and then by calculating a z-statistic for the difference between two rates. In the case-control analysis, a Mantel-Haenszel chi-square statistic [8,10] was first used to test for a dose-response type relationship between years of exposure and summary relative risks. For each exposure category, another Mantel-Haenszel chi-square statistic tested the significance of each summary relative risk, disregarding whether a dose-response relationship existed.

THE USE OF HOSPITAL DATA IN EPIDEMIOLOGICAL RESEARCH

The aforementioned study plan has as its basis hospital records. A summary of the advantages and disadvantages of using hospital data is important to the understanding of the significance and limitations of the results of the study. This type of study is meant to be a rough screening over a variety of conditions and does not replace a carefully directed population study involving examinations and case histories.

The use of hospital data in epidemiological research has been described by Masi [11] and in a report sponsored by the National Center for Health Statistics [12]. Advantages include the availability of a large number of cases of varying diagnoses plus cases which can be used for controls; the possibility of collecting information on independent variables of interest such as smoking; the high degree of diagnostic accuracy in defining case and control population; and, certainly, time and cost considerations.

Limitations include the possibility that hospital-detected cases may be selective subjects of the true disease cases; adequate control groups often are difficult to determine; and often the population at risk cannot be precisely defined. Data can vary in quality and comparability among hospitals. Estimates of the incidence of chronic disease are less valid than for acute attacks. The use of only hospital data loses the diseases and conditions treated on an outpatient basis and the mortality occurring outside the hospital. Berkson [13] has pointed out problems in validity which arise when admission rates for cases and controls are different and are related to the independent variable under study. The use of secondary diagnoses is not necessarily valid since the secondary diagnosis alone often would not result in hospitalization.

Another problem area is the reliability of hospital discharge abstracts. If the researcher has enough time and resources, he can perform a carefully controlled abstracting of the medical records for his own purposes, but usually the researcher can only use already

abstracted data from existing sources. The National Academy of Sciences Institute of Medicine sponsored a study of the reliability of hospital discharge abstracts [14] in which data from six abstracting services, including CPHA, were evaluated. Items such as age, sex, and dates of stay were found to be at least 98% reliable upon reabstracting but the reliability of the fourteen chosen target diagnoses in the sample varied. Using ICD-9 coding, four-digit reliability was 65% and three-digit reliability was 74%. A CPHA study gave 88% reliability for diagnoses coded to four digits [15]. Factors such as training of abstractors, procedures and supervision in the medical record department, thoroughness of record review, and the necessity of relying on professional judgment due to the inadequacy of nomenclature, coding guidelines, or the presence of multiple diagnoses are influential in determining reliability. Since these studies, CPHA and the other abstracting service have attempted to correct some of the reliability problems. Diamond and Lilienfeld [16] studied the effects of misclassification of diagnosis or patient status with regard to the independent variable under study. Problems arise when the misclassification rates are different between cases and controls.

The Institute of Medicine report gave recommendations for using hospital data. Analysis involving age, sex, and length of stay are reliable and data on principal diagnoses are adequate for general program management and monitoring purposes. For research and evaluation, diagnoses should be coded to three rather than four digits and even coarser groupings of diagnoses will provide greater reliability.

With regard to the previous discussion, attempts were made in the Rural Health Study design to incorporate as many of the suggestions as possible, notably the use of multiple hospitals to balance selective admissions, the use of several analyses to evaluate the adequacy of controls and the use of three-digit and cruder ICD-9 coding.

DATA COLLECTION

Questionnaire Administration

Questionnaires were administered by hospital personnel to all patients 18 years of age and older. Those patients under 18 years were required to have only the county and place of residence recorded on the questionnaire form. One questionnaire was to be submitted for each discharge, even if only the county of residence and patient number were recorded. If a patient would not or could not respond to the questionnaire, it was suggested to obtain as much information as possible from the patient's records.

Because of differing hospital procedures and workloads, it was left to the hospital to determine the best time, person, and place to administer the questionnaires. Some hospitals used admitting personnel, some used nurses, and some used special persons designated to collect the information. Time of administration in some hospitals was during admittance, while in others administration came after the patient had been settled in his room or after his condition had stabilized. To minimize missing data, the former method was preferable but the latter method is thought to give more reliable information since more time was taken.

In one hospital, it was necessary to complement the post admittance administration with a telephone follow-up, since a large number of patients with short stays was missed. For patients with more than one admission during the study period, some hospitals repeated administration of the questionnaire unless the patient objected, while other hospitals did not repeat the questionnaire. Repeat administration is the preferred mode of action to get an estimate of the reliability of questionnaire items.

Coding and Receipt of Data

At the end of each month of the study (when preparing the patient abstracts to be sent to CHIA), the medical records personnel added the

precoded questionnaire responses to predetermined, previously unused fields on the PAS abstract form. CPHA then provided quarterly data tapes of the required medical and demographic information, plus the questionnaire responses. Completed questionnaires were then sent by the hospitals to the UBTL after the responses had been recorded each month. These were used to compare with the data tapes to check for transcription errors and were used when editing of the data tapes revealed inconsistencies.

After nine months of the study were completed, one of the hospitals changed abstracting services from CPHA to the MED-ART system of Diversified Computer Services (DCA) of Palo Alto, California. Data for the last three months of the study were then obtained from DCA. The change-over did not disrupt data collection or quality; coding was the same or similar to that previously used; the only differences related to the study were in format.

Data Quality

A total of 16,598 discharge cases were collected from the six hospitals for the period from April 1, 1976, through March 31, 1977. Of these, 3594 cases were under 18 years of age and minimal questionnaire information required. For the remaining 13,004 cases, Table 4 gives a breakdown of the number of cases, and the cases with missing or incomplete data, both on a per hospital basis and a per county resident basis for the population-based hospitals. As a function of the method of questionnaire administration, Douglas County Hospital showed a high proportion of missing data. Telephone follow-up was conducted only for residents of Douglas County, reducing the missing data proportions for the county residents to acceptable levels. Before counting a case as missing, it was checked for additional admissions with complete data during the study period.

For the first few months, all questionnaires were compared to the computer listings and errors tabulated. After that, approximately a 25% sample was compared. Computer editing revealed incorrect codes, missing data, shifts in coding, and inconsistency in responses, while the

Table 4. Rural Health Study Cases - April 1976-March 1977

Hospital		Total No. of Cases	No. of Cases Newborn	No. of Cases <18 Years Other	No. of Cases ≥18 Years	No. of Cases ≥18 Years With Complete Data	(Per Cent)	Per Cent Cases With Missing Data For Selected Questionnaire Items		
								Question 2	Question 3	Question 7
Billings	All Cases	7312	664	835	5813	5705	(98.1)	0.4	1.5	1.9
	County Residents Only*	4244	520	479	3245	3173	(97.8)	0.5	1.7	2.2
Alexandria	All Cases	4534	414	498	3672	3312	(90.2)	7.5	9.7	9.8
	County Residents Only*	3450	330	352	2768	2621	(94.7)	2.8	5.3	5.3
Belrose	All Cases	1512	186	199	1127	1121	(99.5)	0.1	0.5	0.5
Paynesville	All Cases	1371	218	186	967	929	(96.1)	1.8	3.4	3.9
Albany	All Cases	975	120	135	720	719	(99.9)	0.0	0.0	0.1
Greenwood	All Cases	854	72	67	705	697	(98.9)	0.1	0.9	1.1
Total	All Cases	16593	1674	1920	13004	12483	(96.0)	2.4	3.7	4.0
	County Residents Only*	7624	850	831	6013	5794	(96.4)	1.6	3.4	3.6

* Includes data from all study hospitals.

comparison of questionnaires and listings revealed errors in transcription which would not ordinarily be found during computer editing. Table 5 summarizes the frequencies of various types of errors and inconsistencies in questionnaire responses.

When questionnaires differed among multiple admissions, it was decided to use the first response in the analysis, so that the data were comparable to all of the patients with single admissions. Conflicts within admissions, however, were resolved by using the most consistent answers or by taking the positive answer (i.e., if a person stated that he had never been a farmer and then stated that he had worked in agriculture for 20 years, it was assumed that the first answer had been recorded erroneously).

CPHA data had been previously edited and were used as they were received, subject to the limitations described earlier. From multiple admissions, an occasional difference in age or sex was noticed, however, and could be resolved.

Population Estimates

Population estimates were not available for the categories desired except from the 1970 census. Current estimates were made as a combination of 1970 census figures and any new relevant information. U. S. census data for 1970 were the basis for making estimates of the number of farm and nonfarm residents plus the number of farm and nonfarm workers in Kandiyohi and Douglas Counties. The Minnesota State Planning Agency is the official census designate in Minnesota and makes yearly estimates and projections of the population of Minnesota counties, including breakdowns by age and sex [17]. No farm, nonfarm, or employment estimates are made. The Minnesota Department of Employment Services in conjunction with the U. S. Department of Agriculture Statistical Reporting Service makes county monthly employment estimates of farm and nonfarm employment but uses different definitions than the census and does not distinguish by age and sex.

Using 1970 census figures and 1975 State Planning Agency figures for county and major city populations (Willmar in Kandiyohi County and Alexandria in Douglas County), projections were made for the 1976 total

Table 5.

Rates of Errors and Inconsistencies

<u>Type of Error or Inconsistency</u>	<u>No. of Cases with Errors or Inconsistencies</u>	<u>Total Possible Cases</u>	<u>Rate</u>
Coding or Transcription Error	227	12,063	1.9%
Inconsistency in thin Case	261	12,063	2.2%
Inconsistency among Multiple Admissions (Average of 3.6 questions per admission)	661	4,266	15.6%
		(15,358 responses)	(4.3% per question)

population, the difference between the county and city populations being the rural population. Using 1970 census ratios of rural farm to rural nonfarm, the projected 1976 farm population was determined, with the city and rural nonfarm population comprising the nonfarm population. Farm and nonfarm age and sex proportions from the census were adjusted to the 1975 Planning Agency age and sex proportions, and then applied to the 1976 projections. The end result was 1976 estimates of the farm and nonfarm population by age and sex. Table 6 gives these figures. As a check, straightline projections of 1970 age, sex, and residence categories were not far from the estimates in Table 6.

In determining the number of workers, the 1976 population estimates were multiplied by the 1970 census proportions of each age group who were in the labor force, thus obtaining the labor force. Rates of increase in the number of farm workers and nonfarm workers as obtained from the Minnesota Department of Employment Services for 1970 to 1976 were used in conjunction with 1970 census figures to divide the labor force into farm and nonfarm workers. Table 7 presents the estimates. Comparisons of these estimates and the 1970 census figures show the ratio of farm to nonfarm workers to be about the same.

Table 6

POPULATION BY AGE, SEX, & RESIDENCE - ESTIMATED 1976

<u>Kandiyohi County</u>		<u>Males</u>		<u>Females</u>		
Age Category	Farm	Non Farm	Ratio	Farm	Non Farm	Ratio
<15	1184	2786	2.4	1040	2747	2.6
15 - 24	919	2751	3.0	611	2734	4.5
25 - 34	298	1378	4.6	374	1360	3.6
35 - 44	473	1085	2.3	506	1082	2.1
45 - 54	492	1307	2.7	491	1294	2.6
55 - 64	559	1244	2.2	372	1439	3.9
65 - 74	241	1032	4.4	169	1144	6.8
≥75	139	665	4.8	97	1005	10.4
Total Population (33,038)	4305	12,268	2.8	3660	12,805	3.5

<u>Douglas County</u>		<u>Males</u>		<u>Females</u>		
Age Category	Farm	Non Farm	Ratio	Farm	Non Farm	Ratio
<15	904	2084	2.3	1003	1952	1.9
15 - 24	764	1833	2.4	592	1891	3.2
25 - 34	322	937	2.9	297	997	3.4
35 - 44	375	729	1.9	369	793	2.1
45 - 54	429	786	1.8	392	672	2.2
55 - 64	497	863	1.7	381	957	2.5
65 - 74	329	516	2.5	202	1002	5.0
≥75	112	725	6.5	104	901	8.7
Total Population (25,215)	3732	8778	2.4	3340	9365	2.8

Table 7.

MALE FARM WORKERS BY AGE - ESTIMATES 1976

<u>Kandiyohi County</u>				<u>Douglas County</u>		
Age Category	Farm Workers	Other Workers	Ratio	Farm Workers	Other Workers	Ratio
25 - 34	249	1,342	5.4	253	961	3.8
35 - 44	344	1,139	3.3	327	760	2.3
45 - 54	407	1,104	2.7	366	696	1.9
55 - 64	480	1,055	2.2	476	717	1.5
TOTAL	1,480	4,620	3.1	1,422	3,134	2.2

RESULTS AND DISCUSSION

Analysis of Population-Based Hospitals

1. Analysis by Place of Residence. Primary diagnoses were tabulated by age and sex for current farm and nonfarm residents. Age groupings used ten-year intervals with those patients under 15 and 75-and-older comprising the end groupings. Age adjusted discharge rates were calculated for three groupings of residents: less than 25 years old, 25-64 years old, 65 years and older. The ratios of the age adjusted rates for farmers to nonfarmers gave the relative risks. Since the rates are known to be underestimated for both farm and nonfarm residents, only the relative risks and number of cases are presented. Data from both counties are combined in order to maximize the number of cases and to ensure privacy of an individual hospital's data.

Patient origin studies during November, 1976, as conducted for Minnesota Hospital Research and Educational Trust, were used to test the adequacy of the assumption that most of the hospital experience of residents from Douglas and Kandiyohi County was captured. Table 8 presents the results of the one-month study. Eighty percent of Douglas and Kandiyohi County residents went to study hospitals; however, most of the patients attending other hospitals went to large referral hospitals where a bias in hospital selection for farmers is not suggested. In fact, 94% of the county residents going to hospitals in the immediate area went to study hospitals.

In the Rural Health Study, data on only thirty Douglas County residents were obtained from other study hospitals; almost all went to Glenwood. No discernible differences in the proportion of farmers could be seen between these thirty patients and those attending Douglas County Hospital.

Kandiyohi County residents going to other study hospitals numbered 182, 169 of these going to Paynesville Community Hospital, which is two miles from Kandiyohi County, and eleven cases going to the Glenwood

Table 8.
Patient Origin Study*, November 1976,
Kandiyohi and Douglas Counties

Hospital Destination for County Residents	Douglas County	Kandiyohi County	Total
Hospital in the Same County as Residence	270	249	519
Neighboring* Study Hospital	1	8	9
Neighboring* Non Study Hospital	18	13	31
Non Neighboring Non Study Hospital	8	7	15
Referral Hospitals in Twin Cities, Rochester, St. Cloud	42	48	90
Total	339	325	664
Per cent of county residents going to study hospitals	80%	79%	80%
Per cent of county residents going to study hospitals as a per cent of county residents going to hospitals in the immediate area	94%	95%	94%

* Neighboring hospitals are the hospitals which are the closest hospitals to the study county borders.

* Source: Minnesota Hospital Research & Educational Trust.

Hospital, twenty-six miles from the county line. About 40% percent of Kandiyohi County residents admitted to the out-of-county study hospitals lived on farms, as opposed to about 20% admitted to in-county hospital. Willmar Hospital is the largest in the western part of the State so it would lose patients to a smaller hospital usually only when distance or cost was a factor. Since Paynesville is so close to the county border, it naturally attracts many Kandiyohi County residents to it; but only two other hospitals would be closer than Willmar for a few Kandiyohi County residents. Based on the patient origin study plus the size, distance away, and number of neighboring hospitals, at most 150-200 county residents per year would choose these hospitals. As for determining relative risks, the differential in percentage of farm residents attending the in- and out-of-county hospitals could result in underestimating the farm hospital discharges by 30-40 cases; and, likewise, overestimating the nonfarm discharges by the same amount, a possible 7 percent underestimation of the overall relative risk for Kandiyohi County farm residents.

Cases were counted and relative risks tabulated using the major disease classifications from H-ICDA. These major classifications were further broken down using H-ICDA subclassifications and, in some instances, to three-digit coding when the number of cases was sufficiently large. For patients with multiple admissions, only the first admission in the disease class, subclass, or individual code under study was used. In this way, a patient would only be used once for each major classification, but might also be found in several of the subclassifications, so the totals of the subclasses do not necessarily equal the totals in the major classifications. Appendix I presents the number of cases and relative risks of living on a farm compared to not living on a farm.

Tables 9a and 9b summarize the primary diagnoses for which farm residents show increased relative risks over nonfarm residents. The only statistically significant increased relative risks were for lacerations and open wounds for male patients less than 25 years of age; diseases of the liver, gall bladder, and pancreas (primarily gall bladder) for male patients 25-64 years old; and pneumonia, hernia of the abdominal cavity, and benign prostatic hypertrophy in male patients older than 65 years of age. Female farm residents over 65 showed

Table 9a.

Diagnostic Categories with Increased Relative Risks for Farm
Residents as Compared to Non Farm Residents - Males

Males	Diagnostic Category	H-ICDA Codes	No. of Cases		Relative Risk	Significance
			Farm	Non Farm		
Age <25	Appendicitis	540-543	13	17	1.9	N.S.
	Lacerations & Open Wounds	870-897	9	9	2.6	p<.05
Age 25-64	Diseases of the Blood & Blood Forming Organs	280-289	2	1	4.4	N.S.
	Diseases of the Liver, Gall Bladder, & Pancreas	570-577	16	19	2.0	p<.05
Age ≥65	Infective & Parasitic Diseases	001-136	5	9	2.0	N.S.
	Endocrine, Nutritional, & Metabolic Diseases	240-279	7	17	2.3	N.S.
	Diseases of the Blood & Blood Forming Organs	280-289	4	6	3.5	N.S.
	Diseases of the Eye	370-378	7	20	1.9	N.S.
	Acute Upper Respiratory Infections	460-470	2	3	4.3	N.S.
	Pneumonia	480-486	17	35	2.3	p<.05
	Hernia of the Abdominal Cavity	550-553	17	24	2.7	p<.05
	Diseases of the Urinary System	580-599	18	46	1.6	N.S.
	Benign Prostatic Hypertrophy	600	19	49	1.8	p<.05
	Osteomyelitis & Other Diseases of Bone & Joint	720-729	6	7	3.0	N.S.

N.S. Not statistically significant, $\alpha = .05$

Table 9b.

Diagnostic Categories with Increased Relative Risks for Farm
Residents as Compared to Non Farm Residents - Females

Females	Diagnostic Category	II-ICDA Codes	No. of Cases		Relative Risk	Significance
			Farm	Non Farm		
Age <25	Diseases of the Gall Bladder	575	3	6	2.2	N.S.
Age 25-64	Diseases of the Eye	370-378	5	5	3.3	N.S.
	Diseases of the Arteries, Arterioles, & Capillaries	440-448	2	3	2.6	N.S.
	Appendicitis	540-543	4	8	1.8	N.S.
	Uterovaginal Prolapse	623	8	13	1.7	N.S.
	Diseases of the Skin & Sub- cutaneous Tissue	680-709	7	10	2.1	N.S.
Age ≥65	Cerebrovascular Disease	430-438	8	40	1.9	N.S.
	Diseases of Veins, Lymphatics, & Other Circulatory Diseases	450-458	5	26	1.7	N.S.
	Diseases of Gall Bladder	575	11	17	5.1	p<.01
	Uterovaginal Prolapse	623	3	14	1.7	N.S.

N.S. Not statistically significant, $\alpha = .05$

statistically significant increased relative risks for only diseases of the gall bladder.

The relative risks of farm to nonfarm residents for all diagnoses (one admission per patient) was 0.8 for patients less than 25 years old and patients 25 to 64 years of age. For patients over 65, the relative risk jumped to 1.3. This may indicate a problem health area for older farm residents but could also indicate problems with identifying farm residence in older retired farmers. Many older persons might report living on farms which would not be classified as farms by the census because no goods were sold. Over all age groups, farm residents had slightly lower hospitalization rates than nonfarm residents.

Of special note is the category "Injuries and Adverse Effects" for which the relative risks are always close to one for the age and sex groups. If farm and nonfarm residents are at equal risk, then this broad classification with a large number of occurrences and no one frequently occurring condition could be an appropriate control group for the case-control comparison.

2. Analysis by Occupation. Table 10 presents numbers of cases and age-adjusted relative risks for current male farm workers, ages 25-64. Since the number of cases is sharply decreased, only relative risks for the major disease classifications are given. Farm workers showed lower relative risks than nonfarm workers for almost all disease classifications. A possible explanation could be that active farm workers are being compared to a group of nonfarm workers which includes a large number of sedentary occupations. This result could also reflect the true relative health of farmers but might indicate problems due to the lack of precise estimates of the number of farm workers. Douglas County relative risks were lower than those from Kandiyohi County, so the problem may be in Douglas County estimates. Again of notice is the relative risk for injuries and adverse effects. The relative risk is near one (equal to one for Kandiyohi County), which strengthens the assumption that injuries and adverse effects could be used as a control group.

TABLE 10.
RELATIVE RISKS FOR CURRENT FARM WORKERS - MALES, AGE 25-64

Diagnostic Category	II-ICDA Codes	No. of Cases		Relative Risk
		Farm Workers	Non Farm Workers	
Infective & Parasitic Diseases	001-136	1	19	0.1
Neoplasms	140-239	3	25	0.2
Endocrine, Nutritional, & Metabolic Diseases	240-279	2	15	0.4
Diseases of the Blood & Blood Forming Organs	280-289	1	2	1.0
Mental Disorders	290-318	2	27	0.1
Diseases of the Nervous System & Sense Organs	320-389	6	19	0.8
Diseases of the Circulatory System	390-458	26	82	0.8
Diseases of the Respiratory System	460-519	5	21	0.6
Diseases of the Digestive System	520-577	33	112	0.7
Diseases of the Genitourinary System	580-629	11	60	0.4
Diseases of the Skin & Subcutaneous Tissue	680-709	3	17	0.4
Diseases of the Musculo-skeletal System & Connective Tissue	710-739	8	38	0.6
Signs, Symptoms, Ill Defined Conditions	770-796	8	49	0.4
Injuries & Adverse Effects	800-999	22	72	0.8
All Diagnoses	001-999	131	558	0.6

Case-Control Analysis

Because of problems in the accurate estimation of populations at risk and in the collection of all hospital experience in the study counties, plus the limited number of cases used in the population-based analysis, a third type of analysis attempts to utilize all of the data from the six hospitals. Selection of a control group is of primary importance for an inhospital comparison. Because of the consistency of relative risks near one in the previous analyses, the group of cases of primary diagnoses of injuries and adverse effects (H-ICDA codes 800-999) was selected for use as a control group. This category, composed of acute conditions, is also suitable for comparison because the independent variable under consideration is "Years of Farming," which is not necessarily related to acute conditions due to the number of exfarmers or retired farmers. The "Injuries and Adverse Effects" category is composed of a variety of conditions, none of which occurred with high frequency. By comparing all other diagnoses of interest to this control group, diagnoses with large relative risks for farmers can be identified. At the very least, such an analysis can give an idea of the relative importance of various health problems for the farming population.

"Years of Farming" was divided into three categories: none, one to 19 years, and 20 years and over. The relative frequencies of these categories in the control and test groups were then compared by diagnosis. For the age 65-and-older groups, the exposure category 1-19 years was eliminated due to the small number of patients in the category (especially for the control diagnoses). The relative risks were obtained by calculating summary relative risks from the farming-diagnosis breakdown, stratified by age and smoking history. Relative risks are given separately for the age 25- to 64-year-old group, stratified by ages 25-44 and 45-64, and by "never smoked", "previously smoked", "current smokers"; and for the 65 years and older group, stratified by ages 65-74 and 75-and-older, and by "never smoked" and "ever smoked". Appendix II presents the number of cases and the summary relative risks

for all diagnoses containing sufficient numbers of cases in the stratified groups. As in the population-based hospital analysis, only a patient's first discharge is tabulated within a disease class or subclassification and only primary diagnoses are used.

Tables 11a and 11b summarize the diagnoses for which patients with farming exposure show increased relative risk. For patients 25-64 years of age, there were statistically significant relationships between years of farming exposure and relative risk (as tested by the Mantel-Haenszel test) for benign prostatic hypertrophy and osteoarthritis and allied conditions in males, and for acute myocardial infarction and uterovaginal prolapse in females. Females also showed significantly elevated relative risks for patients in the 1-19 year exposure category for diseases of the urinary tract, diseases and conditions of the eye, and ulcer of the duodenum.

For patients over 65 years of age, males with greater than 20 years of agricultural exposure showed relatively few increased relative risks while females with the same exposure had a large number of increased relative risks. Significantly large relative risks for this group of farm females were for the diagnoses: neoplasms (including primary malignant neoplasms); diseases of the respiratory system; diseases of the gall bladder; diseases of veins, lymphatics and other circulatory diseases; diseases of the digestive system (including diseases of the esophagus, stomach, and duodenum); diseases of the genitourinary system (including uterovaginal prolapse); and osteoarthritis and allied conditions.

Over all diagnoses for patients between 25 and 64 years of age, those patients with farming exposure showed relative risks near or slightly less than one, as compared with patients with no farming exposure. Males over 65 with farming exposure had an overall relative risk of 0.7, while females over 65 with the same exposure had a relative risk of 1.3.

Only 114 discharges were recorded for current hired farm workers, 66 for males and 48 for females. Because of the small numbers, no attempts were made to evaluate differences in diagnosis patterns between hired farm workers and family farm workers.

Table 11a.
Diagnoses with High Relative Risks Associated with an
Agricultural Occupational History,
Ages 25-64

	Diagnosis Category	H-ICDA Codes	Relative Risks (No. of Cases)	
			1-19 Yrs. in Ag.	≥20 Yrs. in Ag.
Males	Diseases of the Blood & Blood Forming Organs	280-289	0.0 (0)	3.5 (4)
	Psychoses not Attributable to Physical Conditions	306-309	1.7 (6)	3.1 (6)
	Heart Failure	427	2.9 (1)	5.1 (5)
	Phlebitis & Thrombo-phlebitis	451	1.8 (3)	2.1 (6)
	Hemorrhoids	455	1.3 (5)	2.1 (11)
	Bronchitis, Emphysema, Asthma	489-496	0.9 (3)	2.2 (14)
	Inguinal Hernia	560	1.5 (30)	1.6 (43)
	Biliary Calculus	574	2.4 (3)	1.7 (4)
	Other Bladder Disease	596	1.9 (1)	4.9 (5)
	+ Benign Prostatic Hypertrophy	600	1.0 (6)	2.2* (29)
	+ Osteoarthritis & Allied Conditions	713	5.2 (4)	5.9* (11)
Females	Cancer of Large Intestine	153	0.0 (0)	2.5 (4)
	Diabetes Mellitus	250	0.6 (3)	2.2 (12)
	Diseases & Conditions of the Eye	360-379	2.0* (10)	0.6 (4)
	+ Acute Myocardial Infarction	410	1.3 (3)	8.0** (9)
	Cerebrovascular Disease	430-438	3.0 (4)	2.3 (3)
	Disease of Arteries, Arterioles, Capillaries	440-448	0.5 (1)	2.0 (5)
	Ulcer of Duodenum	532	4.8* (6)	1.4 (3)
	Intestinal Obstruction	560	0.3 (1)	2.1 (3)
	Diverticular Disease of Intestine	562	0.8 (2)	2.1 (5)
	Other Diseases of Urinary Tract	599	5.9** (7)	3.2 (4)
	Endometriosis	619	2.2 (10)	1.4 (5)
	+ Uterovaginal Prolapse	623	0.5 (4)	3.2** (27)
	Diseases of Skin & Subcutaneous Tissue	680-709	0.9 (6)	3.3 (12)
	Osteoarthritis & Allied Conditions	713	2.1 (4)	1.3 (5)

* Statistically significant relationship to years of exposure, $p < .05$.

*, ** Relative risk statistically significantly greater than 1, $p < .05$, $p < .01$.

Table 11b.

Diagnoses with High Relative Risks Associated with a
Agricultural Occupational History
Ages ≥65

Diagnosis Category		H-ICDA Codes	Relative Risk (No. of Cases) ≥20 Yrs. in Ag.
Males	Psychoses not Attributable to Physical Conditions	306-309	2.0 (5)
	Diseases of Veins, Lymphatics, & Other Circulatory Diseases	450-458	2.3 (24)
	Diseases of the Gall Bladder	575	1.6 (31)
	Other Symptoms Referable to Cardiovascular & Lymphatic System	775	2.0 (7)
Females	Neoplasms	140-239	1.7* (94)
	Primary Malignant Neoplasms	140-195	1.6* (60)
	Malignant Neoplasm of Large Intestine	153	2.1 (13)
	Secondary Malignant Neoplasms	196-199	2.0 (14)
	Diseases of the Blood & Blood Forming Organs	280-289	2.1 (9)
	Diseases of Veins, Lymphatics, & Other Circulatory Diseases	450-458	1.9* (39)
	Diseases of the Respiratory System	460-519	1.7* (69)
	Pneumonia	480-486	1.8 (28)
	Other Diseases of the Respiratory System	500-519	2.5 (11)
	Diseases of the Digestive System	520-577	1.6** (140)
	Diseases of the Esophagus, Stomach, Duodenum	530-537	1.8* (38)
	Gastritis & Duodenitis	535	3.6 (8)
	Hernia of Abdominal Cavity	550-553	2.0 (14)
	Biliary Calculus	574	1.9 (14)
	Diseases of Gall Bladder	575	1.9* (36)
	Diseases of Genitourinary System	580-629	1.8* (73)
	Diseases of the Breast	610-611	2.7 (9)
	Uterovaginal Prolapse	623	3.1** (25)
	Infections of the Skin & Subcutaneous Tissue	680-686	2.7 (9)
	Osteoarthritis & Allied Conditions	713	2.3** (53)

*,** Relative risk statistically significantly greater than 1, $p < .05$, $p < .01$

Comparative Hospital Statistics

For the major disease classifications, comparisons of several hospital statistics are given in Tables 12a and 12b. These statistics are tabulated for patients never having worked in agriculture versus those who have worked in agriculture. An obvious result of this dichotomization is that the patients with any agricultural occupational history are older than those patients not having worked in agriculture. Therefore, the statistics describing mean length of stay, case mortality rates, and admission blood pressure have all been age-adjusted to the combined age distribution. Over all diagnoses, patients with farming exposure had almost identical lengths of stay, case mortality rates, and admission blood pressures as those patients having never worked in agriculture.

A comparison of pregnancy and newborn statistics for farm and nonfarm residents or workers is shown in Table 13. No large differences can be seen in the outcome of pregnancies between the farm and nonfarm groups. Current farm workers or housewives had a slightly larger percentage of spontaneous abortions than the nonfarm females, but the difference is not statistically significant (χ^2 [1 d.f.] = 2.37).

Medical characteristics of patients for whom no questionnaire data were obtained were compared to that of patients with complete questionnaire data. Table 14 presents the results. For Douglas County, where a telephone follow-up interview was used to obtain data on patients who did not have a completed questionnaire during their hospital stay, the characteristics of original respondents, telephone respondents, and nonrespondents are compared in Table 15. From these tables, as can be easily seen, there is a much higher proportion of deaths in the nonrespondent group; patients died before questionnaire could be administered. This fact plus the fact that study data do not contain information on persons dying outside of the hospitals make any attempt at meaningful mortality comparisons in these data tenuous. The higher proportion of circulatory diseases in nonrespondents reflects the most common causes of death. Nonrespondents and respondents were basically the same age but the nonrespondents had a slightly shorter length of

Table 12a. In-Hospital Characteristics by Final Diagnosis - Males

Diagnostic Category	H-ICDA Codes	Farm Exposure	No. of Cases	Median Age (Years)	Mean Length of Stay (Days) ^a	Case Mortality Rate % ^a	Mean Admission Blood Pressure ^a	
							Systolic	Diastolic
Infective & Parasitic Diseases	001-136	Ever Farmed	55	65	5.0	1.2	142.4	85.2
		Never Farmed	48	41.5	4.6	3.2	132.0	74.0
Neoplasms	140-239	Ever Farmed	244	73	12.2	13.3	139.7	78.1
		Never Farmed	121	67	10.9	22.8	134.8	76.8
Endocrine, Nutritional, & Metabolic Diseases	240-279	Ever Farmed	51	69	7.7	5.6	137.4	80.3
		Never Farmed	30	59.5	6.7	3.9	146.4	84.2
Diseases of the Blood & Blood Forming Organs	280-289	Ever Farmed	18	78	10.2	10.8	134.3	67.5
		Never Farmed	6	63	5.7	0.0	120.0	65.0
Mental Disorders	290-318	Ever Farmed	96	58	7.4	0.0	141.0	83.7
		Never Farmed	89	41	8.0	0.0	137.6	85.4
Diseases of the Nervous System & Sense Organs	320-389	Ever Farmed	115	69	4.9	0.6	142.6	83.4
		Never Farmed	56	54	5.8	0.0	133.2	75.5
Diseases of the Circulatory System	390-458	Ever Farmed	441	72	8.8	11.9	148.8	85.6
		Never Farmed	275	63	9.3	10.7	145.4	83.6
Diseases of the Respiratory System	460-519	Ever Farmed	175	72	7.5	9.4	137.3	77.6
		Never Farmed	117	60	7.7	6.3	135.2	76.6
Diseases of the Digestive System	520-577	Ever Farmed	443	63	6.9	1.6	138.4	80.3
		Never Farmed	302	51	6.7	1.9	137.5	80.1
Diseases of Genitourinary System	580-629	Ever Farmed	343	70	6.5	0.7	144.1	82.3
		Never Farmed	179	60	6.2	0.7	142.1	82.9
Diseases of the Skin & Subcutaneous Tissue	680-709	Ever Farmed	48	65.5	9.5	1.3	141.2	78.6
		Never Farmed	40	30.5	7.5	0.0	131.7	79.7

Table 12a. In-Hospital Characteristics by Final Diagnosis - Males

Diagnostic Category	H-ICDA Codes	Farm Exposure	No. of Cases	Median Age (Years)	Mean Length of Stay (Days) ^a	Case Mortality Rate % ^a	Mean Admission Blood Pressure ^a	
							Systolic	Diastolic
Diseases of the Musculo-skeletal System & Connective Tissue	710-739	Ever Farmed	147	65	7.7	0.0	142.0	84.1
		Never Farmed	110	48.5	7.5	0.0	142.8	83.0
Congenital Anomalies	740-759	Ever Farmed	15	54	4.2	0.0	141.2	87.8
		Never Farmed	14	39.5	5.8	0.0	134.9	78.3
Signs, Symptoms & Ill-Defined Conditions	770-796	Ever Farmed	149	62	3.9	1.2	138.3	80.6
		Never Farmed	150	46	4.3	1.0	141.9	80.2
Injuries & Adverse Effects	880-999	Ever Farmed	288	57	6.5	1.1	137.8	80.9
		Never Farmed	272	30	6.1	1.5	137.9	78.9
All Diagnoses	001-999	Ever Farmed	2306	67	7.3	4.8	141.5	81.9
		Never Farmed	1658	51	7.3	5.6	139.8	81.0

^a Age adjusted

Table 12b. In-Hospital Characteristics by Final Diagnosis - Females

Diagnostic Category	II-ICDA Codes	Farm Exposure	No. of Cases	Median Age (Years)	Mean Length of Stay (Days) ^a	Case Mortality Rate % ^a	Mean Admission Blood Pressure ^a	
							Systolic	Diastolic
Infective & Parasitic Diseases	001-136	Ever Farmed	53	63	4.6	1.4	134.0	74.2
		Never Farmed	81	36	4.8	2.0	127.8	75.2
Neoplasms	140-239	Ever Farmed	233	65	9.2	6.3	138.0	78.6
		Never Farmed	250	48	9.6	7.1	133.3	80.1
Endocrine, Nutritional, & Metabolic Diseases	240-279	Ever Farmed	63	68	10.0	0.0	144.7	78.3
		Never Farmed	55	60	5.6	0.0	146.8	80.7
Diseases of the Blood & Blood Forming Organs	280-289	Ever Farmed	18	67	8.1	0.0	131.5	70.6
		Never Farmed	16	57.5	4.1	0.0	151.5	77.4
Mental Disorders	290-318	Ever Farmed	92	61	9.6	0.0	135.6	82.8
		Never Farmed	174	43.5	8.2	0.6	140.3	84.1
Diseases of the Nervous System & Sense Organs	320-389	Ever Farmed	150	72.5	6.3	0.6	143.4	80.0
		Never Farmed	135	66	7.0	0.0	143.7	81.2
Diseases of the Circulatory System	390-458	Ever Farmed	337	75	10.1	8.3	149.3	83.8
		Never Farmed	290	70.5	10.9	8.4	149.2	84.2
Diseases of the Respiratory System	460-519	Ever Farmed	107	74	8.2	2.2	135.2	75.3
		Never Farmed	125	54	7.4	1.4	136.5	75.1
Diseases of the Digestive System	520-577	Ever Farmed	309	66	7.5	1.5	134.7	78.8
		Never Farmed	371	50	7.8	0.4	136.0	76.6
Diseases of Genitourinary System	580-629	Ever Farmed	298	52	5.0	0.2	133.5	77.6
		Never Farmed	417	41	4.0	0.0	129.7	76.2
Delivery & Complications of Pregnancy, Childbirth, & the Puerperium	631-678	Ever Farmed	488	26	3.4	0.0	124.6	74.3
		Never Farmed	1224	24	3.5	0.0	122.8	74.3

Table 12b. In-Hospital Characteristics by Final Diagnosis - Females

Diagnostic Category	ICD-9 Codes	Farm Exposure	No. of Cases	Median Age (Years)	Mean Length of Stay (Days) ^a	Case Mortality Rate % ^a	Mean Admission ^a Blood Pressure	
							Systolic	Diastolic
Diseases of the Skin, & Subcutaneous Tissue	680-709	Ever Farmed	47	70	9.4	1.8	136.5	77.8
		Never Farmed	41	41	7.6	0.0	143.7	79.6
Diseases of the Musculoskeletal System & Connective Tissue	710-739	Ever Farmed	119	70	8.4	0.0	146.0	81.2
		Never Farmed	139	57	8.2	1.0	140.8	79.4
Congenital Anomalies	740-759	Ever Farmed	8	56	4.9	0.0	138.6	80.3
		Never Farmed	8	43.5	7.6	0.0	129.9	74.6
Signs, Symptoms & Ill-Defined Conditions	770-796	Ever Farmed	168	60.5	4.5	0.0	138.7	78.5
		Never Farmed	208	46	4.9	0.7	134.6	77.3
Injuries & Adverse Effects	800-999	Ever Farmed	217	72	9.8	0.0	141.0	77.3
		Never Farmed	263	61	9.5	0.0	144.8	80.6
All Diagnoses	001-999	Ever Farmed	2167	59	6.4	1.9	135.7	78.2
		Never Farmed	3537	53	6.5	1.9	134.5	78.0

^a Age Adjusted

Table 13.
Comparative Pregnancy and Newborn Statistics

<u>Females Age 18-35</u>	<u>H-ICDA Codes</u>	<u>Current Farm Worker or Housewife</u>	<u>Not Current Farm Worker or Housewife</u>
Number of Cases	631-678	529	2364
Complications of Pregnancies	631-639	29 (5.5%)	137 (5.8%)
Spontaneous Abortion	643	24 (4.5%)	73 (3.1%)
Delivery	650-664	311 (58.8%)	1152 (48.7%)
Delivery Without Complications	650	201 (64.6% of Deliveries)	788 (68.4% of Deliveries)

Median Age of
Mothers (years)

27

25

<u>Births - All</u>	<u>H-ICDA Codes</u>	<u>Farm Residence</u>	<u>Non-Farm Residence</u>
Total births	Y20-Y32	500	1098
Stillborn	Y30-Y32	4 (0.8%)	6 (0.5%)
Liveborn	Y20-Y29	496	1092
<u>Secondary Diagnoses of Liveborn</u>			
Congenital Anomalies	740-759	11 (2.2%)	22 (2.0%)
Diseases of Newborn Infants	760-768	35 (7.1%)	81 (7.4%)
Other Secondary Diagnoses	All others	9 (1.8%)	33 (3.0%)

Liveborn Statistics

Median Birthweight	7 lb. 13 oz.	7 lb. 10 oz.
Median Length of Stay	3 days	3 days
No. of Males (%)	266 (54%)	561 (51%)
No. of Deaths (%)	1 (0.2%)	2 (0.2%)

Table 14. Comparisons of Original Respondents, Telephone Respondents, and Nonrespondents - Douglas County

		Original Respondents	Telephone Respondents	Nonrespondents			
Total no. of cases (% of all cases)		2279 (82%)	412 (15%)	77	(3%)		
Patients living on a farm (% of total)		484 (21%)	75 (18%)	--	--		
Number of deaths (% of total)		68 (3.0%)	-- --	27	(35.1%)		
Mean length of stay (days)		7.4	4.6	7.5			
Median age (years)		62	52	60			
Diagnostic Category	H-ICDA Codes	Cases	%	Cases	%	Cases	%
Infective & Parasitic Diseases	001-136	44	1.9%	14	3.4%	1	1.3%
Neoplasms	140-239	201	8.8%	16	3.9%	4	5.2%
Endocrine, Nutritional, & Metabolic Diseases	240-279	58	2.5%	2	0.5%	2	2.6%
Diseases of the Blood & Blood Forming Organs	280-289	17	0.7%	2	0.5%	0	0.0%
Mental Disorders	290-318	92	4.0%	15	3.6%	3	3.9%
Diseases of the Nervous System & Sense Organs	320-389	101	4.4%	13	3.2%	1	1.3%
Diseases of the Circulatory System	390-458	318	14.0%	59	14.3%	26	33.8%
Diseases of the Respiratory System	460-519	139	6.1%	19	4.6%	5	6.5%
Diseases of the Digestive System	520-577	310	13.6%	52	12.6%	4	5.2%
Diseases of the Genitourinary System	580-629	230	10.1%	51	12.4%	11	14.3%
Delivery & Complications of Pregnancy, Childbirth, & the Puerperium	631-678	290	12.7%	56	13.6%	13	16.9%
Diseases of the Skin & Subcutaneous Tissue	680-709	32	1.4%	4	1.0%	0	0.0%
Diseases of the Musculoskeletal System & Connective Tissue	710-739	94	4.1%	13	3.2%	2	2.6%
Congenital Anomalies	740-759	8	0.4%	3	0.7%	0	0.0%
Signs, Symptoms, & Ill-defined Conditions	770-796	152	6.7%	39	9.5%	2	2.6%
Injuries & Adverse Effects	800-999	170	7.5%	42	10.2%	3	3.9%
Supplementary Classifications	Y00-Y86	23	1.0%	12	2.9%	0	0.0%

Table 15. Comparisons of Medical Characteristics of
Questionnaire Respondents and Nonrespondents

		Males				Females			
		Respondents		Nonrespondents		Respondents		Nonrespondents	
Total number of cases		5052		257		7431		264	
Number of deaths (% of total)		232 (4.6%)		49 (19.1%)		112 (1.5%)		27 (10.2%)	
Median Age (years)		63		64		47		46.5	
Mean length of stay (days)		7.2		6.3		6.4		5.1	
Diagnostic Category	H-ICDA Codes	Cases	%	Cases	%	Cases	%	Cases	%
Infective & Parasitic Diseases	001-136	99	2.0%	3	1.2%	142	1.9%	4	1.5%
Neoplasms	140-239	484	9.6%	10	3.9%	569	7.7%	13	4.9%
Endocrine, Nutritional & Metabolic Diseases	240-279	87	1.7%	1	0.4%	142	1.9%	5	1.9%
Diseases of the Blood and Blood Forming Organs	280-289	24	0.5%	0	0.0%	46	0.6%	0	0.0%
Mental Disorders	290-318	263	5.2%	21	8.2%	354	4.8%	10	3.8%
Diseases of the Nervous System & Sense Organs	320-389	184	3.6%	2	0.8%	317	4.3%	11	4.2%
Diseases of the Circulatory System	390-458	852	16.9%	62	24.1%	711	9.6%	34	12.9%
Diseases of the Respiratory System	460-519	336	6.7%	15	5.8%	248	3.3%	6	2.3%
Diseases of the Digestive System	520-577	810	16.0%	23	8.9%	780	10.5%	16	6.1%
Diseases of the Genitourinary System	580-629	574	11.4%	19	7.4%	768	10.3%	29	11.0%
Delivery & Complications of Pregnancy, Childbirth & the Puerperium	631-678	---	---	---	---	1842	24.8%	68	25.8%
Diseases of the Skin & Subcutaneous Tissue	680-709	92	1.8%	1	0.4%	94	1.3%	0	0.0%
Diseases of the Musculoskeletal System & Connective Tissue	710-739	276	5.5%	16	6.2%	316	4.3%	14	5.3%

Table 15 (continued). Comparisons of Medical Characteristics
of Questionnaire Respondents and Nonrespondents

Diagnostic Category	H-ICDA Codes	Cases	%	Cases	%	Cases	%	Cases	%
Congenital Anomalies	740-759	31	0.6%	1	0.4%	16	0.2%	1	0.4%
Signs, Symptoms & Ill-Defined Condi- tions	770-796	316	6.3%	21	8.2%	401	5.4%	20	7.6%
Injuries & Ad- verse Effects	800-999	583	11.5%	59	23.0%	505	6.8%	24	9.1%
• Supplementary Classifications	Y00-Y86	41	0.8%	3	1.2%	180	2.4%	9	3.4%

stay. Telephone respondents were younger with shorter lengths of stay than original respondents but the percentage of patients living on farms was close to the same for both sets of respondents indicating that there was no bias as to place of residence in the nonrespondents.

From the case-control analysis, all delivery and complications of childbirth and the puerperium cases showed relative risks near one for females in the low exposure farming group. The high exposure group is composed of older women and is not necessarily a valid comparison.

Comparison of Results with Published Statistics

1. National Center for Health Statistics Reports. A National Center for Health Statistics publication presents health characteristics by geographic region and place of residence for 1969-70 [18]. The number of discharges per 1,000 persons per year is given for the North Central Region (12 states) by sex, tabulated by farm and nonfarm (outside of SMSA's) places of residence. Table 16 gives a comparison of these rates with the Douglas and Kandiyohi County rates. These county rates are acknowledgedly underestimated but they seem to underestimate the NCHS rates by similar proportions for farm and nonfarm breakdowns.

Another NCHS report [5] presents the relative frequency and severity of selected health conditions. Table 17 provides a comparison of 1974 NCHS statistics and all of the discharge data included in this study. The percentage distributions were fairly comparable between the Rural Health Study and the NCHS survey, indicating that the study area hospital experience is somewhat representative of national experience.

2. State-of-the-Art Report. A state-of-the-art report on occupational safety and health in agriculture done by the University of Iowa assessed the relative health of farmers [19]. The health of farmers was compared in a study in Iowa and nationally using National Center for Health Statistics reports. It was concluded that farmers are not as healthy as generally thought.

Data on injuries were somewhat equivocal. Nationally, farm residents had more days of bed disability for injuries than did nonfarm

Table 16.

Comparisons of Discharge Rates

Discharge per 1,000 persons per year

	<u>Males</u>		<u>Females</u>	
	<u>Nonfarm</u>	<u>Farm</u>	<u>Nonfarm</u>	<u>Farm</u>
NCHS North Central Region (1969-70)	122	88	179	121
Douglas County (1976-77)	102	83	157	95
Kandiyohi County (1976-77)	97	72	141	111
Counties Combined (1976-77)	99	77	148	103

Table 17.
Comparative Percentage Distributions for Selected Diagnoses

Diagnosis Category	H-ICDA Codes	Percent Distribution of Total Discharges	
		NCHS Survey	Rural Health Study
Diarrheal Disease	009	1.0	1.3
Malignant Neoplasms	140-209	4.7	5.4
Benign Neoplasms & Neo- plasms of Unspecified Nature	210-239	2.4	2.1
Diabetes Mellitus	250	1.5	1.2
Acute Myocardial Infarction	410	1.3	1.6
Other Ischemic Heart Disease	411-414	0.8	1.8
Cerebrovascular Diseases	430-438	1.9	2.0
Acute Respiratory Infections except Influenza	460-466	1.7	1.1
Pneumonia, All Forms	480-486	2.1	2.0
Hypertrophy of Tonsils and Adenoids	500	2.5	1.3
Ulcer of Stomach, Duodenum, Peptic Ulcer of Unspecified Site & Gastrojejunal Ulcer	531-534	1.3	1.3
Inguinal Hernia	550-552	1.6	2.1
Cholelithiasis, Cholecystitis, and Cholangitis	574-576	1.8	2.8
Disorders of Menstruation	626	1.7	1.3
Complications of Pregnancy, Childbirth, & the Puerperium	631-678	11.0	13.3
Fractures, All Sites	800-829	3.6	4.3
Lacerations & Open Wounds	870-897	1.0	0.9
Mean Length of Stay		7.8 days	6.6 days
Percent Males		40%	43%
Fatality Rate (per 100 discharges)		2.6	2.6

residents. Farm residents under 45 had fewer injuries than nonfarm residents but those farm residents over 45 had higher injury rates than their nonfarm counterparts.

Acute conditions with more days of bed disability for farm residents than for nonfarm residents were infective and parasitic diseases; respiratory conditions other than upper respiratory conditions and influenza; and digestive conditions. For chronic conditions, farmers were found to be more likely to have hernias of the abdominal cavity, gall bladder conditions, and ulcers of the stomach and duodenum. Other possible problem areas for farmers were suspected angina pectoris, hypertension, arthritis, psychological distress, and hearing problems.

3. Smoking and Health. A large number of health problems have been attributed to the smoking of cigarettes [20]. In the Rural Health Study, data on smoking habits were collected to be used as a covariate in the adjustment for the differential in smoking habits between farm and nonfarm workers and residents in the analysis of the diseases associated with smoking. By using the independent variable (farming exposure) as a covariate and by changing the covariate (smoking) to the independent variable, the relationship between smoking and various diseases (adjusted for farming exposure) can be investigated. Data from the Rural Health Study were used in this way as a means of validating known smoking relationships with the data collected by the procedures outlined in this report, so as to lend credence to the use of these procedures.

Appendix III presents age and farming adjusted relative risks for lung cancer, circulatory diseases, respiratory diseases, and ulcers for patients with low and high smoking histories. Those patients in the high smoking group smoked one pack or more per day for at least 10 years, or less than one pack per day for at least 20 years. Patients in the low smoking group consisted of all other patients with a cigarette smoking history. The control group was again injuries and adverse effects.

Table 18 summarizes the significant relationships between smoking and diagnostic categories. Mantel-Haenszel chi square statistics were used to test for dose-response relationships between amount of smoking and increased risk. Two-tailed tests of significance were used in this case in order to be comparable to other studies.

Increased relative risks were found for all of the diagnosis categories studied, with a number of those increased risks statistically significant. Circulatory problems related to smoking seemed to be more prevalent in the 25-64 year old age groups and respiratory problems were more often associated with smoking in the 65-and-older age groups.

The observations that many of the known relationships between smoking and disease were confirmed in this study using crude smoking categories seems to substantiate that data collection procedures, such as those used in the Rural Health Study, have some validity and utility in the assessment of health problems.

Table 18. Diagnoses Significantly Associated with a Cigarette Smoking History

Age and Sex Group	Diagnosis Category	H-ICDA Codes	Relative Risks (No. of Cases)	
			Low Smoking	High Smoking
Males 25-64	Malignant Neoplasm of Trachea, Bronchus, and Lung	162-163	-- (0)	∞ (10)**
	Diseases of the Circulatory System	390-458	0.9 (37)	1.6 (179)**
	Chronic Ischemic Heart Disease	412	0.4 (1)	2.0 (27)+
	Diseases of the Arteries, Arterioles, and Capillaries	440-448	5.3 (3)	8.5 (20)+
	Ulcer of Duodenum	532	2.7 (9)	5.7 (25)+
Males ≥ 65	Malignant Neoplasm of Trachea, Bronchus, and Lung	162-163	0.4 (1)	2.8 (19)+
	Angina Pectoris	413	6.3 (3)	12.1 (9)+
	Bronchitis, Emphysema, Asthma, and Related Conditions	489-496	1.8 (11)	2.8 (37)**
	Chronic Obstructive Lung Disease	496	2.7 (5)	3.9 (19)**
	Ulcer of Duodenum	532	1.8 (4)	2.9 (14)+
Females 25-64	Acute Myocardial Infarction	410	3.1 (2)	13.2 (14)***
	Cerebrovascular Disease	430-438	1.6 (1)	4.7 (7)**
	Ulcer of Duodenum	532	1.6 (2)	3.6 (7)+
Females ≥ 65	Malignant Neoplasm of Trachea, Bronchus, and Lung	162-163	14.7 (1)	11.4 (2)**
	Acute Upper Respiratory Infections	460-470	2.1 (1)	3.6 (1)+

*, **, *** Statistically significant relationship between risk and amount smoked, $p < .05$, $p < .01$, $p < .001$.

CONCLUSIONS AND RECOMMENDATIONS

Agricultural Health

The results of this study show that the health of farmers and the health of nonfarmers in a rural midwestern setting are not radically different when hospital records are the basis for comparison. Overall, patients with an agricultural background even seem to be slightly healthier than patients with no agricultural history. Nevertheless, over all the analyses, several diagnoses consistently showed increased risks for people with farm backgrounds. These include the following conditions for both males and females: diseases of the blood and blood forming organs; osteoarthritis and allied conditions; diseases of the gall bladder; hernia of the abdominal cavity; diseases of the veins, lymphatics, and other circulatory diseases; and diseases and conditions of the eye. In addition to these increased risks, farm males showed increased risks for benign prostatic hypertrophy, and farm females showed increased risks for uterovaginal prolapse, acute myocardial infarction, diseases of the skin and subcutaneous tissue, and neoplasms. This increased risk for neoplasms is somewhat surprising and is an area in which more research might be warranted. Females over 65 years of age with 20 years or more agricultural exposure exhibited the largest number of increased risks and is the only group of farm workers or housewives whose overall health was worse than the corresponding nonfarm group.

Data on smoking history collected by this study gave evidence of relationships of cigarette smoking to lung cancer, ulcers, and several circulatory and respiratory problems. This may be taken as support for the data collection procedures used in this study since these findings corroborate national findings on smoking and disease.

Methodology

The method of administering occupational questionnaires to hospitalized patients and then using such data in conjunction with abstracted hospital data available from abstracting services such as CPHA,

can work efficiently. In this study, hospitalizations to both farm residents and past and present farm workers were evaluated, since it is hard to separate those "working" and "living" on a farm. In choosing agriculture as a target occupational group, a large area (including many small hospitals) must be investigated. This can pose problems such as obtaining cooperation from a large number of hospitals; obtaining consistent questionnaire administration, record abstracting, and data coding; and being able to define the hospital's service area including making accurate population estimates.

To use the methodology in studying other occupational groups, the following recommendations are made: The study should be limited to specific age and sex groups in areas with sufficient estimable numbers of workers at risk. All hospitals in the area of interest should be included; contacts with hospital associations and local medical societies would be of assistance in obtaining cooperation. Sufficient monetary compensation should be awarded and, if feasible, additional persons should be employed to assist with the study so as to minimize hospital staff burden. The amount of monetary compensation could also effect changes in hospital procedures rather than limit the investigator to existing nonresearch-oriented procedures. Hospital selection is important due to the amount and quality of cooperation that must be received.

It is important, but not necessary, that all hospitals subscribe to an abstracting service or have an equally effective inhospital data handling system. To help in identifying areas where there is full or almost full coverage by PAS, CPHA publishes a list of such areas in the U. S. [21]. If only a few of the hospitals do not belong to any abstracting service, it might be possible for the investigator to pay the fee for enrolling in such a program for several years or, if absolutely necessary, the records could be abstracted independently in order to complete full coverage in an area. Patient origin studies done by the hospitals or hospital associations are of great assistance in determining hospital service areas.

Questionnaire design should incorporate the features of being short and relevant but should try to obtain the required occupational information in several ways so that confidence in the responses can be maximized. Available population estimates of the workers at risk should be examined so that questions can be structured to give answers based on the same definitions as those used in the population estimates. The selective collection of data on other variables of interest, such as smoking, is recommended. These questions should be structured to be comparable to similar questions in related studies. Valuable information about biases in hospital utilization among different groups of workers could be obtained by collecting data on insurance coverage, since the presence of insurance coverage may determine whether a person would go to the hospital and which hospital he might choose. These data are routinely available in many hospital data sets.

Administration of the questionnaire should be as soon as the patient can provide reliable answers. All attempts should be made to retrieve missing data such as the use of telephone follow-up or by contacting relatives. In this current study, there were only a few patients who refused to participate; obtaining cooperation is a function of how and when the questions are asked. A re-administration of the questionnaire to a random sample of patients, utilizing telephone follow-up, might prove productive in assessing the reliability of questionnaire responses. A paid interviewer or at least the use of a small number of well-trained hospital personnel would also benefit data quality.

Precoded questionnaire forms help minimize transcription errors. Questionnaire data do not actually have to be added to the abstracting forms. The completed questionnaires could be sent to the investigator for coding and data handling and then paired with the data files supplied by the abstracting service, using the patient number and date of discharge.

Prior to entering into another study, it would be advantageous to try to validate the use of these procedures as a screening technique. This would involve the evaluation of hospital records in an area where health problems have already been discovered by a more thorough study.

If these procedures can also detect the same health problems, as well as fail to detect health problems which were also not evident in the more thorough study, then the procedures would seem to have utility as a relatively low-cost screening technique.

The recommended method of study is the population-based study. The case-control approach can be used when it is necessary to cover a wide area to obtain enough worker cases. It might also be possible to convince CPHA or other abstracting services to include occupation as part of the required abstract information; however, occupation usually cannot be described by a single question. The problem would be formidable to construct a single, relevant, occupational classification system.

The use of a small population-based study as a means of selecting control groups and verifying results of a much larger case-control study is a valuable tool when large scale population-based studies are not feasible.

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APPENDIX I

RELATIVE RISKS FOR POPULATION-BASED HOSPITALS

A. FARM/NONFARM RELATIVE RISKS FOR POPULATION BASED HOSPITALS - MALES

Diagnostic Category	HICDA Codes	Age <25 No. of Cases			Age 25-64 No. of Cases			Age ≥ 65 No. of Cases		
		Farm	Non Farm	Relative Risk	Farm	Non Farm	Relative Risk	Farm	Non Farm	Relative Risk
Infective & Parasitic Diseases	001-136	6	26	0.6	3	20	0.4	5	9	2.0
Neoplasms	140-239	1	5	0.5	6	35	0.3	14	77	0.8
A. Malignant Neoplasms	140-209	0	1	0.0	4	23	0.3	14	72	0.9
Endocrine, Nutritional, & Metabolic Diseases	240-279	2	6	0.9	4	15	0.6	7	17	2.3
Diseases of the Blood & Blood Forming Organs	280-289	1	2	1.5	2	1	4.4	4	6	3.5
Mental Disorders	290-318	3	11	0.7	5	37	0.2	1	22	0.2
Diseases of the Nervous System & Sense Organs	320-389	2	30	0.2	6	23	0.7	11	28	1.9
A. Diseases of the Eye	370-378	1	11	0.2	5	10	1.3	7	20	1.9
Diseases of the Circulatory System	390-458	1	7	0.3	36	103	0.8	39	167	1.0
A. Ischemic Heart Disease	410-414	0	0	--	15	50	0.7	16	59	1.1
1. Acute Myocardial Infarction	410	0	0	--	10	30	0.8	6	26	0.8
2. Chronic Ischemic Heart Disease	412	0	0	--	7	18	0.8	8	35	1.0
B. Cerebrovascular Disease	430-438	0	0	--	4	14	0.7	12	39	1.2
C. Diseases of Arteries, Arterioles, & Capillaries	440-448	0	1	0.0	2	8	0.5	3	26	0.6
D. Diseases of Veins, Lymphatics, & other Circulatory Diseases	450-458	1	5	0.5	13	21	1.4	2	10	0.9

A. FARM/NONFARM RELATIVE RISKS FOR POPULATION BASED HOSPITALS - MALES

Diagnostic Category	IHCDA Codes	Age <25			Age 25-64			Age ≥ 65		
		No. of Cases	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk
		Farm	Non Farm		Farm	Non Farm		Farm	Non Farm	
Diseases of the Respiratory System	460-519	19	100	0.5	9	25	0.8	26	66	1.8*
A. Acute Upper Respiratory Infections	460-470	6	30	0.5	2	3	1.2	2	3	4.3
B. Pneumonia	480-486	5	28	0.4	3	6	0.9	17	35	2.3*
C. Bronchitis, Emphysema, Asthma & Related Conditions	489-496	6	18	0.8	2	6	0.8	6	27	0.9
Diseases of the Digestive System	520-577	26	58	1.1	50	128	0.9	33	105	1.3
A. Diseases of the Esophagus, Stomach & Duodenum	530-537	1	4	0.6	10	23	0.9	2	25	0.3
B. Appendicitis	540-543	13	17	1.9	2	11	0.4	0	1	0.0
C. Hernia of Abdominal Cavity	550-553	10	27	0.9	21	51	1.0	17	24	2.7*
D. Other Diseases of Intestine & Peritoneum	560-569	1	3	0.8	1	19	0.1	4	22	0.7
E. Diseases of the Liver, Gall Bladder, & Pancreas	570-577	0	2	0.0	16	19	2.0*	9	35	1.2
1. Diseases of the Gall Bladder	575	0	1	0.0	9	13	1.6	5	22	0.9
Diseases of the Genitourinary System	580-629	5	28	0.4	22	61	0.8	40	99	1.8**
A. Diseases of the Urinary System	580-599	2	16	0.3	12	37	0.8	18	46	1.6
B. Disease of the Male Genital Organs	600-607	3	12	0.6	11	25	1.0	23	56	1.9*
1. Benign Prostatic Hypertrophy	600	0	0	--	7	11	1.3	19	49	1.8*

A. FARM/NONFARM RELATIVE RISKS FOR POPULATION BASED HOSPITALS - MALES

Diagnostic Category	HICDA Codes	Age <25 No. of Cases			Age 25-64 No. of Cases			Age ≥ 65 No. of Cases		
		Farm	Non Farm	Relative Risk	Farm	Non Farm	Relative Risk	Farm	Non Farm	Relative Risk
Diseases of the Skin & Subcutaneous Tissue	680-709	6	12	1.3	2	19	0.2	1	6	1.1
Diseases of the Musculo-skeletal System & Connective Tissue	710-739	8	15	1.4	14	43	0.7	10	24	1.6
A. Arthritis & Rheumatism	710-718	1	1	2.4	2	10	0.4	5	15	1.4
B. Osteomyelitis & other Diseases of Bone & Joint	720-729	5	13	1.0	11	20	1.3	6	7	3.0
Signs, Symptoms, Ill Defined Conditions	770-796	5	30	0.4	19	59	0.7	10	33	1.3
Injuries & Adverse Effects	800-999	44	98	1.2	33	85	0.9	14	57	1.1
A. Musculoskeletal Injuries	800-849	21	49	1.2	23	49	1.1	7	31	1.1
B. Lacerations & Open Wounds	870-897	9	9	2.6*	2	12	0.4	0	3	0.0
All diagnoses	001-999	126	414	0.8	207	619	0.8	184	608	1.3

*, ** Rate for farm residents is statistically significantly greater than rate for non-farm residents $p < .05$, $p < .01$

B. FARM/NONFARM RELATIVE RISKS FOR POPULATION BASED HOSPITALS - FEMALES

Diagnostic Category	HICDA Codes	Age <25			Age 25-64			Age ≥ 65		
		No. of Cases	Non Farm	Relative Risk	No. of Cases	Non Farm	Relative Risk	No. of Cases	Non Farm	Relative Risk
Infective & Parasitic Diseases	001-136	9	29	1.0	6	22	0.8	1	22	0.5
Neoplasms	140-239	4	18	0.9	28	101	0.8	12	78	1.2
A. Malignant Neoplasms	140-209	2	4	1.3	15	36	1.1	8	65	1.0
Endocrine, Nutritional, & Metabolic Diseases	240-279	1	7	0.5	3	13	0.6	1	24	0.2
Diseases of the Blood & Blood Forming Organs	280-289	0	0	--	3	6	1.2	1	6	0.8
Mental Disorders	290-318	2	19	0.5	11	65	0.5	4	39	0.9
Diseases of the Nervous System & Sense Organs	320-359	7	20	1.0	15	27	1.8	9	82	0.9
A. Diseases of the Eye	370-378	3	5	1.4	5	5	3.5	8	65	1.1
Diseases of the Circulatory System	390-458	2	9	1.0	22	70	1.0	31	192	1.4
A. Ischemic Heart Disease	410-414	0	0	--	5	18	0.9	10	69	1.2
1. Acute Myocardial Infarction	410	0	0	--	3	10	0.9	4	33	0.9
2. Chronic Ischemic Heart Disease	412	0	0	--	2	8	0.8	5	34	1.4
B. Cerebrovascular Disease	430-438	0	0	--	2	5	0.9	8	40	1.9
C. Diseases of Arteries, Arterioles, & Capillaries	440-448	0	1	0.0	2	3	2.6	4	27	1.4
D. Diseases of Veins, Lymphatics, & other Circulatory Diseases	450-458	2	8	1.1	7	30	0.7	5	26	1.7

B. FARM/NONFARM RELATIVE RISKS FOR POPULATION BASED HOSPITALS - FEMALES

Diagnostic Category	HICDA Codes	Age <25 No. of Cases			Age 25-64 No. of Cases			Age ≥ 65 No. of Cases		
		Farm	Non Farm	Relative Risk	Farm	Non Farm	Relative Risk	Farm	Non Farm	Relative Risk
Diseases of the Respiratory System	460-519	20	73	0.7	12	32	1.1	8	56	1.1
A. Acute Upper Respiratory Infections	460-470	3	26	0.3	2	8	0.7	1	9	1.2
B. Pneumonia	480-486	7	17	1.1	3	11	0.8	3	24	0.9
C. Bronchitis, Emphysema, Asthma & Related Conditions	489-496	4	13	0.8	3	9	0.9	3	15	1.6
Diseases of the Digestive System	520-577	15	54	0.9	31	138	0.7	21	94	1.7*
A. Diseases of the Esophagus, Stomach & Duodenum	530-537	2	8	0.6	2	26	0.3	6	30	1.4
B. Appendicitis	540-543	6	28	0.7	4	8	1.8	1	0	--
C. Hernia of Abdominal Cavity	550-553	2	3	1.5	2	17	0.4	0	8	0.0
D. Other Diseases of Intestine & Peritoneum	560-569	1	5	0.9	6	25	0.7	3	32	0.6
E. Diseases of the Liver, Gall Bladder & Pancreas	570-577	3	9	1.5	17	61	0.9	11	25	3.6**
I. Diseases of the Gall Bladder	575	3	6	2.2	9	28	1.0	11	17	5.1**
Diseases of the Genitourinary System	580-629	8	66	0.4	51	190	0.7	8	56	1.0
A. Diseases of the Urinary System	580-599	4	29	0.4	8	27	0.8	3	30	0.8
B. Diseases of the Ovary, Fallopian Tube, Parametrium	612-617	1	20	0.2	3	10	0.8	0	0	--

B. FARM/NONFARM RELATIVE RISKS FOR POPULATION BASED HOSPITALS - FEMALES

Diagnostic Category	HICDA Codes	Age <25			Age 25-64			Age ≥ 65		
		No. of Cases	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk
		Farm	Non Farm		Farm	Non Farm		Farm	Non Farm	
C. Diseases of Uterus & Female Genital Organs	619-629	3	16	0.7	37	126	0.8	3	19	1.3
1. Uterovaginal Prolapse	623	0	0	--	8	13	1.7	3	14	1.7
2. Disorders of Menstrual Cycle	626	2	7	1.1	16	71	0.6	0	1	0.0
Diseases of the Skin & Subcutaneous Tissue	680-709	1	5	0.9	7	10	2.1	3	15	1.4
Diseases of the Musculoskeletal System & Connective Tissue	710-739	2	10	0.8	7	48	0.4	6	50	1.1
A. Arthritis & Rheumatism	710-718	0	0	--	3	13	0.6	4	29	1.1
B. Osteomyelitis & other Diseases of Bone & Joint	720-729	1	7	0.5	3	25	0.4	2	14	1.5
Signs, Symptoms, Ill Defined Conditions	770-796	6	38	0.4	21	60	0.9	10	63	1.1
Injuries & Adverse Effects	800-999	18	56	1.0	27	70	1.1	13	119	1.0
A. Musculoskeletal Injuries	800-849	7	26	0.9	16	39	1.2	6	93	0.6
B. Lacerations & Open Wounds	870-897	3	6	1.2	1	3	0.9	0	3	0.0
All Diagnoses	001-999	92	370	0.8	232	828	0.8	117	752	1.3
(Not including Conditions of Pregnancy and Delivery)										

*,** Rate for farm residents is statistically significantly greater than rate for non-farm residents $p < .05$, $p < .01$

APPENDIX II

CASE-CONTROL RELATIVE RISKS

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	H-ICDA Code	Age 25-64					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	142	60	---	73	---	35	104	---
Infective & Parasitic Diseases	001-136	27	7	0.6	13	0.7	10	22	0.6
A. Intestinal Infectious Diseases	001-006	12	3	0.5	12	1.3	7	16	0.7
1. Diarrheal Disease	009	9	2	0.4	10	1.4	4	13	0.8
Neoplasms	140-239	51	14	0.7	37	0.8	67	166	0.8
A. Primary Malignant Neoplasms	140-195	29	7	0.6	26	1.1	58	135	0.8
1. Primary Malignant Neoplasms of Digestive Organs and Peritoneum	150-159	8	2	0.8	12	1.6	16	32	0.7
a. Malignant Neoplasm of large intestine, except rectum	153	4	0	0	7	1.8	9	13	0.5
2. Primary Malignant Neoplasm of Respiratory System	160-163	5	3	1.7	2	0.6	10	13	0.5
a. Malignant Neoplasm of Trachea, Bronchus & Lung	162-163	5	3	1.7	2	0.6	10	13	0.5
3. Primary Malignant Neoplasm of Genitourinary Organs	180-189	9	1	0.3	7	0.9	28	83	1.0
a. Malignant Neoplasm of prostate	185	4	0	0	5	1.3	20	57	1.0
b. Malignant Neoplasm of bladder	188	2	1	1.2	2	1.1	6	22	1.2

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	H-ICDA Code	Age 25-64					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-909	142	60	---	73	---	35	104	---
B. Secondary Malignant Neoplasms	196-199	7	0	0.0	5	0.7	7	12	0.6
C. Benign Neoplasms	210-228	11	4	0.9	4	0.3	4	6	0.5
Endocrine, Nutritional, & Metabolic Diseases	240-279	15	9	1.8	10	1.0	12	24	0.7
A. Diseases of Other Endocrine Glands	250-258	11	8	2.0	9	1.1	10	18	0.6
1. Diabetes mellitus	250	11	7	1.8	8	1.0	9	18	0.6
Diseases of the Blood & Blood-Forming Organs	280-289	2	0	0.0	4	3.5	3	12	1.2
Mental Disorders	290-318	56	24	0.9	28	0.9	13	30	1.0
A. Organic Brain Syndromes	296-305	10	4	1.0	6	1.1	3	11	1.5
B. Psychoses Not Attributed to Physical Conditions	306-309	7	6	1.7	6	3.1	1	5	2.0
C. Neuroses	310	12	3	0.6	6	0.8	5	9	0.8
D. Personality Disorders & Certain Other Non- psychotic Mental Disorders	311-314	8	13	1.1	9	0.6	5	5	0.3
1. Alcoholism	313	21	12	1.2	9	0.6	4	4	0.4
Diseases of the Nervous System & Sense Organs	320-289	26	13	1.2	23	1.2	20	68	1.2

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	II-ICDA Code	Age 25-64					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-909	142	60	---	73	---	35	104	---
A. Disease of Nerves & Peripheral Ganglia	350-358	6	2	0.8	5	1.7	5	8	0.8
B. Disease and Conditions of the Eye	360-379	10	7	1.8	11	1.2	14	53	1.3
1. Cataract	374	6	3	0.9	5	1.1	14	50	1.2
Diseases of the Circulatory System	390-458	139	44	0.7	99	0.9	129	250	0.6
A. Hypertensive Disease	400-405	12	2	0.3	6	0.8	3	10	1.3
1. Essential Benign Hypertension	401	12	2	0.3	6	0.8	0	10	---
B. Ischemic Heart Disease	410-414	55	18	0.8	42	0.9	53	84	0.5
1. Acute Myocardial Infarction	410	34	9	0.7	25	0.8	28	39	0.4
2. Chronic Ischemic Heart Disease	412	13	8	1.6	14	1.3	22	41	0.6
3. Angina pectoris	413	9	2	0.5	5	0.8	3	8	1.1
C. Disorders of Heart Rhythm	415-416	6	2	0.7	7	1.6	13	19	0.4
D. Other Forms of Heart Disease	420-429	10	2	0.3	6	0.8	18	48	0.8
1. Heart Failure	427	1	1	2.9	5	5.1	16	46	0.8
E. Cerebrovascular Disease	430-438	17	7	1.0	13	0.9	29	60	0.5
1. Transient Ischemic Attack	435	4	2	1.6	5	1.6	8	14	0.4

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	H-ICDA Code	Age 25-64					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-899	142	60	---	73	---	35	104	---
2. Acute, but ill- defined, Cerebro- vascular Disease	436	7	3	1.1	5	0.7	14	28	0.6
F. Disease of Arteries, Arterioles, & Capillaries	440-445	16	2	0.5	6	0.5	17	29	0.5
1. Arteriosclerosis	440	10	2	0.7	3	0.4	10	14	0.3
G. Diseases of Veins and Lymphatics, and Other Diseases of Cir- culatory System	450-458	28	11	0.9	23	1.3	4	24	2.3
1. Phlebitis and Thrombophlebitis	451	4	3	1.8	6	2.1	3	8	1.2
2. Hemorrhoids	455	9	5	1.3	11	2.1	0	6	---
Diseases of the Respira- tory System	460-519	48	15	0.8	34	0.9	51	104	0.6
A. Acute Upper Respiratory Infections	460-470	3	2	0.6	4	0.8	4	9	0.2
B. Pneumonia	480-486	14	3	0.5	14	1.2	24	48	0.6
1. Pneumonia, Organism & Type Not Specified	486	11	1	0.2	10	1.0	17	37	0.6
C. Bronchitis, Emphysema, Asthma, & Related Conditions	489-496	8	3	0.9	14	2.2	21	35	0.6
1. Asthma	493	3	0	0.0	5	1.7	4	4	0.3

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	ICD-9 Code	Age 25-64				Age ≥ 65			
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-900	142	60	---	73	---	35	104	---
2. Chronic Obstructive Lung Disease, Not 1.18 where Classified	496	5	1	0.5	1	0.5	10	14	0.6
D. Other Diseases of the Respiratory System	500-519	18	7	1.0	3	0.3	3	12	1.2
Diseases of the Digestive System	520-577	177	90	1.1	129	1.1	82	170	0.7
A. Diseases of Esophagus, Stomach, and Duo- denum	530-537	47	30	1.6	24	0.7	16	30	0.6
1. Ulcer	531-534	30	11	1.0	14	0.7	9	20	0.8
a. Ulcer of Duo- denum	532	20	6	0.8	11	0.8	7	10	0.6
2. Gastritis and Duodenitis	535	15	10	1.5	5	0.5	5	5	0.3
B. Appendicitis	540-543	16	9	1.3	10	1.4	2	2	0.3
C. Hernia of Abdominal Cavity	550-553	53	31	1.3	57	1.6	25	53	0.8
1. Inguinal Hernia Without Mention of Obstruction	550	42	30	1.5	43	1.6	18	38	0.8
D. Other Diseases of Intestine and Peritoneum	560-569	32	8	0.6	10	0.6	13	34	0.8
1. Intestine Obstruc- tion	560	3	0	0.0	1	0.5	4	18	1.5

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	II-ICDA Code	Age 25-64					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	142	60	---	73	- -	35	104	---
2. Functional Dis- order of Intestine	564	8	1	0.2	2	0.5	2	9	1.2
L. Diseases of the Liver, Gallbladder and Pancreas	570-577	28	14	1.2	29	1.5	24	54	0.9
1. Biliary Calculus	574	3	3	2.4	4	1.7	11	15	0.6
2. Other Diseases of Gallbladder	575	15	9	1.3	14	1.2	6	31	1.6
Diseases of the Genito- urinary System	580-629	89	34	0.9	72	1.1	75	210	1.0
A. Other Diseases of Urinary System	590-599	53	19	0.8	30	0.9	32	64	0.7
1. Calculus of Kidney and Ureter	592	30	8	0.6	17	0.8	6	6	0.4
2. Other Diseases of Bladder	596	1	1	1.9	5	4.9	12	22	0.6
3. Stricture of Urethra (meatus)	598	7	2	0.8	3	0.7	2	6	0.9
4. Other Diseases of Urinary Tract	599	1	2	2.2	1	2.4	3	16	1.6
B. Diseases of the Male Genital Organs	600-607	34	15	1.1	44	1.6	42	149	1.3
1. Benign Prostatic Hypertrophy	600	14	6	1.0*	29	2.2**	40	128	1.2
Diseases of the Skin and Subcutaneous Tissue	680-709	21	10	1.0	11	1.1	7	18	0.9

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	II-ICDA Code	Age 25-64					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	142	60	---	73	---	35	104	---
A. Infections of Skin and Subcutaneous Tissue	680-686	15	8	1.3	8	1.3	2	8	1.5
1. Other Cellulitis and Abscess	682	9	4	1.0	7	1.6	2	7	1.3
Diseases of the Musculo-skeletal System & Connective Tissue	710-739	63	23	0.9	36	0.8	30	66	0.8
A. Arthritis & Rheumatism Except Rheumatic Fever	710-718	12	6	0.9	18	1.9	21	50	0.8
1. Osteoarthritis & Allied Conditions	713	2	4	5.2*	11	5.9**	17	39	0.9
B. Osteomyelitis and Other Diseases of Bone and Joint	720-729	44	17	1.0	15	0.5	9	17	0.8
1. Internal Derangement of Joint	724	13	7	1.4	3	0.4	1	3	1.0
2. Disorders of Inter-vertebral Disc	725	21	6	0.8	4	0.3	5	7	0.7
Congenital Anomalies	740-759	8	5	1.4	6	1.0	2	3	0.4
Signs, Symptoms & Ill-defined Conditions	770-796	88	30	0.8	50	0.9	36	55	0.5
A. Symptoms Referable to Heart & Vessels	774	6	2	1.0	7	1.3	5	3	0.3

A. Case-Control Relative Risks for Farming Exposure - Males

Diagnostic Category	H-ICDA Code	Age 25-64					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	142	60	---	73	---	35	174	---
B. Other Symptoms Referable to Cardiovascular & Lymphatic System	775	7	2	0.7	1	0.4	1	7	2.0
C. Symptoms Referable to Abdomen & Peritoneum	780	18	8	1.1	11	0.9	3	6	0.6
D. Other Symptoms Referable to Musculoskeletal System	789	20	5	0.6	8	0.7	2	3	0.8
All Diagnoses (Except Control)	001-799	755	295	0.9	509	0.9	467	1,019	0.7

- Relative risk statistically significantly greater than one $p < .05$
- Statistically significant exposure-risk relationship over the two risk categories $p < .05$.

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-900	101	37	---	41	---	116	117	---
Infective & Parasitic Diseases	001-136	43	12	0.6	13	0.7	17	23	1.3
A. Intestinal Infec- tious Diseases	001-009	30	6	0.5	9	0.7	13	18	1.3
1. Diarrheal Diseases	001	23	3	0.3	5	0.7	12	10	0.8
Neoplasms	140-239	165	37	0.5	76	1.1	64	94	1.7*
A. Primary Malignant Neoplasms	140-195	56	10	0.5	31	1.2	43	60	1.6*
1. Primary Malignant Neoplasms of Digestive Organs & Peritoneum	150-159	5	0	0.0	5	2.2	17	26	1.9
a. Malignant Neoplasm of Large Intes- tine, except Rectum	153	3	0	0.0	4	2.5	8	13	2.1
2. Primary Malignant Neoplasm of Skin & Breast	170-174	24	3	0.4	14	1.0	14	19	1.4
a. Malignant Neo, lusa of Breast	174	20	2	0.3	14	1.3	12	16	1.4

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	II-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases Relative Risk		Farmed ≥ 20 Years No. of Cases Relative Risk		Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases Relative Risk	
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
3. Primary Malignant Neoplasm of Genitourinary Organs	180-189	23	6	0.8	10	1.4	10	9	1.2
a. Malignant Neoplasm of Cervix Uteri	180	15	2	0.4	3	1.1	0	1	--
B. Secondary Malignant Neoplasms	196-199	10	2	0.6	5	1.2	11	14	2.0
C. Benign Neoplasms	210-228	101	23	0.6	37	0.9	13	14	1.2
1. Uterine Fibroma	218	37	6	0.4	15	0.9	1	0	0.0
2. Other Benign Neoplasm of Uterus	219	23	14	1.3	10	1.0	4	2	0.5
3. Benign Neoplasm of Ovary	220	16	0	0.0	4	1.5	0	1	--
Endocrine, Nutritional, & Metabolic Diseases	240-279	25	10	0.9	14	1.7	24	33	1.4
A. Diseases of Other Endocrine Glands	250-258	16	5	0.7	12	2.1	18	24	1.3
1. Diabetes Mellitus	250	14	3	0.6	12	2.2	18	23	1.3
Diseases of the Blood & Blood-Forming Organs	280-289	11	1	0.2	6	1.1	5	9	2.1
Mental Disorders	290-318	99	26	0.7	26	0.8	37	25	0.8
A. Organic Brain Syndromes	296-305	4	0	0.0	1	0.7	11	5	0.5

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	H-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
B. Psychoses Not Attributed to Physical Conditions	306-309	30	7	0.7	7	0.8	6	3	0.9
1. Schizophrenia	306	19	3	0.5	5	1.0	3	1	0.7
C. Neuroses	310	37	12	1.0	15	1.3	15	14	1.1
D. Personality Disorders & Certain Other Non- psychotic Mental Disorders	311-314	14	5	1.3	3	1.0	1	0	0.0
1. Personality Disorders	311	9	4	1.4	2	1.8	1	0	0.0
Diseases of the Nervous System & Sense Organs	320-339	49	23	1.1	18	0.7	72	82	1.2
A. Diseases of Nerves & Peripheral Ganglia	350-358	15	5	0.9	8	1.0	4	2	0.7
B. Diseases and Conditions of the Eye	360-379	13	10	2.0*	4	0.6	61	71	1.2
1. Cataract	374	9	7	2.4	4	0.9	57	59	1.1
C. Disease of the Ear & Mastoid Process	380-389	13	4	0.6	3	0.4	4	3	0.9
Diseases of the Circulatory System	390-458	98	31	0.9	55	1.3	177	218	1.3
A. Hypertensive Disease	400-405	12	3	0.7	7	1.0	15	18	1.5
1. Essential Benign Hypertension	401	9	3	1.0	6	1.0	12	14	1.5
B. Ischemic Heart Disease	410-414	17	5	1.0	11	1.3	51	53	1.1

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	H-ICDA Code	Age 25-55					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
1. Acute Myocardial Infarction	410	8	3	1.3*	9	8.0***	22	18	0.9
2. Chronic Ischemic Heart Disease	412	7	1	0.5	1	0.2	23	33	1.5
C. Disorders of Heart Rhythm	415-416	12	2	0.7	4	0.6	14	17	1.7
1. Other Disorders of the Heart Rhythm	416	10	2	0.8	3	0.5	12	9	1.0
D. Other Forms of Heart Disease	420-429	3	2	1.3	1	0.8	23	21	0.9
1. Heart Failure	427	2	1	1.9	1	0.9	22	20	0.9
E. Cerebrovascular Disease	430-438	5	4	3.0	3	2.3	39	55	1.3
1. Transient Ischemic Attack	435	1	0	0.0	2	15.9	8	11	1.6
2. Acute, but Ill-Defined, Cerebrovascular Disease	436	2	2	4.4	0	0.0	14	24	1.5
F. Diseases of Arteries, Arterioles, & Capillaries	440-448	5	1	0.5	5	2.0	22	30	1.3
1. Arteriosclerosis	440	3	0	0.0	2	5.4	12	18	1.5
G. Diseases of Veins and Lymphatics, and Other Diseases of Circulatory System	450-458	47	16	0.8	25	1.4	23	39	1.9*

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	H-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
1. Phlebitis and Thrombophlebitis	451	12	5	1.0	9	1.6	8	8	1.2
2. Varicose Veins of Lower Extremities	454	14	8	1.3	6	0.8	7	11	1.8
3. Hemorrhoids	455	14	2	0.3	4	0.9	0	4	--
Diseases of the Respiratory System	460-519	62	10	0.5	15	0.6	43	69	1.7*
A. Acute Upper Respiratory Infections	460-470	18	1	0.2	4	0.5	10	13	1.5
B. Pneumonia	480-486	19	4	0.5	3	0.6	16	28	1.8
1. Pneumonia, Organism & Type Not Specified	486	14	3	0.5	3	0.8	12	17	1.4
C. Bronchitis, Emphysema, Asthma, & Related Conditions	489-496	13	4	1.1	2	0.3	15	18	1.3
D. Other Diseases of the Respiratory System	500-519	14	1	0.1	6	1.2	4	11	2.5
Diseases of the Digestive System	520-577	220	72	0.9	75	0.8	92	140	1.6**
A. Diseases of Esophagus, Stomach and Duodenum	530-537	48	17	1.3	10	0.4	23	38	1.8*
1. Ulcer	531-534	10	10	2.2	9	1.0	18	24	1.5
a. Ulcer of Stomach	531	10	3	1.3	5	1.0	9	12	1.7

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	H-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
1. Ulcer of Duodenum	532	5	6	4.8*	3	1.4	7	6	0.8
2. Gastritis and Duodenitis	535	20	7	1.2	1	0.1	2	8	3.6
B. Appendicitis	540-543	13	5	0.7	6	1.4	1	1	--
C. Hernia of Abdominal Cavity	550-553	26	6	0.5	8	0.8	8	14	2.0
1. Other Hernia of Abdominal Cavity Without Mention of Obstruction	551	15	2	0.3	4	0.8	3	7	3.2
D. Other Diseases of Intestine and Peritoneum	560-569	46	12	0.7	17	1.2	33	35	1.1
1. Intestine Obstruction	560	5	1	0.3	3	2.1	7	12	1.6
2. Diverticular Disease of Intestine	562	7	2	0.8	5	2.1	7	9	1.1
3. Functional Disorder of Intestine	564	20	3	0.3	6	1.0	10	7	0.9
E. Diseases of the Liver, Gallbladder, and Pancreas	570-577	85	29	0.9	34	0.8	30	53	2.0**
1. Biliary Calculus	574	40	15	0.9	15	0.8	9	14	1.9
2. Other Diseases of Gallbladder	575	42	14	0.8	18	0.9	21	36	1.9*

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	II-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
Diseases of the Genito-urinary System	580-629	296	79	0.7	125	1.0	50	73	1.6**
A. Other Diseases of Urinary System	590-599	45	12	0.7	24	1.1	28	30	1.2
1. Infection of Kidney	590	9	1	0.3	1	0.3	4	3	0.9
2. Calculus of Kidney and Ureter	592	18	3	0.4	8	0.8	5	4	0.9
3. Cystitis	595	5	0	0.0	4	1.4	5	5	1.3
4. Other Diseases of Urinary Tract	599	4	7	5.9**	4	3.2	7	11	1.9
B. Diseases of the Breast	610-611	48	5	0.3	10	0.5	5	9	2.7
1. Fibrocystic Disease of Breast	610	45	5	0.3	10	0.5	5	5	1.5
C. Diseases of Ovary, Fallopian Tube, Parametrium	612-617	20	6	0.9	3	0.5	--	--	--
1. Other Diseases of Ovary and Fallopian Tube	615	9	6	1.9	3	1.1	--	--	--
D. Diseases of the Uterus & Other Female Genital Organs	619-629	184	56	0.7	88	1.1	16	29	2.4*

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	H-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
1. Endometriosis	619	9	10	2.2	5	1.1	--	--	--
2. Uterovaginal Prolapse	623	17	4	0.5*	27	3.2**,*	10	25	3.1**
3. Other Diseases of Uterus	625	26	8	0.8	13	0.8	1	1	2.1
4. Disorders of Menstrual Cycle	626	107	25	0.5	27	0.7	1	0	0.0
5. Menopausal Postmenopausal Symptoms	627	14	0	0.0	12	0.9	2	0	0.0
Delivery and Complications of Pregnancy, Child-birth & the Puerperium	631-678	599	263	0.8	52	0.5	--	--	--
A. Complications of Pregnancy	631-639	51	23	0.8	4	0.3	--	--	--
1. Hemorrhage of Pregnancy	632	10	5	0.9	1	0.5	--	--	--
2. Other Complications Mainly Related to Pregnancy	634	25	14	1.0	2	0.4	--	--	--
B. Abortion	640-646	33	10	1.3	10	1.4	--	--	--
1. Spontaneous Abortion	643	32	20	1.3	9	1.3	--	--	--
C. Delivery	650-664	546	233	0.8	42	0.5	--	--	--

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	II-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years		Farmed ≥ 20 Years		Never Farmed No. of Cases	Farmed ≥ 20 Years	
			No. of Cases	Relative Risk	No. of Cases	Relative Risk		No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
1. Delivery Without Mention of Complication	650	362	154	0.7	26	0.4	--	--	--
2. Delivery Complicated by Dystocic Position of Fetus	656	25	10	0.7	0	0.0	--	--	--
3. Delivery Complicated by Prolonged Labor of Other Origin	657	10	5	0.6	2	1.1	--	--	--
4. Delivery with Laceration of Perineum Without Mention of Other Laceration	658	64	35	1.1	8	0.5	--	--	--
5. Delivery with Other Complications	664	38	17	0.9	4	0.6	--	--	--
Diseases of the Skin and Subcutaneous Tissue	680-709	17	6	0.9	12	3.3	14	26	1.8
A. Infections of Skin and Subcutaneous Tissue	680-686	7	5	1.5	4	2.2	3	9	2.7
B. Other Diseases of Skin and Subcutaneous Tissue	700-709	8	0	0.0	4	3.0	7	12	1.8

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	II-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years No. of Cases	Relative Risk	Farmed ≥ 20 Years No. of Cases	Relative Risk	Never Farmed No. of Cases	Farmed ≥ 20 Years No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	-	41	---	116	117	---
Diseases of the Musculoskeletal System & Connective Tissue	710-739	73	20	0.7	34	1.1	55	80	1.5
A. Arthritis & Rheumatism except Rheumatic Fever	710-718	19	4	0.5	12	1.0	31	63	2.2**
1. Osteoarthritis & Allied Conditions	713	6	4	2.1	5	1.3	24	53	2.3**
B. Osteomyelitis and Other Diseases of Bone and Joint	720-729	40	13	0.8	16	1.0	19	11	0.6
1. Disorders of Intervertebral Disc	725	24	4	0.3	6	0.7	4	0	0.0
C. Other Diseases of Musculoskeletal System	730-739	15	3	0.6	7	1.4	6	7	1.4
Signs, Symptoms & Ill-Defined Conditions	770-796	184	35	0.7	55	1.3	54	60	1.2
1. Other Symptoms Referable to Cardiovascular & Lymphatic System	775	6	1	0.5	5	1.2	6	11	1.6
2. Symptoms Referable to Abdomen & Peritoneum	780	32	12	0.6	14	1.6	8	12	1.9

B. Case-Control Relative Risks for Farming Exposure - Females

Diagnostic Category	II-ICDA Code	Age 25-65					Age ≥ 65		
		Never Farmed No. of Cases	Farmed 1-19 Years		Farmed ≥ 20 Years		Never Farmed No. of Cases	Farmed ≥ 20 Years	
			No. of Cases	Relative Risk	No. of Cases	Relative Risk		No. of Cases	Relative Risk
CONTROL GROUP (Injuries & Adverse Effects)	800-999	101	37	---	41	---	116	117	---
3. Other Symptoms Referable to Musculoskeletal System	789	17	5	0.8	5	0.8	10	7	0.7
All Diagnoses	001-799	1,732	586	0.8	530	1.0	628	802	1.3

*,** Relative risk statistically significantly greater than one $p < .05$, $p < .01$.

• Statistically significant exposure - risk relationship over the two risk categories $p < .05$.

APPENDIX III

RELATIVE RISKS FOR SMOKING AND SELECTED DIAGNOSES

A. Relationships Between Smoking History and Selected Diagnoses - Males

Diagnostic Category	II-ICDA Codes	Age 25-64					Age ≥ 65				
		Never Smoked	Low Smoking		High Smoking		Never Smoked	Low Smoking		High Smoking	
		No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk
Control Group (Injuries & Adverse Effects)	800-999	82	84	--	109	--	63	31	--	56	--
Malignant Neoplasm of Trachea, Bronchus & Lung	162-163	0	0	--	10	~**	5	1	0.4	19	2.8*
Diseases of the Circulatory System	390-458	66	37	0.9	179	1.6**	187	59	0.6	178	1.1
A. Hypertensive Disease	400-405	3	5	1.4	12	3.5	4	4	2.2	6	1.5
B. Ischemic Heart Diseases	410-414	30	6	0.4	79	1.4	56	29	1.1	69	1.3
1. Acute Myocardial Infarction	410	19	2	0.2	47	1.3	27	12	0.9	37	1.4
2. Chronic Ischemic Heart Disease	412	7	1	0.4	27	2.0*	28	14	1.0	28	1.2
3. Angina Pectoris	413	2	3	2.9	11	2.8	1	3	6.3	9	12.1*
C. Disorders of Heart Rhythm	415-416	3	3	1.2	9	1.9	15	7	0.7	13	1.1
D. Other Forms of Heart Disease	420-429	5	3	1.0	10	1.2	37	6	0.3	25	0.8
E. Cerebrovascular Disease	430-438	9	5	1.0	23	1.3	54	10	0.4	34	0.7
1. Transient Ischemic Attack	435	1	2	1.8	8	6.1	11	1	0.1	14	1.5
2. Acute, but Ill-defined Cerebrovascular Disease	436	4	2	1.0	9	1.1	24	2	0.1	19	1.0
F. Diseases of Arteries, Arterioles, & Capillaries	410-418	1	3	5.5	20	8.5*	25	6	0.4	25	1.1
1. Arteriosclerosis	440	1	2	4.2	12	5.1	14	1	0.2	13	1.0
G. Diseases of Veins, Lymphatics & Other Circulatory Diseases	450-458	15	15	1.2	32	1.4	13	2	0.4	18	1.3
1. Phlebitis & Thrombophlebitis	451	4	5	1.9	4	0.6	5	1	0.5	3	1.2
2. Hemorrhoids	455	7	3	0.5	15	1.6	3	0	0.0	3	0.9

A. Relationships Between Smoking History and Selected Diagnoses - Males

Diagnostic Category	II-ICDA Codes	Age 25-64					Age 65				
		Never Smoked	Low Smoking		High Smoking		Never Smoked	Low Smoking		High Smoking	
		No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk
Control Group (Injuries and Adverse Effects)	800-999	82	84	--	109	--	63	31	--	56	--
Diseases of the Respiratory System	460-519	25	15	0.6	57	1.4	71	19	0.5	82	1.3
A. Acute Upper Respiratory Infections	460-470	3	2	0.6	9	2.2	9	1	0.2	5	0.7
B. Pneumonia	480-486	11	3	0.4	17	0.9	40	5	0.2	34	1.0
C. Bronchitis, Emphysema, Asthma & Related Conditions	480-496	4	5	3.0	16	2.1	14	11	1.8	37	2.8**
1. Asthma	493	3	2	1.7	3	0.4	4	3	1.8	1	0.2
2. Chronic Obstructive Lung Disease	496	1	0	0.0	6	2.8	5	5	2.7	19	3.9**
D. Other Diseases of the Respiratory System	500-519	8	5	0.6	15	1.3	8	3	0.6	7	1.1
Ulcer	531-534	10	10	1.3	35	2.0	9	6	1.0	23	2.6*
A. Ulcer of Duodenum	532	3	9	2.7	25	5.7*	4	4	1.8	14	2.9*
All Diagnoses (Except Controls)	001-799	433	310	0.8	816	1.2	681	255	0.7	720	1.1

*,** Statistically significant relationship between amount smoked and relative risk $p < .05$, $p < .01$

B. Relationships Between Smoking History and Selected Diagnoses - Females

C-111

Diagnostic Category	H-ICDA Codes	Age 25-64					Age ≥ 65				
		Never Smoked	Low Smoking		High Smoking		Never Smoked	Low Smoking		High Smoking	
		No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk
Control Group (Injuries & Adverse Effects)	800-999	95	45	--	39	--	231	5	--	14	--
Malignant Neoplasm of Trachea, Bronchus & Lung	162-163	1	0	0.0	3	7.4	3	1	14.7	2	11.4**
Diseases of the Circulatory System	390-458	104	25	0.5	55	1.4	380	15	2.0	33	1.5
A. Hypertensive Disease	400-405	15	3	0.4	4	0.7	29	2	2.2	4	2.2
B. Ischemic Heart Disease	410-414	15	2	0.5	16	2.4*	100	4	2.1	12	2.0
1. Acute Myocardial Infarction	410	4	2	3.1	14	13.2***	38	2	2.6	6	2.3
2. Chronic Ischemic Heart Disease	412	7	0	0.0	2	0.6	56	2	2.0	4	1.4
C. Disorders of Heart Rhythm	415-416	8	2	0.6	8	2.0	25	1	1.5	6	3.6
D. Other Forms of Heart Disease	420-429	5	1	0.7	0	0.0	46	1	1.3	2	0.8
E. Cerebrovascular Disease	430-438	4	1	1.6	7	4.7**	97	2	1.4	5	1.2
F. Diseases of Arteries, Arterioles and Capillaries	440-448	7	3	1.8	1	0.3	48	0	0.0	5	2.0
1. Arteriosclerosis	440	1	3	14.7	1	2.9	29	0	0.0	2	1.4
G. Diseases of Veins, Lymphatics, & Other Circulatory Diseases	450-458	52	16	0.5	20	1.1	60	5	3.1	2	0.6
1. Phlebitis & Thrombophlebitis	451	17	4	0.5	5	0.9	14	2	3.6	1	1.0

B. Relationships Between Smoking History and Selected Diagnoses - Females

Diagnostic Category	II-ICDA Codes	Age 25-64					Age ≥ 65				
		Never Smoked	Low Smoking		High Smoking		Never Smoked	Low Smoking		High Smoking	
		No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk	No. of Cases	No. of Cases	Relative Risk	No. of Cases	Relative Risk
Control Group (Injuries & Adverse Effects)	800-999	95	45	--	39	--	231	5	--	14	--
G. Diseases of Veins, Lymphatics, & Other Circulatory Diseases (cont.)											
2. Varicose Veins of Lower Extremities	454	19	6	0.5	3	0.5	17	2	5.1	0	0.0
3. Hemorrhoids	455	9	3	0.5	8	2.0	6	0	0.0	0	0.0
Diseases of the Respiratory System	460-519	38	24	1.0	25	1.4	108	3	1.3	13	2.2
A. Acute Upper Respiratory Infections	460-470	10	9	1.6	4	0.7	19	1	2.1	1	3.6*
B. Pneumonia	480-486	9	8	1.5	9	2.1	44	1	1.2	4	1.7
C. Bronchitis, Emphysema, Asthma, & Related Conditions	489-496	9	3	0.5	7	1.7	30	0	0.0	5	2.6
D. Other Diseases of the Respiratory System	500-519	11	5	0.5	5	1.0	18	1	3.5	0	0.0
Ulcer	531-534	16	7	1.8	14	2.1	38	2	2.1	3	1.2
A. Ulcer of Stomach	531	8	5	2.4	5	1.4	19	1	1.8	2	1.7
B. Ulcer of Duodenum	532	5	2	1.6	7	3.6*	12	1	4.7	0	0.0
All Diagnoses (Except Controls & Pregnancy)	001-799	1127	383	0.7	451	1.0	1400	75	2.2	99	1.1

*. **, *** Statistically significant relationship between amount smoked and relative risk p<.05, p<.01, p<.001

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