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THE EFFECT OF THE "TENDENCY TO REPORT INJURIES" ON MINOR ACCIDENT STATISTICS: A FOLLOW-UP STUDY

J. E. Sergent

(Thesis)

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THE EFFECT OF THE "TENDENCY TO REPORT INJURIES" ON MINOR ACCIDENT STATISTICS: A FOLLOW-UP STUDY

J. E. Sergent

Submitted as a thesis to the Graduate Council of the University of Tennessee in partial fulfillment of the requirements for the degree of Master of Science.

FEBRUARY 1964

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TABLE OF CONTENTS

CHAPTER PAGE

I. SIGNIFICANCE OF THE STUDY 1

Introduction 1

Statement of The Problem 3

Definition of Terms 4

Source of Data and Scope of The Study 5

Procedure 6

Organization of The Study 6

II. HISTORY OF THE PROBLEM 7

Introduction 7

General References on Accident Proneness 7

Some Approaches to The Study of Accident Proneness 11

Related Statistical Studies 13

III. SAMPLE SELECTION AND COLLECTION OF DATA 16

Selection of Sample 16

Homogeneity of Sample 18

Nature of Data 18

Collection of Data 20

Method of Analysis 20

IV. TABULATION OF RESULTS 21

Dispensary Visitation Data 21

Distribution of Sample 21

CHAPTER PAGE

Association of Minor Injuries in a Six-Year Exposure Period 24

Association of Non-occupational Visits in a Six-Year Exposure Period. 24

Association of Non-occupational Visits and Injury Visits. 26

V. ANALYSIS OF RESULTS. 37

Distribution of Sample 37

Association of Minor Injuries in a Six-Year Exposure Period. 37

Association of Non-occupational Visits in a Six-Year Exposure Period 38

Relationship Between Non-occupational and Injury Visits. 39

Testing of Hypothesis of Study 40

Correlation of Injury Visits by Quartile Distribution of Non-occupational Visits 43

VI. SUMMARY AND CONCLUSIONS 47

Summary. 47

Conclusions. 48

BIBLIOGRAPHY 50

LIST OF TABLES

TABLE PAGE

I. Composition of Sample 19

II. Total Dispensary Visitations For Nine Occupational Groups (1954-1959). 22

III. Chi-Square Test of Total Injury Frequency Nine Occupational Groups. 23

IV. Chi-Square Test of Total Injury Frequency Six Occupational Groups 25

V. Correlation of Non-occupational Visits and Injury Visits 27

VI. Mean Injury Visits and Standard Deviations of a Quartile Distribution of Total Six-Year Non-occupational Visits for Nine Craft Groups 30

VII. Correlation of Injury Visits by Quartile Distribution of Non-occupational Visits 32

VIII. Correlation of Injury Visits by Quartile Distribution of Total Non-occupational Visits for Two-Year Intervals From 1954 to 1959 34

IX. Correlation of Injury Visits by Quartile Distribution of Total Non-occupational Visits for Two-Year Intervals From 1954 to 1959. 35

X. Correlation of Injury Visits by Quartile Distribution of Total Non-occupational Visits for Four-Year Intervals From 1954 to 1959 36

CHAPTER I

SIGNIFICANCE OF THE STUDY

I. INTRODUCTION

In any industrial environment it is inevitable that employees will become involved in a large number of accidents ranging in severity from death to a simple cut or scratch. This phenomenon of occupational accidents and their causes (and motives leading to unsafe behavior of individuals) has plagued industry and intrigued investigators since the turn of the century.

In the last few decades the matter of industrial accidents has become extremely important in the hierarchy of problems confronted by leaders of industrial organizations. This concern by industry is predicated on economic as well as moral considerations. The economic concern is due chiefly to the impact of the cost of accidents on total cost of doing business. This era in our economic growth has witnessed increasing business competition, and the tremendous costs of industrial accidents have played an important role in lower profit margins. The moral consideration is based upon industry's concern for the welfare and physical and mental well-being of employees.

Dr. Alan McLean[1] reported that there were more than ten million accidents in 1954 and that one-third resulted in permanent physical

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[1]Alan McLean, M.D., "Accidents and the Human Factor," Personnel Journal, 34:342-345, February, 1956.

impairment. These accidents cost industry about $45 per employee in 1954.

It was revealed by the Bureau of Labor Statistics[2] that in 1959 job injuries disabled 1,970,000 American workers (0.7 per cent fatally) resulting in 16.8 million workdays of disability - the cost equivalent to a year's full-time employment of about 540,000 workers. Approximately 84,200 of these injuries resulted in permanent physical impairment ranging from amputation or partial loss of use of a toe or finger to complete inability to resume gainful employment.

The National Safety Council[3] reported that there were 3.18 occupational injuries per one hundred workers in 1957 resulting in cost to industry of approximately $4,000,000,000.

A large number of studies have been conducted and a voluminous amount of material written on causes, effects, costs, etc., of industrial accidents. Studies generally conclude that a small number of the working population is responsible for the largest number of occupational accidents and that accident liability is related to personality and human factors.[4]

Mintz and Blum[5] reported that although the observed distribution

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[2]H. F. Merrill, "The 1959 Accident Toll," Supervisory Management, 5:62, July, 1960.

[3]Accident Facts, 1957, A Report Prepared by the National Safety Council (Chicago: National Safety Council, 1957), p.35.

[4]A. Davids and J. T. Mahoney, "Personality Dynamics and Accident Proneness in an Industrial Setting," Journal of Applied Psychology, 41:303-305, May, 1957.

[5]Alexander Mintz and Milton L. Blum, "A Re-examination of the Accident Proneness Concept," Journal of Applied Psychology, 33:195-211, March, 1949.

of injuries may suggest unequal liability, the magnitude of liability is not determinable and that chance factors may be operating simultaneously.

One consideration which would possibly affect the distribution of accident data and any determinations to be made therefrom would be the relationship between the tendency to report injuries and accident statistics. In a review of studies in the general area of accident proneness, Arbous and Kerrich[6] pointed out that the tendency of an individual to report injuries has not been considered in making determinations on accident liability and that this factor might affect the results of prior studies in this field.

The first study in this area was published by Barker[7] in 1960 and concerned the lower level of injury severity (such as cuts, scratches, etc.) which required minor treatment, since this is the area in which individuals have some latitude in reporting to the dispensary in which human factors assume a great importance.

II. STATEMENT OF THE PROBLEM

This study is a follow-up of Barker's study concerned with the effect of the "tendency to report injuries"[8] on minor accident statistics. It was designed to investigate the reliability of Barker's results.

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[6]A. G. Arbous and J. E. Kerrich, "Accident Statistics and the Concept of Accident Proneness," Biometrics, 4:341-390, December, 1951.

[7]J. A. Barker, "The Effect of the Tendency to Report Injuries on Minor Accident Statistics," (Master's thesis, The University of Tennessee, Knoxville, 1960), pp. 1-55.

[8]Ibid.

It is questioned whether employees who visit the dispensary more frequently for non-occupational reasons would more readily report to the dispensary due to minor injuries.

It is hypothesized that:

> The tendency to report injuries has no significant effect on the systematic variance in reported injuries for a six (6) year period of exposure.

III. DEFINITIONS OF TERMS

Accident. "An accident results from a completed sequence of events resulting from an unsafe act or behavior of an individual or by a mechanical or physical factor; an accident may or may not result in an injury to a person or persons."[9]

Minor Injury. For purposes of this study, minor injuries will be considered as those not resulting in death, disability, hospitalization, or lost time from the job - but which do require medical treatment.

Accident Liability. ". . . environmental factors plus the personal factor of accident proneness in the individual determine the accident liability of individuals in any given situation."[10]

Accident Proneness. This concept holds that individual differences exist in accident behavior as in most other human qualities and, futhermore, that a relatively small proportion of the human population can be

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[9] Ibid., p. 5.

[10] Arbous and Kerrich, p. 351.

held to account for most of the accidents that occur.[11]

IV. SOURCE OF DATA AND SCOPE OF THE STUDY

As in Barker's [12] study, the data for this follow-up study were furnished by the Health Division of the Oak Ridge National Laboratory located at Oak Ridge, Tennessee, and operated for the Atomic Energy Commission by the Nuclear Division of Union Carbide Corporation.

This study covered the six-year period from 1954 through 1959 and the population was limited to 245 of the 291 employees included in Barker's study covering the two-year period of 1953-54. The 245 employees were continuously employed during the entire period of this study.

Only journeyman level craftsmen in nine (9) highly skilled occupational categories were included. Barker's study included some apprentices; however, these had attained journeyman status by the beginning of 1954. The criterion used in selection of the sample was that environmental conditions as regards exposure to accidents be similar for all employees. Forty-six (46) of the original sample of 291 were deleted from this study due to changes in jobs affecting exposure to accidents and terminations due to various reasons.

In this study, data included only voluntary first visits to the dispensary for specific matters of a non-occupational nature and only

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[11]Herbert H. Jacobs, "Operational Aspects of the Accident Proneness Concept," (Lecture presented at the New York Academy of Sciences, Section of Mathematics and Engineering), December 16, 1955.

[12]Barker, pp.1-55.

initial visits for minor injuries during the six successive one-year periods. Involuntary and normally scheduled visitations were not included in the data.

V. PROCEDURE

Through statistical techniques and analysis, an attempt was made to determine the effect of the tendency to report accidents on the systematic variance in minor injury data in a six-year period.

VI. ORGANIZATION OF THE STUDY

The study was divided into the following six chapters:

I. Significance of the Study

II. History of the Problem

III. Sample Selection and collection of Data

IV. Tabulation of Results

V. Analysis of Results

VI. Summary and Conclusions

CHAPTER II

HISTORY OF THE PROBLEM

I. INTRODUCTION

The basic assumption in the accident proneness concept is that individuals have unequal liability toward injuries and that this unequal disposition is constant. Farmer and Chambers,[13] who introduced the term "accident proneness,"[14] were exponents of these assumptions.

Although physical and mechanical factors of any working environment may be responsible for some accidents, literature in the field reveals that factors of a personal nature are responsible for the larger frequency of accidents.

To date, studies in the field have been significant and informative but somewhat inconclusive. However, investigations have proved that certain ideas on accident proneness are measurable.

II. GENERAL REFERENCES ON ACCIDENT PRONENESS

Greenwood and Woods[15] pioneered studies in the general area of accident proneness in 1919. Results of their work indicated that persons

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[13]E. Farmer and E. G. Chambers, "A Psychological Study of Individual Differences in Accident Rates," Industrial Fatigue Research Board, Report No. 38, 1926.

[14]Ibid.

[15]Major Greenwood and Hilda M. Woods, "The Incidence of Industrial Accidents upon Individuals with Special Reference to Multiple Accidents," Industrial Fatigue Research Board, Report No. 4, pp. 3-28, 1919.

generally repeat their injury records - that there is a positive correlation between accidents in successive periods of time.

Their results indicated a noticeable difference between the observed frequency of injuries and chance distribution (Poisson) which could normally be expected under similar environmental conditions and pointed out that individuals' liability to accidents varies and includes a host of factors difficult to measure. Generally, they concluded that the chances of a person having an accident were biased against those persons who had previously sustained the most accidents.[16]

During World War I the Industrial Fatigue Research Board in Great Britain demonstrated that a very high percentage of accidents repeatedly occurred in seemingly well-regulated individuals. This study revealed that 20 per cent of employees were responsible for the vast majority of accidents.[17] A later study in Germany showed that the more accidents a person has the more likely he is to have another.[18]

Newbolt[19] extended the studies of Greenwood and Woods and concluded that:

1. Individuals who experience more accidents generally visit the dispensary more often for minor sickness.

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[16]Greenwood and Woods, pp.3-28.

[17]Alan McLean, p. 342.

[18]Ibid.

[19]E. M. Newbolt, "A Contribution to the Study of the Human Factor in the Causation of Accidents," Industrial Fatigue Research Board, Report No. 34, pp. 3-61, 1926.

2. A small number of employees significantly influences the number of accidents, and accident distributions are due to non-chance factors.

3. There is some indication that personal factors influence accident rates.

4. Correlations of between 0.2 and 0.3 were found between accidents in different periods, accidents of different types, and accidents in the factory and at home.

In 1949 Mintz and Blum[20] analyzed the earlier studies in the field and questioned findings that personal factors were significant in accident distributions. They pointed out that personal factors alone are not responsible for all differences in accident liability.

It is obvious that mechanical and physical factors of the industrial environment play an important role in accidents. Also, it is generally agreed that, although difficult to measure, many injuries are caused by psycho-physiological factors which may affect the accident liability of individuals in the same environment.

Many studies have been conducted regarding the relationship of personal factors (such as vision, age, experience, intelligence, reaction time, fatigue, alcohol consumption, hearing loss, etc.) to accident causation.[21] It would appear axiomatic that these factors certainly play some role in accident causation since all accidents occur in an environment

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[20]Alexander Mintz and Minton L. Blum, "A Re-examination of the Accident Proneness Concept," Journal of Applied Psychology, 33:195-211, March, 1949.

[21]Barker, pp. 11-15.

of human feeling and human motivations even though degrees of these factors may not be measurable.

A study by the Executive Analyses Corporation[22] stated that measurable personality factors related to accident proneness can be classified into the following seven trait syndromes:

1. "Injury-prone employees tend to be more distractible than safe employees.

2. Accident repeaters show less personal restraint than do non-repeaters.

3. The injury-repeater is inclined to be more negative and independent than the safe worker in his attitude toward other people.

4. The accident-prone person tends to obtain lower scores on those personality traits which may be classed under the heading of sensitivity.

5. The accident-prone person reacts differently to pain.

6. Accident-prone persons tend to differ from safe workers with respect to feelings of superiority, inferiority, and mental adequacy.

7. The pattern of scores for the social orientation of the repeaters also differs significantly from that of the non-repeater."[23]

In 1951 Arbous and Kerrich[24] critically reviewed studies in the field of accident-proneness and stated that proneness apparently existed but that it was difficult to measure. They disagreed with a neat interpretation of the results of previous investigations which indicated that

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[22]Thomas N. Jenkins, "The Accident-Prone Personality," Personnel, July, 1956, pp.29-32.

[23]Ibid.

[24]Arbous and Kerrich, pp.340-390.

personal factors predisposed some individuals to have more accidents than others and that the same individuals would repeat their accident records.

Arbous and Kerrich[25] further questioned the relevance of reported injuries as a measure of accidents pointing out that these data may include the effects of the tendency of an individual to report injuries and that these effects had not been studied in previous investigations.

III. SOME APPROACHES TO THE STUDY OF ACCIDENT PRONENESS

Clinical Approach. Investigators in this area point out that the clinical approach is concerned with the entire individual and the significance of various aspects of his personality on accident causation. It attempts to determine the relative importance of each personality factor in a given situation and involves a complete study of physical, mental, social, and economic factors which play a part in accidents.[26] Arbous and Kerrich[27] indicated the clinical approach has been used quite successfully in reducing accidents but observed it was not suitable to use on a large scale. Too, there was evidence that persons subjected to this method may have responded as they thought they should rather than in a normal manner as was found in the Hawthorne experiments at the Western Electric Company.

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[25] Ibid.

[26] M. S. Viteles, Industrial Psychology (New York: W. W. Morton and Company, Inc., 1932), pp. 382-84.

[27] Arbous and Kerrich, p. 386.

Intermediate Criterion Approach. In a recent study by Whitlock[28] in the area of accident proneness, it was pointed out that most injuries result from accident behaviors (intermediate criterion). Hence, injuries could be predicted from unsafe behaviors.

The assumption was made that persons who commit more accident behaviors would experience more injuries. A positive relationship was found between number of unsafe behaviors reported and injury experience (correlation coefficient of .27). However, the reliability of the injury data was only .37, thereby seriously limiting the correlation of any measure with number of injuries. It was concluded, however, that the criterion measure was relevant and reliable and this intermediate criterion measure correlated positively with injuries.[29]

Subsequently, Clouse[30] conducted a study similar to Whitlock's and obtained a reliability coefficient for accident behavior of .93 by correlating odd-and-even week observed unsafe behaviors. However, there was not a significant positive correlation between unsafe behaviors and injury experience due primarily to the unreliability of injury data and a reduction of the sample size during the study (from 48 to 32).

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[28] G. H. Whitlock, J. A. Barker, F. E. Blackett, and C. H. Stone, "The Relation of Accident Proneness and the Tendency to Report Injuries," Personnel Psychology, (Volume 16, Number 2), Summer, 1963, p. 167.

[29] Ibid.

[30] Robert J. Clouse, "A Study of the Relationship Between Industrial Injuries, Personal Factors, and Accident Proneness," (M.S. degree thesis, The University of Tennessee, June, 1960), p. 43.

IV. RELATED STATISTICAL STUDIES

In three recent studies, it was hypothesized that the tendency to report injuries as estimated by non-occupational dispensary visitations would contribute significantly to the systematic variance in the injury distributions as measured by the correlation coefficient between the first and second year injuries. Results of these investigations are as follows:

1. J. A. Barker[31] - Barker conducted a study using a sample of 291 craft employees of nine craft groups of the Oak Ridge National Laboratory which is operated by the Nuclear Division of Union Carbide Corporation. His study covered a two-year period (1952-53). A sample size of 245 (7 craft groups) was found to be homogeneous with respect to previous injuries. Barker found that the tendency to report injuries had a significant effect on the systematic variance in reported minor injuries between the two successive exposure periods. A significant positive relationship existed between injury visits in two successive one-year periods, but the reliability of non-occupational visits was generally higher, indicating that there is a greater tendency for individuals to repeat their non-occupational visit record rather than their injury record.

   Barker also found that individuals with a below average number of non-occupational visits demonstrated a significant tendency to repeat their injury records while individuals with an above average number of non-occupational visits demonstrated an insignificant tendency to repeat their injury records.

2. Carl H. Stone[32] - Stone conducted a study using a sample of 275 office employees engaged in professional or clerical work in the General Finance and Materials Division of the Oak Ridge Gaseous Plant of the Nuclear Division of Union Carbide Corporation. The study covered a two-year period (1958 and 1959).

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[31]Barker, pp. 50-53.

[32]Carl H. Stone, "Interrelationships Among Measures of Absences, Injuries, Dispensary Visits and Attitudes," (M.S. degree thesis, The University of Tennessee, Knoxville, June, 1960), pp.77-83.

Stone found a significant relationship between injury visits and non-occupational visits for each of the two-year periods and the mean injury visits increased systematically with the increase in non-occupational visits.

Stone also found that individuals with a low tendency to report injuries exhibited a significant tendency to repeat their injury records, and those with a high tendency to report injuries exhibited a low tendency to repeat their injury records.

These results are similar to those reported by Barker.[33]

3. Frank E. Blackett[34] - Blackett's sample included approximately 200 journeyman craftsmen in the same seniority group because of apparent homogeneity. The following job classifications were used: machinists, experimental machinists, maintenance machinists, shop inspector, and shop maintenance man. Persons in the sample were employees of the Oak Ridge Chemical and Metallurgical Processing Plant of the Nuclear Division of Union Carbide Corporation. The study covered a period of two years (1957 and 1958). Results revealed that individuals with a low tendency to report injuries demonstrated an insignificant tendency to repeat their respective injury records and those with a high tendency to report demonstrated a significant tendency to repeat their respective injury records.

These results are the converse of those found by Barker[35] and Stone.[36]

Whitlock, Barker, Blackett, and Stone stated that "the effect of the tendency to report injuries would be to decrease the systematic variance (reliability) in the injury distribution of individuals who are reluctant to report injuries and to result in the 'purest' injury

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[33]Barker, pp. 50-53.

[34]Frank E. Blackett, "The Effects of Absenteeism and the Tendency to Report Injuries on Minor Accident Statistics," (M.S. degree thesis, The University of Tennessee, Knoxville, June, 1960), pp. 70-75.

[35]Barker, pp. 50-53.

[36]Stone, pp. 77-83.

distributions for individuals with the highest tendency to report injuries."[37]

The following table represents a comparison (between the three preceding studies) of the correlations between first and second year injuries by non-occupational quartiles.[38]

	Corr. Between 1st and 2nd Yr. Injuries		
Quartile	Barker	Blackett	Stone
1	.37*	.06	.47*
2	.43*	.20	.64*
3	.14	.58*	.19
4	.21	.55*	.09

*$p < .05$

If the hypothesis in the preceding three studies were true, the higher the quartile of non-occupational dispensary visits, the greater the correlation coefficient between first and second year injuries. The hypothesis is accepted only in Blackett's study.

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[37]Whitlock, Barker, Blackett, and Stone, p. 164.

[38]*Ibid.*, p. 167.

CHAPTER III

SAMPLE SELECTION AND COLLECTION OF DATA

I. SELECTION OF SAMPLE

Since this study was designed to determine the validity of results obtained by Barker,[39] it was necessary that the same sample be used as in his study. However, it was decided that this study should include the subsequent six successive one-year intervals (1954-1959) instead of a two-year period as was investigated by Barker.[40] The period from 1954 to 1959 was a relatively stable period of employment at Oak Ridge National Laboratory and was selected since the original sample did not decrease substantially as a result of the termination and transfer of employees.

The Oak Ridge National Laboratory is operated for the Atomic Energy Commission by the Nuclear Division of Union Carbide Corporation. It is the largest research and development laboratory in the United States, and its research efforts are concentrated in the physical and life sciences and various fields of engineering primarily in the field of atomic energy. The activities of Oak Ridge National Laboratory have major significance on national defense and in furthering peaceful application of atomic energy.

The Health Division of this Laboratory provides a high quality medical service for pre-employment examination of applicants, annual

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[39]Barker, pp. 1-53.

[40]*Ibid.*, p. 20.

physical examinations for employees, treatment of occupational injuries, and for the diagnosis and treatment of non-occupational illnesses or other cases.[41]

The general philosophy of the Health Division is preventative medicine. Its facilities include a central dispensary staffed with physicians, nurses, technicians, and clerks whose services are easily accessible to all employees. There are two other area dispensaries which provide minor medical services for employees further removed from the central dispensary.

Barker[42] found that the composition of the craft-work force at this Laboratory would greatly limit the possibility of obtaining a suitable sample size within any craft group. As a result, it was decided that all skilled craft groups at the installation should be used in this study to afford an adequate sample size. A total of 291 employees (journeymen and apprentices) were selected for the sample from the same craft shown in Table I. Generally, all craft groups worked under very similar environmental conditions.

In this study the same sample was used. However, forty-six (46) employees were removed from the original 291 leaving a total sample of 245. These forty-six were removed due to:

1. Terminations (deaths, transfers, resignations, etc.).
2. Promotions to weekly or monthly salaried jobs with change in job content and environmental conditions.

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[41]Barker, p. 23.

[42]*Ibid.*, p. 21.

The reduction was not considered too much to greatly influence statistics in the study.

The sample consisting of 245 journeymen in nine basic skilled craft groups is shown in Table I.

II. HOMOGENEITY OF SAMPLE

Since the same sample was investigated as in Barker's study, the same criteria for homogeneity were accepted. Only those workers were included in the study who were in Barker's sample and were continuously employed during the subsequent six-year period (1954 to 1959). This long company service is indicative of employment stability and minimizes possibilities of unfamiliarity with the work environment.[43]

Employees were not included who had physical limitations which could bias their susceptibility to injuries.

III. NATURE OF DATA

As in Barker's[44] study, data for minor injuries included only the first visitation to the dispensary for each injury so as to eliminate bias which would result from re-visits to the dispensary for treatment of the same injury. Most of the minor injuries consisted of small cuts, lacerations, burns, bruises, etc.

Data for non-occupational visits to the dispensary included only the first visit for any specific condition. Second or repeat visitations

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[43]Barker, p. 20.

[44]*Ibid.*, pp. 23-24.

TABLE I

COMPOSITION OF SAMPLE

Occupational Group	Number in Sample	Percent of Total Samples	Mean Age of Group (Yrs.)*	Mean Months of Company Service*
Carpenter	21	8.6	49.0	139.6
Electrician	30	12.2	42.6	84.0
Instrument Mechanic	28	11.4	31.1	69.6
Machinist**	74	30.2	42.9	81.7
Millwright	37	15.1	47.3	82.4
Pipefitter	26	10.6	42.5	58.1
Rigger and Iron Worker	12	4.9	44.7	90.0
Sheetmetal Worker	11	4.5	44.2	80.5
Welder	6	2.4	50.3	67.3
TOTAL	245	99.9	43.0	83.2

*At beginning of six-year period.

**Includes: Tool and Model Maker and Mechanical Instrument Maker.

for the same condition were not included, thereby eliminating bias arising from the severity of the case.

IV. COLLECTION OF DATA

The Health Division of Oak Ridge National Laboratory maintains complete records (on 5" x 7" cards) on all employees including such information as birthdate, date of hire, job classification, and division to which assigned. Also, information was recorded as to the number, date, and nature of dispensary visits.

On the cards of each employee included in the sample, data were listed separately for non-occupational and occupational dispensary visits for the period 1954 through 1959. The number of non-occupational first visits and the total number of minor occupational injuries were listed for each of the six years.

V. METHOD OF ANALYSIS

Utilizing the 1604 Control Data Computer, the following statistical analyses were made:

1. Using the product-moment method of correlation, coefficients (odd vs. even years) were computed to determine the stability of injury visits and non-occupational visits for the six-year exposure period.

2. The relationship between non-occupational visits and injury visits during the six-year exposure period was determined by the techniques of simple and multiple correlation (using standard partial regression coefficients). Also, correlation coefficients for injury data were computed for quartile distributions of non-occupational visits.

CHAPTER IV

TABULATION OF RESULTS

I. DISPENSARY VISITATION DATA

Dispensary visitation data were obtained from the medical records of each employee included in the sample. Injury and non-occupational visitations were recorded separately by each year from 1954 to 1959. The total frequency of injury and non-occupational visits by craft group were obtained for the six-year period. These data are shown in Table II.

II. DISTRIBUTION OF SAMPLE

In order to test the hypothesis that the nine craft groups represented a homogeneous sample, a chi-square test of the total injury frequency for the nine groups was performed. The results are shown in Table III. The theoretical frequency of injuries for each craft group was obtained under the assumption of equal liability for injuries.

Since a chi-square of 351.14 was obtained with a probability of occurrence through chance of $< .001$, the hypothesis of homogeneity was rejected.

A comparison of the reported injuries of the nine craft groups with the theoretical frequencies revealed that three groups differred substantially as follows:

1. Carpenter - reported injuries were approximately 54 per cent more than expected injuries.

2. Instrument Mechanic - reported injuries were only 27 per cent of expected injuries.

TABLE II

TOTAL DISPENSARY VISITATIONS FOR NINE OCCUPATIONAL GROUPS
OCCUPATIONAL VS. NON-OCCUPATIONAL
(1954-1959)

Occupational Group	No. in Sample	1954		1955		1956		1957		1958		1959		Total	
		O	N	O	N	O	N	O	N	O	N	O	N	O	N
Instrument Mechanic	28	14	83	13	90	11	86	13	98	10	94	6	106	67	557
Carpenter	21	62	97	65	107	59	138	58	127	41	126	56	147	341	742
Welder	6	9	38	10	40	6	61	11	77	2	83	14	68	52	267
Electrician	30	42	152	39	161	35	159	37	159	29	177	25	205	207	1013
Machinist	74	97	347	100	376	88	379	97	451	91	396	83	387	556	2336
Millwright	37	71	136	70	160	55	166	76	193	54	191	50	207	376	1053
Pipefitter	26	58	119	64	118	60	110	42	131	54	137	33	199	311	814
Rigger and Iron Worker	12	23	56	19	63	18	88	20	73	14	91	17	110	111	481
Sheetmetal Worker	11	14	43	17	60	27	60	22	81	27	105	21	112	128	461
TOTAL	245	390	1071	397	1175	359	1247	376	1390	322	1400	305	1541	2149	7824

O - Occupational Visits
N - Non-occupational Visits

TABLE III

CHI-SQUARE TEST OF TOTAL INJURY FREQUENCY
NINE OCCUPATIONAL GROUPS

Occupational Group	No. in Sample	Observed Frequency*	Theoretical Frequency*	Chi-Square
Carpenter	21	341	184.2	133.58
Electrician	30	207	263.1	11.96
Instrument Mechanic	28	67	245.7	143.39
Machinist	74	556	649.0	13.33
Millwright	37	376	324.5	8.17
Pipefitter	26	311	228.0	30.21
Rigger and Iron Worker	12	111	105.3	.31
Sheetmetal Worker	11	128	96.5	10.28
Welder	6	52	52.7	.01
TOTAL	245	2149	2149.0	351.14 X^2 d.f 8 $P < .001$

*Total for six-year period.

3. Pipefitter - reported injuries were 27 per cent less than expected injuries.

A chi-square test of the remaining six groups (excluding Carpenter, Instrument Mechanic and Pipefitter) was performed and the results are shown in Table IV. A chi-square of 43.41 was obtained with a probability of occurrence through chance of $< .001$. Hence, the hypothesis of homogeneity for these six groups was rejected.

No further tests were made to determine the homogeneity of sample. It was decided that all craft groups should be included in the study. The effect of non-homogeneity will be discussed in Chapter V.

III. ASSOCIATION OF MINOR INJURIES IN A SIX-YEAR EXPOSURE PERIOD

The product-moment method of correlation was used to compute the coefficient of correlation between total injury data for each individual for the three odd years and total injury data for each individual for the three even years during the period from 1954 to 1959. A correlation coefficients of .78 was obtained which was significant at the .001 level.

IV. ASSOCIATION OF NON-OCCUPATIONAL VISITS IN A SIX-YEAR EXPOSURE PERIOD

The product-moment method of correlation was used to determine the coefficient of correlation between total non-occupational data for each individual for the three odd years and total non-occupational data for each individual for the three even years. A correlation coefficient of .87 was obtained which was significant at the .001 level.

TABLE IV

CHI-SQUARE TEST OF TOTAL INJURY FREQUENCY
SIX OCCUPATIONAL GROUPS

Occupational Groups	No. in Sample	Observed Frequency*	Theoretical Frequency*	Chi-Square
Electrician	30	207	252.4	8.17
Machinist	74	556	622.5	7.10
Millwright	37	376	311.2	13.49
Rigger and Iron Worker	12	111	101.0	.99
Sheetmetal Worker	11	128	92.5	13.62
Welder	6	52	50.5	.04
TOTAL	170	1430 d.f. 5 $P < .001$	1430.1	43.41 X^2

*Total for six-year period.

V. ASSOCIATION OF NON-OCCUPATIONAL VISITS AND INJURY VISITS

Correlation of Non-occupational Visits and Injury Visits. The relationship between non-occupational visits and injury visits for the six-year period was determined. The total number of non-occupational visits for each individual for the entire six-year period was correlated with the total injury visits for each individual for the six-year period. The correlation coefficient was found to be .56 which was significant at the .001 level.

The Effect of Non-occupational Visits on Injury Visits. In this study it was hypothesized that the tendency to report injuries had no significant effect on the systematic variance in reported injuries in a six-year exposure period.

The simple correlation coefficients between the second three years of injury data vs. first three years injury data and the second three years injury data vs. first three years non-occupational data were .46 and .29, respectively. Also, a coefficient of .40 was obtained when the first three years injury data were correlated with the first three years of non-occupational data. This information is shown in Table V.

Using standard formulas as in Guilford,[45] the standard partial regression coefficients (Betas) for the first three years of injury data and the first three years of non-occupational data were found to be .41

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[45] J. P. Guilford, Fundamental Statistics in Psychology and Education. York, Pennsylvania: McGraw-Hill Book Company, 1956, pp. 393-394.

TABLE V

CORRELATION OF NON-OCCUPATIONAL VISITS AND INJURY VISITS

(Sample: 245)

Method of Calculation	Observed Correlation, r
Second 3 years injury data vs. First 3 years injury data	.46
Second 3 years injury data vs. First 3 years non-occuational data	.29
First 3 years injury data vs. First 3 years non-occupational data	.40
Non-occupational visits (six-years) vs. Injury visits (six-years)	.56

$P < .01$ for all r's

and .13, respectively. Both beta coefficients were significant at the .002 level of confidence.

The technique of multiple correlation was utilized to determine the proportion of variance in injury data contributed by non-occupational variance.

Using the following formula, the coefficient of multiple determination between the second three years of injury data (dependent variable) and the first three years of injury data plus the first three years of non-occupational data (independent variables) was found to be .2277.

$$R^2_{a.bc} = \beta_{ab.c} \times r_{ab} + \beta_{ac.b} \times r_{ac}$$
$$23 = (.41)(.46) + (.13)(.29)$$
$$23 = 19 + 4$$

In other words, the independent variables accounted for 23% of the variance in the second three years of injury data.

Using the following formula, the unique variance contributed to the dependent variable by the independent variables was determined. Also, the variances contributed by the interaction of the two independent variables was determined.

$$R^2_{a.bc} = \beta^2_{ab.c} + \beta^2_{ac.b} + 2r_{bc} \times \beta_{ab.c} \times \beta_{ac.b}$$
$$= (.41)^2 + (.13)^2 + 2(.40)(.41)(.13)$$
$$= .1681 + .0169 + .0426$$

a = Total second three years of injury data.
b = Total first three years of injury data.
c = Total first three years non-occupational data.

The significance of these results is discussed in Chapter V.

Association of Injury Visits with a Quartile Distribution of Non-occupational Visits. Whitlock, Barker, Blackett, and Stone[46] reported that it was believed possible to estimate the tendency to report injuries from an individual's dispensary visits for non-injury (non-occupational) purposes. They reasoned that a person who would report the slightest injury (minor scratches, cuts, etc.) would also report minor ailments such as headaches, colds, etc. Therefore, the set of those individuals who visit the dispensary more frequently for non-occupational purposes should include those who have the greatest tendency to report all injuries regardless of the severity. Conversely, individuals who are reluctant to report even a serious injury would visit the dispensary only for fairly serious non-occupational matters.

If this were true, it should follow "that the higher the quartile of non-occupational visits, the greater the amount of systematic variance in the injury distribution for employees in that quartile and, hence, the greater the intra-quartile correlation coefficient for injury data."[47]

Within this framework, the relationship between injury visits and non-occupational visits for the six-year period was determined. The sample was divided into a quartile distribution based upon frequencies (from low to high) of non-occupational visits. For each quartile of non-occupational visits, the mean injury visit and standard deviation of injury visits were computed. This information is shown in Table VI.

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[46] Whitlock, Barker, Blackett, and Stone, p. 164.

[47] Ibid., p. 167.

TABLE VI

MEAN INJURY VISITS AND STANDARD DEVIATIONS OF A QUARTILE DISTRIBUTION OF TOTAL SIX-YEAR NON-OCCUPATIONAL VISITS FOR NINE CRAFT GROUPS

Distribution of Two-year Non-occup. Visits	No. in Quartile	Frequency of Non-occup. visits within Quartile	Mean Injury Visits Six-year Period	Standard Deviation Six-year Injury Visits
Quartile 1	61	0-13	3.21	2.95
Quartile 2	61	14-26	6.45	5.09
Quartile 3	61	27-44	10.74	7.83
Quartile 4	62	45-151	14.85	9.90

To further explain the relationship between non-occupational and injury visits for the six-year period, the intra-quartile coefficients of correlation for injury data were obtained for each quartile distribution of non-occupational visits. Total injury data for each individual for the odd years were correlated with total injury data for each individual for the even years. Correlation coefficients of .48, .65, .70, and .77 were obtained for quartiles one through four, respectively. All intra-quartile correlation coefficients were within the 95 per cent level of confidence. These data are shown in Table VII.

Since the results of intra-quartile correlations of injury data obtained in this study were different from those obtained by Barker, an attempt was made to investigate factors which affected the systematic variance in the injury data.

Since Barker's study encompassed a two-year period as opposed to a six-year period in this study, the effect of the length of the reporting period was investigated.

Discussions with staff members of the Medical Department of this Research Laboratory revealed that it was their experience that individuals who have a high tendency to report (for both non-occupational and occupational purposes) may vary considerably in total visits from year to year. Also, individuals who have a low tendency to report may vary from year to year. In other words, to obtain an accurate measurement of an individual's disposition to report may involve more than a two-year period of time.

TABLE VII

CORRELATION OF INJURY VISITS BY QUARTILE
DISTRIBUTION OF NON-OCCUPATIONAL VISITS*

Distribution of Six-Year Non-occup. Visits	No. in Quartile	Range of Non-occup. Visits Within Quartile	Observed Correlation, r
Quartile 1	61	0-13	.48
Quartile 2	61	14-26	.65
Quartile 3	61	27-44	.70
Quartile 4	62	45-151	.77

*Total injury visits for three odd years vs. total injury data for three even years

To investigate this phenomenon, it was decided to divide the period of study into sub-periods of two and four year intervals and to compute intra-quartile correlation coefficients for all quartiles of non-occupational visits for all periods.

To study the effects of the elapse of time on the systematic variance in injury data, the intra-quartile correlation coefficients for injury data were obtained comparing 1954 with each of the other five years. These results are shown in Table VIII. Also, the same coefficients were computed for every possible two-year interval during the six-year period. These results are shown in Table IX.

To further investigate the effect of the length of the reporting period on the intra-quartile Correlation of injury data, the six-year period was sub-divided into three four-year intervals. These results are shown in Table X.

TABLE VIII

CORRELATION OF INJURY VISITS BY QUARTILE DISTRIBUTION OF TOTAL NON-OCCUPATIONAL VISITS FOR TWO-YEAR INTERVALS FROM 1954 TO 1959*

Two-Year Period	Distribution of Non-occupational Data			
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1954-1955	.38	.35	.42	.47
1954-1956	.29	.02	.39	.30
1954-1957	.17	.42	.39	.25
1954-1958	-.16	.35	.20	.44
1954-1959	.27	.38	.19	.10

d.f.: Q_1, Q_2, and Q_3 = 59; Q_4 = 60

Pr [$|r| > .297$] = .01

Pr [$|r| > .21$] = .05

*Total injury data for each individual, 1954 vs. each successive year

TABLE IX

CORRELATION OF INJURY VISITS BY QUARTILE DISTRIBUTION OF TOTAL NON-OCCUPATIONAL VISITS FOR TWO-YEAR INTERVALS FROM 1954 TO 1959*

Two-Year Period	Distribution of Non-occupational Data			
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1954-1955	.38	.35	.42	.47
1955-1956	.37	.25	.48	.33
1956-1957	.45	.19	.51	.44
1957-1958	.32	.60	.31	.80
1958-1959	.21	.41	.60	.38

d.f.: Q_1, Q_2, and Q_3 = 59; Q_4 = 60

Pr $[|r| > .297] = .01$

Pr $[|r| > .21] = .05$

*Total injury data for each individual, first vs. second year of each period

TABLE X

CORRELATION OF INJURY VISITS BY QUARTILE DISTRIBUTION OF TOTAL NON-OCCUPATIONAL VISITS FOR FOUR-YEAR INTERVALS FROM 1954 TO 1959*

Period	Distribution of Non-occupational Data			
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
1954-1957	.45	.36	.50	.30
1955-1958	.54	.52	.48	.55
1956-1959	.24	.39	.73	.74

d.f.: Q_1, Q_2, and Q_3 = 59; Q_4 = 60

Pr [$|r| > .297$] = .01

Pr [$|r| > .21$] = .05

*Total injury data for each individual, odd vs. even years of each period

CHAPTER V

ANALYSIS OF RESULTS

I. DISTRIBUTION OF SAMPLE

Since no single craft group was sufficiently large for the study, nine craft groups were included. Chi-square tests of the total injury frequency for the sample were performed to determine if the nine craft groups represented a homogeneous sample. The hypothesis of homogeneity was rejected. However, it was decided that non-homogeneity would not limit the usefulness of the data since the effects would tend to exert the same influence in all intra-quartile correlations. Hence, while the absolute magnitude of all these coefficients may be inflated as a result of heterogeneity of groups, the comparative magnitudes should retain their significance for the purposes of this study.

II. ASSOCIATION OF MINOR INJURIES IN A SIX-YEAR EXPOSURE PERIOD

The odd-even year correlation coefficient for reported injuries for the six successive years was .78. Comparable coefficients for minor injuries of .38, .44, and .49 were obtained by Barker,[48] Blackett,[49] and Stone,[50] respectively. Also, literature in the field reported that

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[48]Barker, p. 40.

[49]Blackett, p. 33.

[50]Stone, p. 31.

other studies show that correlation coefficients for injury data generally range from .2 to .4.[51]

The coefficient of .78 for the injury data for this study indicated the injury data were highly stable and that there is a tendency for individuals to repeat their injury records over the six-year period.

III. ASSOCIATION OF NON-OCCUPATIONAL VISITS IN A SIX-YEAR PERIOD OF EXPOSURE

The odd-even year coefficient of correlation for the non-occupational data for the six-year period was .87 and was significant at the .001 level of confidence. Barker,[52] Blackett,[53] and Stone[54] obtained comparable coefficients for non-occupational visits of .67, 72, and .73, respectively.

The coefficient of .87 obtained in this study was higher than in other reported studies (as above). The coefficient of .87 for the non-occupational data was higher than that for the injury data (.78) indicating that individuals have a greater tendency to repeat their non-occupational visit record.

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[51]Barker, p. 40.

[52]Ibid., p. 30.

[53]Blackett, p. 33.

[54]Stone, p. 31.

IV. RELATIONSHIP BETWEEN NON-OCCUPATIONAL AND INJURY VISITS

Since the results of correlations revealed that both the injury data and the non-occupational data were relatively stable over the six-year period, investigations were made to determine their interrelationship.

The sample was divided into a quartile distribution based upon the individuals' total six-year frequency of non-occupational visits. For each quartile of non-occupational visits, the mean injury visits were computed for the total six-year period. The results (Table VI) indicated a significant positive relationship between injury and non-injury data. The mean injury visits (within quartile) for quartiles 1 to 4 were 3.21, 6.45, 10.74, and 14.85, increasing consistently from Q_1 to Q_4 by a magnitude of ~ 4.60. Therefore, as the frequency of non-occuational visits increased, the injury visits increased systematically.

To assess the degree of the interrelationship between injury and non-injury visitations, simple correlation coefficients were obtained between the second three years of injury data vs. first three years of injury data ($r = .46$), the second three years of injury data vs. first three years of non-occupational data ($r = .29$), and the first three years of injury data vs. first three years of non-occupational data ($r = .40$). Also a correlation coefficient of .56 was obtained between injury data and non-occupational data for

the six-year period. These coefficients were all significant at better than the five per cent level.

These findings supported those of Barker[55] who obtained coefficients of .45 (injury visits, year two vs. non-occupational visits, year one), .42 (injury visits, year one vs. non-occupational visits, two-years), and .51 (injury visits, two years vs. non-occupational visits, two years).

The magnitude of the correlation coefficients in this study indicated a strong positive relationship between non-occupational visits and injury visits and suggests that individuals who have higher non-occupational visit records tend also to have higher injury records.

V. TESTING OF HYPOTHESIS OF STUDY

The hypothesis of this study was that the tendency to report injuries has no significant effect on the systematic variance in reported injuries between two successive three-year periods. To test the hypothesis, the technique of multiple correlation was utilized to determine the proportion of variance in injury data contributed by non-occupational visit variance.

The standard partial regression coefficients (Betas) for the first three years of injury data and the first three years of non-occupational data were found to be .41 and .13, respectively, which were significant at the .002 level of confidence.

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[55] Barker, p. 35.

The coefficient of multiple determination (R^2) between second three years injury data as dependent variable and first three years injury data plus first three years of non-occupational data (independent variables) was found to be .2277. In other words, the independent variables were responsible for about 23 per cent of the variance in the second three years of injury data.

It was found that 19 per cent of the variance in the second three years of injury data was accounted for by the first three years of injury data when the variance in common with non-occupational visit variance was ignored. Too, non-occupational visit variance accounted for 4 per cent of the variance in the second three years of injury data when its common variance with the first three years of injury data was ignored. In other words, about 17 per cent of the variance accounted for was due to the tendency to report.

Using an alternate formula for multiple correlation (p. 28) the unique variance contributed to the dependent variable by the independent variables was determined. Also, the variance contributed by the interaction of the two independent variables was determined.

Using this approach, it was found that the total first three years of injury data accounted for 16.8 per cent of the variance in the second three years of injury data, and that the effect of the tendency to report accounted for 1.7 per cent of the variance in the second three years of injury data. Too, the interaction of the independent variables accounted for 4.3 per cent of the variance in the second three years of injury data.

Barker[56] reported similar results: that second-year injuries accounted for 5.6 per cent of the variance in first-year injuries, that the effect of the tendency to report accounted for 9.7 per cent of the variance in first-year injuries, and that the interaction of the independent variables accounted for 6.8 per cent of the variance in first-year injuries.

Blackett[57] found similar results with first-year injuries contributing 16.9 per cent and non-occupational visits contributing 5.6 per cent of variance accounted for in second-year injuries.

Although in this study, the tendency to report accounted for a lesser amount (than injury data) of the variance in the second three years of injury data, the null hypothesis that the tendency to report injuries had no significant effect on the systematic variance in reported minor injuries in a six-year exposure period was rejected due to the significant effect of non-occupational visits on injury data in the regression equation (Betas were significant at the .002 level).

As regards this sample, the following factors may have affected the tendency of individuals to report:

1. The proximity of the dispensary to employees which could encourage some employees to conveniently report when others (farther removed from the dispensary) with similar problems would not.

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[56] Barker, p. 45.

[57] Blackett, p. 60.

2. The philosophy of supervision (autocratic vs. permissive) from one group to another may have much the same effect as in (1) if some individuals are more prone than others to withdraw from the working environment due to personal factors.

3. The practice of supervisors in handling minor injuries may systematically vary from one group to another. For example, some supervisors may insist that employees report to the dispensary for treatment of a scratch or cut; other supervisors may treat the minor injury without it being reported.

VI. CORRELATION OF INJURY VISITS BY QUARTILE DISTRIBUTION OF NON-OCCUPATIONAL VISITS

To further investigate the relationship between non-occupational visits and injury visits for the six-year period, intra-quartile correlation coefficients for injury data were obtained for each quartile distribution of non-occupational visits for six-years. Since the basic hypothesis of the study was rejected, it should follow that the magnitude of the coefficients should increase consistently from quartile 1 to quartile 4. The intra-quartile correlation coefficients for injury data were found to be .48, .65, .70, and .77 for quartiles 1 through 4 which supports rejection of the null hypothesis of this study.

Barker's[58] coefficients for quartiles 1 through 4 were .36, .43, .14, and .21, respectively. In another study, Stone[59] reported coefficients of .47, .64, -.19, and .09 for quartiles 1 through 4,

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[58]Barker, p. 38.

[59]Stone, p. 67.

respectively. These results are the converse of those obtained in this study and suggest the following:[60]

1. Employees with a low tendency to report (quartiles 1 and 2) evidence a significant tendency to repeat their injury visits.

2. Employees with a high tendency to report (quartiles 3 and 4) did not tend to repeat their injury records.

Blackett[61] reported intra-quartile correlation coefficients of .06, .20, .58, and .55, respectively, for quartiles 1 through 4.

The results of the present analysis support Blackett's findings and suggest these conclusions:

1. Employees with a high tendency to report (quartiles 3 and 4) demonstrated a significant tendency to repeat their injury records as evidenced by the intra-quartile correlation coefficients of .70 and .77. Thus, the injury data for these individuals is highly reliable. Employees in these quartiles evidenced more accident-proneness as a group tendency.

2. Employees with a low tendency to report (quartiles 1 and 2) demonstrated a lesser tendency to repeat their injury records than employees in quartiles 3 and 4 as evidenced by the intra-quartile correlation coefficients for injury data of .48 and .65.

This study did not reveal any systematic causes of Barker's low intra-quartile correlation coefficients for injury data in the upper two quartiles of the distribution of non-occupational visits. However, an attempt was made to determine the effect of the length of the reporting period on the magnitude of the intra-quartile correlation coefficients. Total injury data for each individual for 1954 were correlated with total

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[60] Stone, p. 68.

[61] Blackett, p. 33.

injury data for each individual for each successive year from 1955 through 1959 (Table VIII). Too, correlation coefficients were computed for every possible successive two-year interval during the six-year period (Table IX).

The results show that the intra-quartile coefficients for both sets of calculations reveal no consistent pattern. In most cases, the correlation coefficients were of higher magnitude when adjacent intervals were investigated (1954 vs. 1955, rather than 1954 vs. 1956, etc.).

Intra quartile correlation coefficients of an increasing magnitude (by quartile) were obtained only for 1954-1955.

The effect of the length of the reporting period on intra-quartile correlation coefficients was further investigated by sub-dividing the six-year period into three four-year intervals (Table X). The results indicated that the coefficients followed no consistent pattern except that they were generally of higher magnitude than those obtained for the two-year intervals.

In view of the systematic pattern of the intra-quartile coefficients for the six-year period and the inconsistent findings for the two-year and four-year sub-periods, it appeared that the length of the reporting period may have a significant effect on the distribution of non-injury and injury data.

Discussions with staff members of the Health Division of this Laboratory revealed that individuals report to the dispensary in a cyclic manner, and the length of the cycle varies among individuals.

Also, it was indicated that in periods when an individual is reporting frequently for nonoccupational purposes, there is more reluctance to report injuries, and the converse is true. As a result, a two-year period of time may not be sufficient for the number of individuals' dispensary visits to approach normality.

CHAPTER VI

SUMMARY AND CONCLUSIONS

I. SUMMARY

The purpose of this study was to investigate the effects of a tendency to report minor injuries on the systematic variance in reported minor injuries in a six-year period of exposure. It was designed to follow-up a similar study by Barker[64] covering a two-year period (1952-1953).

This study covered the period from 1954 through 1959 and included nine skilled craft groups consisting of 245 journeymen who were continuously employed during this period. These 245 employees were included in the previous study by Barker.[65]

The data for this study were obtained from the medical records of employees which were provided by the Health Division of the Oak Ridge National Laboratory which is operated for the Atomic Energy Commission by the Nuclear Division of Union Carbide Corporation.

For each of the 245 employees in the sample, the numbers of non-occupational first visits and injury first visits to the dispensary were obtained for each year of the six-year period.

The correlation coefficients for the injury data and non-occupational data for the six-year exposure period (odd vs. even years)

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[64]Barker, pp. 1-55.

[65]*Ibid.*

were found to be .78 and .87. Both coefficients were significant at the .001 level.

The coefficient of correlation between non-occupational visits and injury visits for the six-year exposure period was .56. The technique of multiple correlation was used to determine the effect of the tendency to report injuries. It was found that the variance contributed by the tendency to report (as measured by non-occupational visits) contributed significantly to the variance in reported injuries. As a result, the null hypothesis was rejected.

To further investigate the relationship between non-occupational and injury visits, non-occupational visits were arranged in a quartile distribution and intra-quartile correlation coefficients for the injury data were computed (odd vs. even years) for the six-year exposure period. Correlation coefficients of .48, .65, .70 and .77 were obtained for quartiles one through four, respectively.

II. CONCLUSIONS

The results of this investigation suggest the following conclusions:

1. As evidenced by the high split half correlation coefficients obtained the injury visits and non-occupational visits were relatively stable during the six-year exposure period.

2. There was a significant positive relationship between non-occupational and injury visits during the period of study ($r = .56$). Further evidence of this association was the systematic increase in intra-quartile mean injury visits with an increase in non-occupational visits (tendency to report).

3. The systematic variance in minor injuries included the effects of a tendency to report injuries; therefore, reported injuries are not completely representative of actual injuries.

4. Employees with a high tendency to report (quartiles 3 and 4) demonstrated a significant tendency to repeat their respective injury records. Employees with a low tendency to report (quartiles 1 and 2) demonstrated a lesser tendency to repeat their injury records.

5. The findings of this study closely followed and supported the results of Barker's study with the exception of 4 above. The results were similar in all respects to those obtained by Blackett.[66]

6. This study failed to reveal the exact causes of Barker's low intra-quartile correlation coefficients in the upper two quartiles; however, there was evidence that a two-year period may not be sufficient for the number of individuals' dispensary visits to approach normality.

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[66]Whitlock, Barker, Blackett, and Stone, pp. 164-167.

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