Environmental factors contributing to Parkinsons disease in rural Montana
by Janis Mae Majerus

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Nursing
Montana State University

Abstract:
Parkinson's disease is a neurodegenerative disorder that reduces muscular control. There are many theories about the cause of Parkinson's disease, but at this time the cause or causes remain unknown. An exploratory, descriptive study design was used to explore the history of Parkinson's clients and to enrich health care professionals' understanding and awareness of the importance of environmental factors associated with Parkinson's disease.

Martha Rogers' conceptual model was used to help guide the study. The aim of this study was to explore the relationship of exposure to herbicides/pesticides, rural living and consumption of well water to the onset of Parkinson's disease. The study was conducted during a two-month period in 1992.

Study participants included 70 Parkinson's disease clients. Participants were accessed through the Montana Chapter of the American Parkinson Disease Association located in Great Falls, Montana. In addition to demographic questions, data were obtained by utilization of the "Parkinson's Disease Tool" adapted with permission from Dr. Wm. Koller. Demographics and the Parkinson's Disease Tool were descriptively analyzed for the entire sample.

Findings from the study revealed the majority of the sample had Parkinson's disease 25 years or more and had worked or lived on farmland. In the study over half of the participants had been exposed to herbicides/pesticides and had not worn protective equipment of any kind when mixing or applying herbicides/pesticides. Well water consumption was found difficult to measure, specifically the number of years the participant had ingested well water.

Implications of this study pertain to the need for nurses to include the environmental dimension in the individual's assessment. The client's use of herbicides/pesticides and/or chemicals in general should be evaluated. Use of protective equipment should be discussed and reinforced. Further research is needed to examine the magnitude and nature of environmental factors that may contribute to Parkinson's disease.

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by

Janis Mae Majerus

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Janis Mae Majerus

This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Signature Janis Mae Majerus

Date November 29, 1994

This work is dedicated to my parents, Francis and Lorna Majerus, and to my sons, Matthew and Michael.

VITA

Janis Mae Majerus, the daughter of Francis and Lorna Majerus, was born February 22, 1954, in Great Falls, Montana. She received her secondary education from Charles M. Russell High School, Great Falls, Montana. She graduated from Montana Sate University's College of Nursing with a Bachelor of Science in Nursing in 1976.

Janis is a single parent and has two children, Matthew Lee and Michael Scott. At the time of this printing their ages are thirteen and fifteen respectively.

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ABSTRACT

Parkinson's disease is a neurodegenerative disorder that reduces muscular control. There are many theories about the cause of Parkinson's disease, but at this time the cause or causes remain unknown. An exploratory, descriptive study design was used to explore the history of Parkinson's clients and to enrich health care professionals' understanding and awareness of the importance of environmental factors associated with Parkinson's disease.

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CHAPTER 1

INTRODUCTION

The environmental awareness of the 80's and the identification of harmful chemicals has brought a renewed interest in the cause of Parkinson's disease. Although the cause of Parkinson's disease is yet unknown (Tanner & Langston, 1990), most of the breakthroughs have been in the last 20 years (Duvoisin, 1991). Parkinson's disease is a disorder of the nervous system that reduces muscular control. The onset is so insidious that often it is many years before the individual is diagnosed with the disease. Although the disorder can cripple its victims, it is rarely a direct cause of death.

Purpose

The purpose of this descriptive study was to explore the use of identified pesticides, consumption of water from a well source, and rural living with Parkinson's disease. Exploring the history of Parkinson's patients will enrich the understanding of and may contribute to the delineation of the relationship between the environment and Parkinson's disease. The elements of the conceptual model for this study are derived from Martha Rogers' representation of

person-environment. Rogers identified human beings and their environments as the central focus of her conceptual system.

Relevance to Nursing

"Nurses constitute the largest group of health professionals in the workplace" according to U.S. Congress, Office of Technical Assistance Report (cited in Butterfield, 1992). By virtue of the rural nurse's capacity for initial contact with rural residents, previous environmental relationships and exposures may be explored firsthand. Nurses need to utilize the opportunity to become investigators and environmental advocates through the use of preventive health teaching. By modifying and teaching agricultural workers awareness of potential risks involved in the use of pesticides, nurses will impact rural dwellers and their working habits. This preventive education will reduce personal risk and protect the person working in the rural environment. Rural nurses find themselves continually dealing with the rural farmer and rancher's sense of invincibility regarding their life style as stewards of the land. Rural nurses functioning in agricultural disease prevention illustrate Rogers' symphonic interaction with the environment. By working in close harmony with the county extension service and weed control departments, rural nurses can raise the level of

awareness regarding pesticide use and risks. This illustrates a modification environment which could prevent disease within the human-environment field. The identification of relationships between person and environment provides for an ordering of knowledge and for the development of nursing's hypothetical generalizations and unifying principles.

Statement of the Problem

The impact of environmental factors on Parkinson's disease in Montana is not known. Factors associated with occurrence of Parkinson's disease in analytic and descriptive epidemiology studies include rural habitation, farming and the consumption of well water from a private well (Barbeau, Roy, Bernier, Campanella & Paris, 1987; Granieri, Carreras, Casetta, Govoni, Tola, Paolino, Monetti, & Bastiani, 1991; Ho, Woo, & Lee, 1989; Koller, Langston, Hubble, Irwin, Zack, Golbe, Forno, Ellenberg, Kurland, Ruttenber, Spencer, Tanner, Tetrud, Wilcox, Roman, Mayeux, Smith, & Goetz, 1990; Rajput, Stern, Christ, & Laverty, 1984; Rajput, Utti, Stern, & Laverty, 1986; Tanner, Chen, & Wang, 1989) (cited in Hubble, Cao, Hassanein, Neuberger, & Koller, 1993) and exposure to pesticide products (Golbe, Farrell, & Davis, 1990; Semchuk, Love, & Lee, 1992). General categories of pesticides or specific agents are being researched (Coye, Lowe, & Maddy,

1986). Various researchers, for example, Semchuk, Love, & Lee (1992), propose that if Parkinson's disease is caused by an environmental herbicide/pesticide, continuous exposure to the chemicals may be associated with an increased risk of Parkinson's disease.

Conceptual-Theoretical Framework

A paradigm shift is taking place in regard to health and disease. The majority of conceptual models in the nursing literature have been based on a view of the patient as a person in good or bad health and needing more or less help from nursing to regain a state of health or well-being. Rogers' (1986) view represented a turning point in the conceptualization of person-environment interaction. Rogers' (1980) model represents an absence of boundaries between person and environment and the emphasis is on "mutual simultaneous interaction of person-environment." The old paradigm was focused on the identification of problems and the development of strategies to solve the illustrated problem. The new paradigm illustrated by Rogers' model is relational. Rogers is not trying to change a person's being but to recognize it and relate to it in an actual way.

Definition of Terms

Demographic Data: Include sex, age, occupation, prior history of medical problems, and residence of the family when the patient was born.

Energy Field: Made up of the human being and environment. A field is open to interaction with other fields and is characterized by pattern and organization.

Environment: Riehl and Roy (1980) describe Rogers' environment as a continuous and mutual exchange of matter and energy.

Farm: Refers to land cultivated for the purpose of agricultural production (Pederson, 1985).

History of Disease: Rogers (1980) identifies disease as a disruption in the interaction between the human being and their environment.

Pattern: Description of a predictable relationship between the human being and the environment. Rogers (1980) describes this as a helicy, and lacking boundaries.

Ranch: An extensive farm on which herds of cattle, sheep, horses, and other agricultural animals are raised (Pederson, 1985).

Risk Factors: Any influence that could result in a possibility of loss, injury, disadvantage or destruction, dangerous element or factor; to expose to hazard or danger (Webster, 1981).

Rural Environment: A city or town under 49,999 population with homes located more than 31 minutes, but less than 59 minutes from a hospital of more than 100 beds (Lee, 1989).

Urban Environment: A city of 50,000 or more population with homes located less than 30 minutes from a hospital of more than 100 beds (Lee, 1989).

Limitations

A convenience sample was used in this study and may not have been an accurate representation of the population of north central Montana. The sample size was limited to the north central area of Montana. Use of a mailed questionnaire does not allow researchers to collect data on the environmental risks of those people who did not respond to the questionnaire. Personal interviews can provide more data than questionnaires and would have let the researcher know more about the topics questioned. The nature of a level one study using a select sample makes it difficult to generalize to the universal population. When using questionnaires, the accuracy of respondents' recall tends to weaken the information gained.

CHAPTER 2

LITERATURE REVIEW

In 1817, James Parkinson gave the first full clinical description of the disease which bears his name (Parkinson, 1955). Parkinson's disease is characterized by progressive rigidity of the limbs, trunk, and face, and by a regular 4 to 6 per second tremor present in repose and diminishing with increasing movement. Associated with the rigidity and tremor are stooping posture, autonomic dysfunctions, a paucity of semiautomatic spontaneous movements, and difficulty initiating voluntary movements termed akinesia (England & Schwab, 1961). The disease appears to be associated with catecholamine (dopamine) depletion. It occurs in middle life, around ages 40 to 60, and males are affected more than females (Stern & Lees, 1983).

There are many theories about the cause of Parkinson's disease, including viral encephalitis, which damages the extrapyramidal nervous system (Duvoisin, 1991). Many such cases of Parkinson's disease occurred during a worldwide epidemic between 1918 and 1932. However, there is no evidence to confirm that Parkinson's disease is related to an infectious process (Koller et al., 1990).

The cause of Parkinson's disease is unknown although recent evidence suggests that the interaction between age and certain environmental factors may underlie the pathogenesis of Parkinson's disease (Dulaney et al., 1990). Ward's work (cited in Vieregge, Schiffke, Friedrich, Muller, & Ludin, 1992) "gave a low concordance rate in monozygotic twins and thus could not establish a major genetic contribution to the etiology" (p. 1453). Parkinson's disease involves degeneration of the basal ganglia, particularly the substantia nigra and corpus striatum, and is associated with deficiency of dopamine, a neurotransmitter required for control of posture, support, and voluntary motion.

Researchers have identified that a neurotoxin may be a factor in development of Parkinson's disease. A number of drug addicts in northern California, mostly young adults, inadvertently injected themselves with a drug contaminated with 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) and developed full-blown symptoms of Parkinson's disease within days. The discovery of MPTP suggests that a similar neurotoxin may cause Parkinson's disease (Koller et al., 1991). In the early 1980's, MPTP was discovered to cause Parkinson's symptoms by destroying dopamine-producing cells in the substantia nigra. Since then, scientists have uncovered numerous compounds, both natural and man-made, which have a chemical structure

similar to MPTP (Ballard, Tetrud, & Langston, 1985). These include specific pesticides and agricultural herbicides which have a chemical similarity to MPTP and may enter through ground water, resulting in the presence of toxins in rural well water (Langston & Ballard, 1984; Mesaros, 1990). Studies have implicated these compounds as the cause of Parkinson's disease and/or Parkinson-like symptoms in certain individuals (Langston, 1990; Rajput, Uitti, Stern, & Laverty, 1986; Semchuk, Love, & Lee, 1992). Previous studies have implicated rural living, well water use, proximity to industrial chemicals, and exposure to pesticides as risk factors for developing Parkinson disease (Tanner & Langston, 1990). Drinking well water in childhood and early adulthood increased the risk of Parkinson's disease when well water was evaluated as a single variable (Koller et al., 1990). "It is possible that ingesting of a neurotoxin through drinking water may be related to the development of Parkinson's disease. . . . Many agricultural chemicals are leached from soil into ground water, where concentrations may build since there is relatively little turnover of ground water" (Koller et al., 1990, p. 1220).

The disease affects 100 to 150 persons in every 100,000 (Hamilton, 1988). Carlsson and Winblad, in 1976, and McGreer, McGreer, and Suzuki, in 1977, (cited in Koller et al., 1990) found "age-related loss of the nigrostriatal

dopamine system occurs, but is insufficient to cause parkinsonism" (p. 1218). The disease has been identified as having a distinct geographic pattern, specifically in the northern tier of states (roughly above 37 degrees north latitude). Those in the north contract the disease at a higher rate than those living in the southern part of the United States (Lux & Kurtzke, 1987). Researchers report that they can furnish a list of environmental toxins that people could avoid and substantially reduce, perhaps eliminate, their chances of developing Parkinson's disease (Campanella, Roy, & Masson, 1988). Over the past five years, scientists have noted a connection between rural living, the drinking of well water, pesticide exposure, and possibly farming as increasing the risk factors for developing Parkinson's disease (Koller et al., 1990). The U.S. Congress, Office of Technology Assessment (cited in Butterfield, 1992) summarized the situation:

> In recent years, concern about the neurotoxic effects of chemicals has increased as evidence has become available linking exposure to chemicals and drugs with long-term changes in the nervous system . . . . More than 65,000 chemicals are in the U.S. Environmental Protection Agency's inventory of toxic chemicals; and the agency annually receives approximately 1,500 notices of intent to manufacture new substances . . . . The number of substances that pose a significant risk to public health and the extent of that risk are unknown because the potential neurotoxicity of only a small number of chemicals have been adequately evaluated. (pp. 3-4)

The search for an environmental cause for Parkinson's disease is greatly complicated because of the possibility that a variety of risk factors are at play and that no single factor by itself is sufficient to cause the disease. Other risk factors such as alcohol, head trauma, and diet have been identified. The toxin is never present in quantities sufficient to cause acute toxicity syndrome (Rajput et al., 1987).

A recent study done by Butterfield, Valanis, Spencer, Lindeman, and Nutt used a multivariate approach and examined the relationships between Parkinson's disease and water source, rural residency, pesticide exposure, and participation in farming. This study "found a significant relationship between certain types of pesticide exposures and Parkinson's disease" (Butterfield et al., 1993, p. 1154). A study in Montana has not been done (to date) examining exposure to environmental factors, well water use, and herbicide/pesticides by individuals with Parkinson's disease. This study will contribute to the body of data that has been collected from Canada and the United States.

Conceptual Framework

Environmental factors influencing Parkinson's disease illustrates a conflict with Rogers' promotion of symphonic interaction between person and environment (Rogers, 1986).

Symphonic interaction is meant to strengthen the coherence and integrity of the human field, and to direct and redirect patterning of the human and environmental fields for realization of maximum health potential. In the case of Parkinson's disease, it is hypothesized that there is an interruption between person and environment by risk factors such as pesticide use.

Rogers explains that each environmental field is specific and unique to its given human field. The human field is theorized to have its boundary continuous with the boundary of the environment. The environment is, itself, an energy field electrical in nature. Both change continuously, mutually, and creatively. Rogers proposed two general principle qualities of the human field: (1) the principle of helicy and (2) the principle of resonancy (Rogers, 1980).

Principle of Helicy

Helicy claims that field changes are innovative, probabilistic, acausal, patterned, qualitative, and characterized by increasing diversity of field patterns. This study explores person and the environment in relation to the history of Parkinson's disease. The principle of helicy states that the development of diseases such as Parkinson's are facilitated by interaction with the environment, and in turn the human who develops a disease

such as Parkinson's alters and impacts their environment. These field factors are characterized by increasing diversity of human field and environmental field pattern and the result of Parkinson's disease simultaneously interacting between the human and environmental fields. This research focused on a study of the relationship between pesticide and well water use as an interaction between human and environmental fields.

Principle of Resonancy

The principle of resonancy proposes that change in pattern and organization of the human field and the environmental field is communicated by waves (Rogers, 1980). When a disease process, such as Parkinson's, enters a human being's life, a multiplicity of waves surround the human being, creating a resonance of change from a state of health to disease. An example of Rogers' view of disease is evident when a Parkinson's patient can process information but their mind does not receive the appropriate data because of the unbalanced dopamine function of the brain. The nature of the wave pattern changes continuously from low frequency to higher frequency patterns. This change in the human being's health relates to the resonance of change as a continuously propagating series of waves between person and environment (Rogers, 1980). Parkinson's disease represents an invariance of environmental waves and

reflects a change in a human being's health status. Parkinson's disease reduces and distorts the person's sensory ability of movement within their environment.

The study methodology is designed to facilitate a search for potential environmental pesticides that would possibly contribute to Parkinson disease. Rogers' theoretical model was chosen to complement the structure of research in order to maintain perspective of the perception of human being predominantly subjected to multiple negative waves (pesticide influences) with pathological outcomes (Parkinson's disease).

Implicit in Rogers' view of human being is the responsibility of the nurse to value with compassion each person's individuality. Researching the possible influencing factors of Parkinson's disease and the frustration of the human being not being in tune with their environment supports Rogers' theory of interchange between person and their environment. For the purpose of this project the central concept is person in his/her entirety. In other words, human behavior reflects the merging of physical, biological, psychological, social, cultural, and spiritual attributes into an indivisible whole; a whole in which the parts are not distinguishable (Rogers, 1980). Nursing seeks to care for human beings in accordance with its science that is emergent and based on research and logical analysis of the principles of homeodynamics.

Nursing science seeks to describe, explain, and predict so that nursing's goal of maximization of health potential is achieved consistent with its ever-changing nature. Nursing then has as its goal maximum health potential for the unitary person, achievable by artfully applying emerging science based on the principles of homeodynamics.

CHAPTER 3

METHODOLOGY

The research design used in this study was descriptive and exploratory. Descriptive designs are created in order to make accurate statements about the characteristics of individuals, situations, or groups (Castles, 1987). Exploratory designs are created in order to become familiar with the variables of interest and to gain insight into their relationships (Castles, 1987). The survey method was selected to elicit information from a subset of a population about environmental factors within the Parkinson's population. This particular design was chosen due to the ease of distribution and administration to a broad geographic area, north central Montana; data were collected using a mailed survey.

The questionnaire was printed as a booklet, questions were not printed on the cover pages and the size was reduced to half pages of 8½" x 11" paper (see Appendix A). The booklet was reproduced on white paper. These recommendations resulted in a questionnaire that was pleasing to the eye and readable to most people. The paper was folded in the middle and stapled to form a booklet that fit in a standard Monarch-size or business reply envelope.

The questionnaire that is mailed to potential respondents must speak for itself (Woods & Catanzaro, 1988). In this case the investigator was not present to answer questions, allay anxiety, or clarify items; therefore, clear directions were necessary. Use of the mailed questionnaire had several advantages. It was less time consuming and more cost effective than a personal or telephone interview in a state as vast as Montana. Participants were able to remain anonymous and therefore may have been more willing to answer personal questions about their Parkinson's disease if they felt they could not be identified.

The descriptive, exploratory survey research method also has its limitations. The questionnaire was unable to explore Parkinson's disease issues in great depth without becoming too lengthy. Respondents could omit or disregard any item they chose without giving an explanation. The amount of information gathered by the questionnaire was limited to those who were literate, but the respondents were given the choice of having someone else help complete the questionnaire for them. The participants who did return the questionnaire may not have provided a representative sample of the target population. Since the mailed questionnaire required self-administration, care was taken to make instructions and questions as clear and unambiguous as possible.

Pilot Testing

The questionnaire was subjected to pilot testing with a small sample of persons (n= 10). Pilot activities were designed to gather subject feedback on the clarity and comprehensiveness of the questionnaire and to obtain an estimate of questionnaire completion time. The pilot testing was conducted in two stages, first with health care professionals (n=4) followed by Parkinson clients (n=6) residing in Great Falls, Montana. The health care professionals were chosen to establish validity of the questionnaire. The Parkinson clients were selected to determine the length of time required to complete the questionnaire and to ascertain and clarify unclear directions, items, and print size. Pilot testing focused on garnering professionals' and clients' overall impressions of the questionnaire and difficulties encountered with any particular items. Results from the pilot test revealed unclear wording of three questions. Seven of the pilot testing participants said the questionnaire was clear and easy to read. The participants reported that it took an average of thirty (30) minutes to complete the questionnaire. The recommendations were implemented and the questionnaire was changed according to the pilot study suggestions.

Population and Sample

Target Population

The target population for this investigation consisted of north central Montana residents who had been diagnosed with Parkinson's disease and were members of the Montana Parkinson Association. Through contact with the Montana Parkinson Association, a convenience sample of study participants was obtained via the American Parkinson Association (Appendix B). The accessible population for this investigation were members of the Montana Parkinson Association (Appendix C).

Sample

The sample was purposive, random, and convenient. This type of sample was suitable for the purpose of establishing a beginning-level descriptive data base about environmental factors influencing Parkinson's disease. A random sample was selected from recipients of the Montana Parkinson Association newsletter. Because the sample list included others besides individuals diagnosed with Parkinson's disease, the list was carefully sorted by the executive director of the Montana Parkinson Association. The executive director eliminated educators and others not diagnosed with Parkinson's disease. The number of people receiving this newsletter was approximately 700. A random sample of 200 was chosen after the list was purged of

educators. The use of random sampling procedures is the optimal way to ensure that the sample is indeed representative of the underlying population (Woods & Catanzaro, 1988). No discrimination was made on the basis of age, race, occupation, education, or family income. Subjects for this study were 40 males and 30 females. The 70 subjects who responded represented a 35% response rate. The average age of those responding was 73 years. Eighty-four percent of the subjects were born in Montana. A majority of the respondents, 68%, lived in rural and frontier Montana.

Location of Study

The study was conducted in the north central Montana region, the farthest north being a participant from Cut Bank and the closest being a resident of Great Falls. Montana is the fourth largest state. This north central geographic area covers over 1000 square miles and primarily includes agriculture, manufacturing, and mining based industry.

Data Collection Procedure

The Montana Parkinson Association was contacted to obtain a random sample of study participants. An introductory letter (Appendix D) was sent via the Montana Parkinson Association monthly newsletter indicating the

association's endorsement of the study and encouraging participation in the survey. The newsletter issue was received by Montana Parkinson Association potential study participants 2 to 3 days prior to the mailing of the questionnaire. A cover letter provided information about the study including the purpose, risks and benefits, and an assurance of anonymity was mailed with the questionnaire to study participants (Appendix D). Questionnaires were mailed to 200 of 700 members on the mailing list. The questionnaire was completed by the participant in an environment of his/her choosing and returned within 2 weeks of receipt. A follow-up reminder postcard was sent one week after the mailing of the questionnaires. Those incapable of completing the questionnaire were encouraged to have a friend or family member help them. Participants were instructed to rest as much as needed during completion of the questionnaire. The questionnaire took approximately 30 minutes to complete. A follow-up notice was included in the August issue of the Montana Parkinson Association newsletter, reminding participants to return the questionnaire. Upon completion, the respondent returned the questionnaire in the stamped, addressed envelope provided. Questionnaires were distributed from June 5, 1992 to August 5, 1992. A two-month cut-off date was established for return questionnaires. A thank you letter was written by the researcher and published in the Montana

Parkinson Association newsletter two weeks after completion of the data collection.

Human Subjects Protection

Three key ethical principles of protecting human rights in scientific research are informed consent, freedom from harm, and confidentiality (Polit & Hungler, 1987). This study was reviewed and approved in writing by the Montana State University College of Nursing Human Subjects Review Committee (Appendix E). Participants were informed by a written explanation of the study which accompanied the questionnaire (Appendix F). Participation in this study was voluntary and without monetary compensation. Participants' responses were kept anonymous by asking participants not to write their names anywhere on the questionnaires. Questionnaires were not coded prior to mailing. The potential participants were informed that the study held no direct benefits for them, but the information obtained would be used to gain further understanding of the factors that influence the onset of Parkinson's disease. Participation in the study did not represent a risk, but it may have been an inconvenience because of the time needed to answer the questions. Data obtained from the questionnaire were reported as group data and did not identify the participants personally in any way. The data were kept in a locked cabinet and only the

investigator and members of the thesis committee had access to the data. The questionnaires did not include the participants' names, only identification numbers which were used to track the participants. Only the investigator had access to the list that linked the participants' names with their identification numbers. The list was destroyed following data collection. Written consent was not obtained; consent was implied by return of the completed questionnaire.

Instrument

The questionnaire included 20 background questions created by the investigator and a modified version of the Parkinson's Disease Study Instrument (Koller, 1988). This questionnaire was used to collect data measuring the environmental factors influencing Parkinson's disease and contained questions concerning pesticide use and water source. It was developed for use in a study by William C. Koller, M.D., Ph.D., Professor and Chairman of the Department of Neurology, University of Kansas Medical Center, titled "Environmental Risk Factors in Parkinson's Disease." Written permission was obtained from Koller to utilize his instrument (Appendix G). Reliability and validity were not available for this specific instrument at the time of this study. Rural living and drinking well water were significant variables in the Parkinson's

patients in Koller's study. Koller's study also identified that drinking well water was dependent on rural living and that there were no significant differences between cases and controls for farming or any measure of exposure to herbicides or pesticides. Koller and associates' data contribute to evidence that an environmental toxin could be involved in the etiology of Parkinson's disease. This instrument was the only one known at the time of this research that addressed rurality in relation to Parkinson's disease. Background questions were added that addressed basic demographics including date of birth, age, gender, month and year Parkinson's disease was diagnosed, and initial Parkinson's symptoms (Appendix A).

Data Analysis

Data were coded and entered into the computer by Montana State University College of Nursing Office of Applied Research Service. Each question was individually coded for analysis depending on the item. The Parkinson's symptoms were coded numerically. The individual responses to the open-ended questions were coded when encountered with each returned questionnaire. Descriptive statistics were used to describe the demographic characteristics of the participants in the study. The independent variables of well water and pesticide use were examined for

association with the dependent variable, onset of Parkinson's disease.

CHAPTER 4

RESULTS

Data collection began in mid-1992 and was finalized in November of 1993. During the data collection period, one additional data collection site was added in order to increase the potential sample size. Of the 200 questionnaires distributed, 76 questionnaires were returned for a response rate of 38%. Four questionnaires were not used in the data analysis because the questionnaires were not completed. Two questionnaires were returned as undeliverable. The study sample consisted of 70 respondents.

Description of Sample

The average age of those responding was 73 years. Participants were born between 1907 and 1972. Eight respondents did not give their age. Fifty-eight percent (n=40) of the respondents were male, 42% (n=30) indicated they were female. Thirty-four of the 70 subjects were born and had lived at their place of birth for over 20 years. Eighty-four percent (n=58) of the subjects were born in Montana. When asked what other places the participant had lived the longest, rural and frontier Montana continued to

dominate the study, with 68% (n=47) of the respondents continuing to reside in Montana an additional 15 to 45 years.

Disease Characteristics of Participants

When asked when the respondent had first noticed any Parkinson's symptoms, the range of years from 1933 to 1980 was identified. This represents a range for recognition of symptoms from 13 to 60 years ago. The most frequent recall of the 70 respondents' initial symptoms were 25 years (n=4) to 30 years (n=4) ago.

Seventy-one percent (n=50) of those responding identified tremor-shakiness as their initial Parkinson's symptom. The next most frequent symptom, experienced by 62% (n=44) of the participants, was slowing of movement. Thirty-eight percent (n= 27) stated they had experienced rigidity or stiffness (see Table 1).

Table 1. Initial Symptoms of Parkinson's Disease Reported by Respondents.

Symptom Experienced	Frequency	Percentages
Tremor - shakiness	50	70.4
Slowing of movement	44	62.0
Rigidity	27	38.0

Occupations of Participants

Eighteen percent (n=13) of the respondents reported their occupation as a farmer or rancher. Other careers of participants included office manager/management, 16% (n=11); laborer, 14% (n=10); housewife, 13% (n=9); nurse, 9% (n=6); salesman, 6% (n=4); grocery clerk and produce manager, 6% (n=4); exterminators, 3% (n=2); and 8% (n=6) listed "other" in regards to occupation. Five percent (n=7) did not answer in regard to their occupation (see Table 2).

Table 2. Occupation of Respondents.

Response	Percentage	Frequency
Farmer or Rancher	18	13
Office Manager/Management	16	11
Laborer	14	10
Housewife	13	9
Nurse	9	6
Salesman	6	4
Grocery Clerk/Produce Manager	6	4
Exterminator	3	3
Other	8	5
Did not answer	7	5
Total	100	70

Exposure to Herbicides/Pesticides

Seventy percent (n=49) of the study subjects indicated they had worked or lived on farmland. Forty-nine percent (n=34) of the respondents (n=70) reported they had been

exposed to herbicides/pesticides being applied to crop-ground/pasture land. Of those exposed to herbicides/pesticides (n=34), 30% (n=10) had mixed and prepared the herbicides themselves, and 40% (n=14) had applied the herbicide/pesticides themselves. Thirty percent (n=10) of the exposed sample (n=34) indicated that someone else usually mixed and prepared the herbicides the participants used.

One respondent had been stationed in Vietnam and had served for three months in an area where herbicides had been applied. This participant did not believe he became ill from any exposure to herbicides while in the military.

When asked if any of the exposed sample had used any protective equipment when mixing or applying the herbicides/pesticides, interestingly, 62% (n=21) of the 34 persons exposed had not worn any protective equipment when mixing or applying herbicides/pesticides, 17% (n=6) had used rubber gloves, 16% (n=5) had worn protective coveralls, 5% (n=2) wore masks (see Table 3).

Table 3. Protective Equipment Used.

Type of Equipment	Frequency	Percentages
None	21	62
Rubber gloves	6	17
Coveralls	5	16
Face masks	2	5
Total	34	100

The subjects (n=70) indicated they had used numerous methods to apply herbicides/pesticides and were instructed to indicate all methods used to apply herbicides/ pesticides. The method most frequently reported as being used to apply herbicides/pesticides was tractor mounted or mist blower spray (n=21). The second most common method of applying herbicides/pesticides was spreading by hand (n=17). Forty-six percent (n=13) indicated they utilized a backpack or hand sprayer. Thirty-two percent (n=8) of respondents indicated they had participated in application of herbicides/ pesticides by airplane. Thirteen percent (n=3) applied herbicides/pesticides via 4-wheeler vehicle. Twenty-six percent (n=7) related they had applied herbicides/pesticides by pouring. Twenty-five percent (n=6) of the sample had applied herbicides/pesticides by a hose-end mixer. Other methods less frequently used for application of herbicides/ pesticides were: cyclone spreader (n=2), stump painting (n=1), and notching (n=1) (see Table 4).

Twenty-seven percent (n=8) of the sample had been exposed to herbicides/pesticides for 40 years or more, 10% (n=3) reported exposure 25 years or more, and 16% (n=5) had reported some contact with herbicide/pesticides for at least 10 years. Therefore, 53% of those who were exposed to herbicides/pesticides had reported an exposure of 10 years or more (see Table 5).

Table 4. Method of Application of Herbicides/Pesticides.

Method	Frequency	Percentages
Tractor mounted or Mist blower spray	21	67
Spread by hand	17	51
Airplane	8	32
4-wheeler vehicle	3	13
Pouring	7	26
Hose-end mixer	6	25
Cyclone spreader	2	8
Stump painting	1	4
Notching of trees	1	4

Table 5. Years Exposed to Herbicides/Pesticides.

Years	Frequency	Percentages
40 years or more	8	27
25 years or more	3	10
10 years or more	5	16
30 days per year	4	13
10 days per year	4	13
No Exposure	7	21
Total	34	100

Forty-eight percent (n=34) of the 70 participants stated they had handled and or laundered clothing exposed to herbicides/pesticides. Ninety-two percent (n=64) did not believe they had ever become ill from any exposure to herbicide/pesticides; 8% (n=5) believed they had become ill from an exposure to herbicides/pesticides. Sixty-seven percent (n=23) of the 34 respondents exposed to herbicides/pesticides indicated that the herbicide 2-4D®

was the name of the herbicide most commonly used on the crop-growing land. Other herbicides identified infrequently were Round-Up® (n=9), Banvel,II S6P® (n=1), and arsenic (n=1). When asked if the participants had ever used herbicides/pesticides at home in yard work or for other purposes not previously discussed, 68% (n=43) of the total sample (n=70) indicated that they had used weed killers or defoliants at home. Those herbicides identified were 2-4D® (n=7), Round-Up® (n=8), and Weed-Be-Gone® (n=11). The most frequently reported number of days participants used herbicide on their yards was 3 days (n=10) and the next most frequent was 10 days (n=7).

Source of Drinking Water

Identifying the source of drinking water is a current environmental research topic. The participants' source of drinking water at their place of birth was identified by three choices: city, well, and cistern water. The study indicated well water to be the source of drinking water at their birth place of 52% (n=33) of the participants. Forty percent (n=26) reported city water and 5% (n=3) indicated cistern water as their source of drinking water (see Table 6).

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