

METHYLMERCURY RISK COMMUNICATION NEEDS AMONG WOMEN OF
CHILDBEARING AGE

by

John Lance Willcut

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master

of

Nursing

MONTANA STATE UNIVERSITY
Bozeman, Montana

April 2007

© COPYRIGHT

by

Johnny Lance Willcut

2007

All Rights Reserved

APPROVAL

of a thesis submitted by

John Lance Willcut

This thesis has been read by each member of the thesis 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 Division of Graduate Education.

Sandra Kuntz, PhD, APRN BC, chair

Approved for the Department of Nursing

Elizabeth Nichols, DNS, RN, FAAN

Approved for the Division of Graduate Education

Carl A. Fox, PhD

STATEMENT OF PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the Library shall make it available to borrowers under rules of the Library.

If I have indicated my intention to copyright this thesis by including a copyright notice page, copying is allowable only for scholarly purposes, consistent with "fair use" as prescribed in the U.S. Copyright Law. Requests for permission for extended quotation from or reproduction of this thesis in whole or in parts may be granted only by the copyright holder.

Johnny Lance Willcut

April 2007

DEDICATION

First and foremost, I give all praise, honor and glory to my Heavenly Father, Lord, and Savior Jesus Christ. Through Christ all things are possible. To my beautiful wife, Brynn, for her constant love, encouragement, and hard work that has made the dream of thesis completion a reality. You inspire me, daily, to become a better person, husband, and best friend.

ACKNOWLEDGEMENTS

I would especially like to thank Sandra Kuntz, PhD, APRN BC, my committee chair, for guiding me through the thesis process with her constant encouragement and support. You have gone above and beyond the call of duty to ensure every step was complete, competent and correct. I would also like to thank my committee members, Wade Hill, PhD, APRN BC and Laura Larsson, MPH, BSN, RN for their efforts and comments to ensure the completion of this thesis. All three committee members have spent selfless time editing this paper.

I would like to thank my Mom and Dad who gave me life and have been constant pillars of strength and support throughout my educational endeavors. Thank you! To our dog, Cleveland, thank you for sticking by my side even though “bugging” me every 10 minutes, to play, while I sat to type. May I hear the jingle of your collar for years to come. Lastly, this thesis and completion of the MSN degree was completed to help secure a positive future for the children that my wife and I have had in our thoughts and prayers since our marriage 4 ½ blessed years ago.

TABLE OF CONTENTS

1. INTRODUCTION TO THE STUDY	1
Introduction.....	1
Background	3
History of Methylmercury Poisoning	3
Pathophysiological Findings	4
Rural Impact.....	5
Statement of the Problem.....	6
Purpose of the Study	6
Research Questions	7
Significance to Nursing.....	7
Organization of the Remainder of the Study	8
2. LITERATURE REVIEW	9
Introduction.....	9
Precautionary Principle	10
Risk Communication	11
Methylmercury Regulation	11
Federal Guidelines	12
Montana Guidelines	13
Risk Communication Studies.....	14
Advisory Awareness	17
Advisory Regulation	17
Advisory Awareness Studies	19
Risk Awareness.....	24
Risk and Benefits	24
Risk Awareness Studies	24
Conceptual Framework.....	26
Summary	29
3. METHODOLOGY	30
Introduction.....	30
Design	30
Sample.....	32
Instrumentation	33
Procedure	33

TABLE OF CONTENTS- CONTINUED

4. RESULTS	36
Introduction.....	36
Findings.....	37
Sample Characteristics.....	37
Fish Consumption Patterns	38
Advisory Awareness	43
Risk Awareness.....	43
Risk Communication Preferences.....	48
5. DISCUSSION	50
Summary	50
Sample Characteristics.....	51
Fish Consumption Patterns	51
Advisory Awareness	53
Risk Awareness.....	54
Risk Communication Preferences.....	55
Limitations	58
Sample Size.....	58
Pilot Study Survey	58
Recommendations.....	60
REFERENCES CITED.....	63
APPENDICES	68
APPENDIX A: Definition of Terms.....	69
APPENDIX B: Methylmercury Risk & Awareness in American Indian Women of Childbearing Age Survey	73
APPENDIX C: Question 13 Answer Key	85

LIST OF TABLES

Table	Page
1. Participant's Knowledge Regarding Mercury Contaminants in Fish	45

LIST OF FIGURES

Figure	Page
1. Jardine’s “holistic” approach to creating a successful and effective fish consumption advisory	28
2. Average Number of Meals Consumed per Month (shellfish/seafood)	39
3. Average Number of Meals Consumed per Month (fish sticks, fillets, sandwiches)	40
4. Average Number of Meals Consumed per Month (light tuna)	41
5. Average Number of Meals Consumed per Month (albacore tuna)	42
6. Participant’s Response as to Why People May Not Always Follow the Recommendations in the Fish Advisory	44
7. In General, How Much Do You Know About Mercury Contaminants in Fish?	46
8. Participant’s Ideation of Where the Highest Levels of Mercury in Fish Exists	47
9. Total Number of Participant Responses as to the Most Important Sources of Health Information	49

ABSTRACT

While the consumption of fish is an essential part of the human diet, there are certain environmental toxins that reside within the earth's watersheds. One toxin in particular, methylmercury (MeHg) has been linked to neurotoxicity and consequent neuro-developmental health effects in growing fetuses and young children, even in minute doses. MeHg is known to accumulate in fish and fish products and with their consumption by women of childbearing age (WCBA), growing fetuses and young children are possibly placed in harm's way. To help prevent these health threats from occurring, guidelines and recommendations are placed into fish advisories by governmental agencies (federal, state, and tribal) through the application of the precautionary principle.

The purpose of this study was to describe the risk communication status of the Montana fish consumption advisory in non-Native American women of childbearing age residing on an open reservation. Variables studied included fish consumption patterns, advisory awareness, risk awareness, and risk communication preferences. Secondary analysis of data compiled through a pilot study provided the cohort ($n = 10$) for this study. The majority regularly consumed fish ($n = 7$), while most denied prior knowledge of any fish advisory ($n = 9$). Half ($n = 5$) of the participants denied any knowledge about mercury contaminants in fish, while three stated they knew "only a little". This was emphasized through a series of true/false questions and with the majority ($n = 9$) having difficulty determining where the highest levels of mercury are found within a fish. A majority of the participants ($n = 7$) felt that they did not eat enough fish to worry about following the recommendations of the Montana Fish Consumption Guidelines. Important sources of health information to the cohort included: (a) doctors or other healthcare providers, (b) newsletters or brochures, (c) television, (d) magazines, (e) friends and relatives, and (f) government agencies.

The results of this descriptive, hypothesis-generating study point to the need for larger scale studies involving non-Native rural women with the recommendations to include information on fish species, portions consumed, children of WCBA, user-friendly advisory pamphlets, and mercury exposure testing through hair and blood sampling.

CHAPTER 1

INTRODUCTION

Introduction

The developing fetus and young children are considered especially vulnerable to environmental toxins. One toxin in particular, methylmercury, has been scientifically linked to adverse neurodevelopment effects, even at minute doses. Maternal consumption of contaminated fish during the prenatal period comprises the primary route of exposure to the fetus (National Resource Council [NRC], 2000). However, navigating the complex risk/benefit messages associated with fish consumption can prove challenging for the average consumer. This study will describe risk awareness, fish consumption patterns, and preferred risk communication choices among a cohort of rural women of childbearing age.

When fish is added as a portion of a consumed diet, there are lower risks of coronary artery disease, myocardial infarction, and possibly a reduction in cerebral vascular accidents (American Heart Association [AHA], 2000, 2002). The primary component found in fish is the omega-3-fatty acid, which is a cornerstone for the development of the retina, brain, and other portions of the central nervous system for a growing fetus and newborn. In addition, all fish contain high-quality protein, vitamins including niacin and B12, and minerals such as heme iron and zinc (Knuth, Connelly, Sheeshka, & Patterson, 2003). Nearly 90% of the population in the United States consume fish on a regular basis (Knobeloch, Anderson, Imm, Peters, & Smith 2005).

While keeping these essential nutritional benefits of consuming fish products in mind, it is still important to realize that the environment has become contaminated with certain by-products of industrial waste over the past several years. One contaminant, inorganic mercury, is one of these by-products and is released into the ecosystem from anthropogenic and natural sources (Carrington, Montwill, & Bolger, 2004). Coal-fired power plants account for up to fifty tons of airborne inorganic mercury emissions (Wright, 2005). Other sources of mercury arise from fossil fuel combustion, municipal solid waste and medical waste incineration, and chlorine manufacturing (Anderson, et al., 2004). This creates a two- to five-fold increase in the amount of mercury that is circulating throughout the atmosphere. Natural sources of mercury are released into the environment from volcanoes, degassing of the earth's crust, and evaporation from water (Gilbert & Grant-Webster, 1995). The mercury settles within the oceans, rivers, lakes, and streams of the ecosystem and it is within these watersheds that bacterial reactions convert the inorganic mercury into methylmercury, in a process known as methylation.

As methylmercury biomagnifies in the aquatic food chain, it accumulates in the fatty tissues and organs of fish and seafood (Office of Environmental Health Hazard Assessment [OEHHA], 2006). The two main accumulation factors include longevity and predation (Gilbert & Grant-Webster, 1995). In predatory fish, the methylmercury accumulates at a faster rate as the larger, more aggressive fish eat the smaller fish. Also, the longer a fish lives, the greater the accumulation of methylmercury within it. Predatory ocean fish known to have accumulated toxic levels of methylmercury include king mackerel, shark, swordfish, and tilefish.

Predatory freshwater fish include northern pike, walleye, largemouth bass, and lake trout.

Background

History of Methylmercury Poisoning

Both commercially acquired and sport-caught fish provide important nutritional benefits to women and children. However, the National Resource Council (NRC), the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA) have raised concerns regarding the methylmercury safe dose range for the vulnerable populations most at risk (NRC, 2000). While the actual numbers of cases of human toxicity from fish are scant, case studies of high dose effects are available in the literature. In 1956, the city of Minamata, Japan experienced an epidemic of neurological symptoms in hundreds of its people (Smith & Smith, 1975). The townspeople experienced paresthesia, ataxia, constriction of visual fields, hearing loss, mental confusion, and numerous reported deaths. The worst effects were seen in fishermen and their families.

An investigation by the Japanese government concluded that the source of contamination came from fish that were caught in Minamata Bay that were inadvertently polluted by mercury from a local factory. The neurological effects became known as Minamata Disease. Expectant mothers who had been exposed to methylmercury from the fish gave birth to babies that had profound neurological disabilities (Wright, 2005). The effects included deafness, blindness, mental retardation, and cerebral palsy. In 1965,

methylmercury poisoning occurred in similar fashion in Niigata, Japan where a chemical reaction released methylmercury into the Agano River.

During the winter of 1971-1972 in Iraq, mercury was used as a fungicide in wheat seed that was intended for planting to later make bread. The Iraqi people instead consumed the wheat prior to planting it. Adult victims experienced paresthesia, tremors, ataxia, visual problems, mental confusion, and in some cases loss of consciousness and death. In all, 6,500 people were admitted to the hospital and 459 deaths occurred. Fetuses that were exposed to the mercury in-utero sustained a higher incidence of blindness, cerebral palsy, and developmental delays (Bakir, et al., 1973). In addition to these historical epidemiological studies, there are also case studies that contribute to the evidence of mercury's potential as a poison.

In 1996, a chemistry professor at Dartmouth College accidentally spilled "a few drops" of dimethyl mercury onto one of her hands (Wright, 2005). Although she was wearing latex gloves at the time, the accumulation of mercury in her body led to mercury poisoning. Six months after coming in contact with the mercury and treatment to rid the metal from the body, the professor succumbed to mercury poisoning and died.

Pathophysiological Findings

When ingested by humans, methylmercury has the potential to eventually reach neurotoxic levels. Within a pregnant woman's body, methylmercury is readily able to enter the fetus, by way of the placenta. Due to the smaller size of the fetus, mercury levels are often found in higher amounts within the fetus than their maternal counterpart (Gilbert, Grant-Webster, 1995). Due to the cross-over to the fetus, there is a great concern

of neurotoxicity (EPA, 1997). Symptoms of methylmercury poisoning include “constriction of visual fields, behavior changes, memory loss, agitation, insomnia, headache, paresthesias of extremities, ataxia, and hearing loss” (Hayes, 2005, p.37). The fetal brain is rapidly developing and the cells are rapidly dividing making the brain a possible site of teratogenicity from the damaging effects of the methylmercury. Equally disturbing is that many of the symptoms described above are not readily assessed in infants. Davidson, Myers, and Weiss (2004) point out that “babies could be exposed to methylmercury through breast milk should their mothers consume high levels of contaminated fish and fish products” (p.1023). According to the NRC committee report “Toxicological Effects of Methylmercury” (2000) it is estimated that each year about sixty-thousand children may be born in the United States with neurological problems that could lead to poor school performance because of exposure to methylmercury in-utero.

Taking a preventive and precautionary approach, women of childbearing age are targeted as especially vulnerable as they can potentially, but unintentionally, deliver the toxic effects associated with methylmercury to their unborn child. The most vulnerable period is seen as the reproductive period in which a woman is physiologically able to conceive children. Generally, this occurs from the onset of puberty (10-14) until menopause (40-56).

Rural Impact

Rural women of childbearing age pose a distinct uniqueness as a vulnerable population. Rural women of childbearing age may live further from health care resources (distance), abstain from help by others (self-reliance), and have a lack of adequate health

care resources (availability). In addition to self-reliance, rural women are also known to possess a strong physical and mental outlook (hardiness) (Lee & Winters, 2006). Adding to this, matters of health care are “usually sought through an informal rather than a formal system” (Long & Weinert, 2006, p.120). These factors become important when designing fish consumption advisories in order to make sure the proper audiences are targeted and their needs are met.

Statement of the Problem

Maternal consumption of contaminated fish during the prenatal period comprises the primary route of methylmercury exposure to the fetus (NRC, 2000). However, navigating the complex risk/benefit messages associated with fish consumption can prove challenging for the average consumer. As the Anderson et al. (2004) study demonstrated, only 8% of the women surveyed in Montana were aware of the State’s fish consumption advisory. Montana residents registered the lowest fish advisory awareness among the 12 states studied. More information regarding current risk awareness, advisory awareness, fish consumption patterns, and preferred risk communication preferences among a cohort of rural women of childbearing age is needed in order to improve risk communication strategies.

Purpose of the Study

The purpose of this study was to describe current risk awareness, advisory awareness, fish consumption patterns, and preferred risk communication choices among

rural, non-Native American women of childbearing residing on an open reservation. On this particular reservation, the purchasing of land and homes is open to Native Americans and non-Native Americans. With the wide-spread dissemination of risks and advisories regarding methylmercury and fish consumption, the level of public risk communication and awareness needs further evaluation in this unique cohort.

Research Questions

1. What fish consumption patterns exist among the cohort?
2. Are rural non-Native women of childbearing age residing on an open reservation and participating in WIC clinic services a) aware of the Montana sport fish consumption advisory and b) aware of the risks associated with consuming fish contaminated with methylmercury?
3. What are the risk communication preferences among the cohort?

Significance to Nursing

Nurses have the direct opportunity to care for others. A holistic approach maximizes an individual's physical, psychological, emotional, and spiritual well-being. All nurses, including Advanced Practice Registered Nurses (APRN's), are at the forefront as agents of progress and change in helping others reach their own holistic well-being. "When examining the sources of environmental health risks in communities and planning intervention strategies, it is important to apply basic principles of disease prevention" (Sattler, McPhaul, Afzal, & Mood, 2004, p. 237). Primary prevention of disease is an

essential part of nursing that is concerned with health promotion and the encouragement of life-style modifications to better one's health. Effectively communicating the risks of methylmercury neurotoxicity as well as the benefits of eating fish is part of primary prevention of disease.

The health disparities and disease that can occur from methylmercury can be avoided with the proper risk communication messages delivered to the general public. Specifically, women of childbearing-age have the responsibility and opportunity to increase the chance of having delivering a baby to help ensure that the baby has a positive start to its life. Therefore, it is essential for nurses to help this vulnerable population avoid the devastating health effects from eating methylmercury contaminated fish and fish products. Simultaneously, nurses must encourage the consumption of safe fish levels for proper nutritional benefit to all women of childbearing age.

Organization of the Remainder of the Study

In the next chapter, current and relevant literature is examined to find out what is already known about risk communication, advisory awareness, risk awareness, and fish consumption patterns as they relate to the subject of this study. In chapter three, the methods used to collect the data are discussed. In chapter four, the data that was collected for this thesis is presented according to the results of analysis. In chapter five, the overview of the thesis is briefly summarized and recommendations are given as they relate to this and further research.

CHAPTER 2

LITERATURE REVIEW

Introduction

Methylmercury poisoning from consuming contaminated fish and seafood is a potential threat to human life. Growing fetuses and young children are vulnerable populations that are especially susceptible to this environmental toxin. In order to effectively communicate these health risks to women of childbearing age, it is necessary to find out what is already known about risk communication, advisory awareness, risk awareness, and fish consumption patterns as they relate to the subject of this study. In this chapter, current and relevant research was examined to help lay a foundation that will guide the remainder of the current study.

Description of Literature Search

A review of the literature was conducted through the Montana State University library internet access portal. The search engines utilized were CINAHL, PubMed, Online Journal Database, *JournaList*, and Fish and Fisheries Worldwide. Key word searches included “methylmercury”, “women of childbearing age”, “precautionary principle”, “advisory awareness”, “risk communication”, “fish”, “seafood”, “fish consumption”, “risk awareness”, and “secondary data analysis”. The broad-based search engine Google was used, in addition, to find journal based articles and to provide a

general search on the subject matter. Articles were then obtained in one of two ways; either the articles were found in full text for free online or a request was made to the Montana State University Inter-Library Loan office to provide the articles in full text for free and sent electronically.

Precautionary Principle

The precautionary principle is best defined in the following two aphorisms: ‘better safe than sorry’ and ‘look before you leap’. As seen in Health Canada (2000), taking a precautionary approach “emphasizes the need to take timely and appropriately preventative action, even in the absence of a full scientific demonstration of cause and effect” (p.8). “It has been suggested that we adopt a precautionary approach when animal research or other indicators demonstrate a possible toxic relationship between a chemical and a health effect” (Stattler et al., 2004, p.236). Kriebel and Tickner (2001) believe that public health and environmental policies are commonly based on reaction rather than taking precaution. The authors argued that science based on reaction is more likely to harm the public initially. Although the exact amount of an exposure in the population is unknown, scientists often apply the precautionary principle as an approach for protecting the public’s health. Demonstrating awareness of a fish advisory and acting upon an advisory is a fraction of applying the precautionary principle into practice. The research assists in learning how to avoid the possible neurodevelopmental effects of ingesting methylmercury at the primary prevention level. The remainder of this literature review will discuss risk communication, advisory awareness, risk awareness, and fish

consumption patterns as they relate to possible methylmercury contamination in consumed fish and fish products.

Risk Communication

Methylmercury Regulation

In the United States, mercury regulation in fish and seafood is shared by the U.S. FDA and the EPA (How Mercury in Fish is Regulated, 2006). The FDA is responsible for regulating the fish and seafood commercially sold in food stores and restaurants. In contrast, the EPA is in charge of regulating the amount of mercury that is released into the environment. Therefore, one of the EPA's responsibilities is to monitor the amount of mercury in sport-caught fish products. Based on the mercury poisoning epidemic that occurred in Iraq, the EPA, in 1995 derived a reference dose (RfD) for methylmercury, set at 0.1 micrograms per kilogram per day (Rice, Schoeny & Mahaffey, 2003).

The RfD is the amount of methylmercury that is safely consumed without causing harmful effects over ones lifetime. In 1997, Congress mandated the EPA to develop an expert panel to further examine the RfD for methylmercury. The NRC concluded that the current RfD was suitable, however, recommended that the EPA base its findings on newer research information. By 2001, the EPA completed a risk assessment of methylmercury based on longitudinal developmental studies based upon three separate epidemiological studies within the Seychelles Islands, the Faroe Islands, and New Zealand. The Faroe Islands and New Zealand studies provided an association between neurodevelopmental deficits in children and chronic, low dose prenatal methylmercury

exposure. The Seychelles Islands study failed to demonstrate the above-said association (NRC, 2000).

Federal Guidelines

In 2004, the EPA and FDA collaborated to form the federal guidelines for women of childbearing-age. The guidelines include the following recommendations:

1. Do not eat shark, swordfish, king mackerel, or tilefish because they contain high levels of mercury
2. Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury. This includes a variety of seafood, such as canned tuna, crab, haddock, cod, spiny lobster, mahi-mahi, U.S. Pollock, whitefish, and imitation crab meat. Women of childbearing age may eat up to four 6 ounce meals per week of the following commercially available foods: salmon, perch, tilapia, shrimp, cod, scallops, crappie, catfish, flounder, clams, oysters, farm-raised trout, and hake. One four to six ounce meal per week is acceptable with tuna steaks, red snapper, marlin, bluefish, grouper, northern lobster, sea bass, halibut, and imported Pollock. The safe consumption of albacore tuna is six ounces (one meal) per week.
3. Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers and coastal areas. If no advice is available, eat up to six ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week (FDA 2004; EPA, 2004).

Montana Guidelines

In Montana, the Department of Public Health and Human Services is responsible for providing the sport fish consumption guidelines (Montana Department of Public Health & Human Services, 2005). The advisory contains meal guidelines for fish caught in Montana, advice on how to safely eat fish that are caught in Montana's waters, and specific guidelines for fish consumption in women of childbearing age. The general guidelines include the following:

1. Keep smaller fish for eating
2. Eat smaller meals when you eat big fish and eat them less often
3. Eat fish that are less contaminated
4. High-risk individuals, such as women of childbearing age are at the greatest risk for adverse health effects.

It should be noted that proper cooking and cleaning of the fish has no impact on the mercury level in the fish as the mercury lies within the muscle (the meat consumed). The sport-caught fish guideline lists laboratory test results of actual methylmercury concentrations within selected fish species found in selected Montana waters. The fish species are broken down into specific size ranges in inches. "Sport-caught fish refers to fish that are caught recreationally for sport by licensed anglers in a particular state" (Anderson, et al., 2004, p. 316). These fish are usually consumed by the fishing license holders or by their family members.

For Montana sport-caught fish, women of childbearing age (WCBA) should avoid all lake trout, northern pike, and walleye over 15 inches in length. These are

known as predatory fish and tend to accumulate higher levels of methylmercury and should also be avoided in nursing mothers, and children under the age of six. WCBA should consume one four- to six-ounce meal per week of walleye under 15 inches in length, burbot, and bass. The guidelines do not specify if lake trout or northern pike under 15 inches of length are acceptable to consume. WCBA should consume up to two six-ounce meals per week of perch, brown trout, and lake whitefish. Finally, WCBA should consume up to four 6 ounce meals per week of rainbow trout, salmon, cutthroat trout, brook trout, mountain whitefish, sunfish, and arctic grayling. With these basics of methylmercury regulation and guidelines in place, current risk communication research studies are now discussed.

Risk Communication Studies

In 2003, Jardine wanted to determine the communication of risk in 109 people living along the Athabasca River in Alberta, Canada. In the survey, 60% heard about the advisory through the fishing regulations, 36% from the newspaper and 24% by word of mouth. Twenty-one participants out of the 109 volunteered for more in depth interviews and focus group discussions. Everyone in these groups felt the advisories could be communicated better. Eight of the 21 cited newspapers as a means of effective communication, four people mentioned local television and radio, seven people felt signs should be posted at fishing access sites, and three people listed the internet as a source for communication.

Minority groups in the United States are a vulnerable population at risk to the dangers from environmental contaminants. It could be speculated that women, and their

unborn or young offspring, who consume sport-caught fish are considered a vulnerable minority group. Beehler, McGuinness, and Vena (2003) conducted a qualitative study among Latino anglers' and the understanding of risk perceptions and advisory awareness. The authors found that this minority group was more likely to fish without a license and thus not receive any advisory guidelines when purchasing a license. It was felt by the participants that environmental contaminants could cause illness from consuming fish through food poisoning and that they would know right away if that had occurred. They were unaware that invisible toxic chemicals, such as methylmercury, might be in the fish and could affect their health. Finally, the advisory guidelines were written in English and thus not readable for many of the Latinos. The study participants felt that the government lacked in efforts to inform the community and any risks associated with consuming the fish they catch.

Pflugh, Lurig, Von Hagen, Von Hagen, & Burger (1999) studied the advisory awareness, perceived risk, and sources of advisory and risk awareness in Newark Bay. The survey consisted of 300 anglers at 26 different fishing and crabbing locations in the Newark Bay Complex. The authors found while 60% were aware of the advisories, they did not believe or were unconcerned about possibly consuming contaminated fish. In this study, fishermen were mostly likely to receive information regarding any advisory from their peers. Newspapers were cited as the source most used about community news, health, and food safety.

Thirlaway and Heggs (2005) explored "the meanings women take from risk communication focusing on how personal risk perceptions and lifestyle choices are

influenced” (p.107). For the study, an open-ended qualitative survey was issued to 650 women. One-hundred and seventy-six women between the ages of 18 and 55 completed the questionnaires and comprised the sample. The women were given an article entitled ‘Drinking a single glass of wine a day increases a woman’s chance of developing breast cancer by six percent and asked to respond to three open-ended questions. The questions consisted of: 1) What do the figures in this report mean to you, 2) How does reading this report make you feel, and 3) Will this information change/influence your behavior? Twenty-five women (14%) clearly stated the risk was low, while eighteen women (10%) clearly stated that the risk was high. Fifty-five women (31%) acknowledged the risk as: frightening, disturbing, concerning or worrying. Eight (4.5%) of the women stated that they did not have enough information to arrive at the risk estimate. Only seven (4%) of the women stated that the number meant “nothing” or “not a lot”.

When asked if the article would change/influence their behavior, 71 women (40%) stated that they didn’t drink enough to affect their risks, 35 women (20%) stated it would change their behavior, 31 women (18%) stated there were too many health reports, 24 women (14%) felt the message was confusing/contradictory, 21 women (12%) state that it is only a small risk, 19 women (11%) stated that they don’t trust science/statistics, and only one woman (0.6%) was prepared to take the risk. This study provides a glimpse into the strategies and decision making process that women undertake when assessing and communicating risk.

Advisory Awareness

Advisory Regulation

With the results of these studies, the EPA and FDA worked with individual state governments to develop fish advisories in regards to mercury contamination. Since the EPA's release of the RfD for mercury in fish, the information on fish consumption advisories has begun to target consumers. A current hot topic involves the public wanting to know what fish and seafood are acceptable and in what amounts. According to Hayes (2005), it is difficult to inform people about chemical contaminants without causing alarm. The FDA has the ability to regulate the commercially sold fish products; however, sport-caught fish regulation provides a greater challenge.

Current sport-fish consumption advisories seek to (a) inform the public regarding chemical contaminants contained in some sport fish, (b) educate consumers about how to reduce the risks of contamination, (c) remind consumers of the health benefits of eating fish, (d) present the advisory information as a guideline and not a mandate, and (e) to provide consumption-frequency recommendations for childbearing-aged women (Anderson et al., 2004, p. 316).

Setting up these guidelines can be difficult due to different methylmercury levels among fish species and locations coupled with various methods of fish preparation and eating habits (Hayes, 2005).

As of 2004, 48 States had advisories regarding fish and methylmercury (EPA, 2004; 2004a). Each State that has an advisory is responsible for informing the public of the recommendations. Advisory awareness and risk awareness fall under a broader term of risk communication. The National Resource Council (NRC) defines risk communication as "an interactive process of exchange of information and opinion among

individuals, groups, and institutions” (U.S. Public Health Service, February/March 1995).

The definition includes "discussion about risk types and levels and about methods for managing risks." Specifically, this process is defined by levels of involvement in decisions, actions, or policies aimed at managing or controlling health or environmental risks. According to Bennet and Calman (1999), effective communication is the basis of preventative medicine and health promotion. These authors feel that health hazard information must be available and readily accessible for people to “take actions or change behaviors” and reduce risks.

According to Alaszewski (2005), the information needs to be targeted toward “high-risk or vulnerable groups” (p. 102), such as women of childbearing age. Additionally, Knuth et al. (2003) stated that “a common objective for health advisory communication programs is to enable consumers to make their own, informed decision about fish consumption” (p.1186). Jardine (2003) noted that “risk communication research has demonstrated that sharing information, perceptions, and understanding among the various participants in the advisory process is vital to successful fish consumption advisory communication programs” (p.461). For various reasons, communicating these risks through advisories might be different for some women due to geographical location.

According to Jardine (2003), the purpose of any fish advisory is to “enable people to make an informed choice on whether to change consumption behavior” (p.461). In order for this to occur, the public must possess “awareness of the advisory, know and understand the advisory information, and believe the information to be true”. The

advisories are designed to “manage health risks and protect the public from exposure to any environmental contamination estimated to exceed some predefined health-based limit”. For the sake of this thesis, the environmental contamination is methylmercury and the public consists of childbearing-age women.

Advisory Awareness Studies

Tilden et al. (1997) examined the fish consumption and health advisory awareness among eight Great Lakes states. To gather data, the authors used a population-based telephone survey of 8,306 adults in this region. Fish were caught and consumed by 8.4% of adults or about 4.7 million residents of the Great Lakes states; 43.9% of these were women. Of this group, 60.9% of the females were unaware of any health advisory regarding the consumption of fish caught in the Great Lakes waters. Of the sport fish that were consumed, a large percentage came from the predatory fish known as walleye, lake trout, and brown trout.

Levine, Miller, Kamrin & Dearing (1999) wanted to better understand the impact that the Michigan fish consumption advisory had on fishermen’s attitudes, beliefs, and behaviors about consuming sport-caught fish. In this study, 396 anglers were randomly surveyed in regards to their own beliefs about the advisories and the risks of eating fish. Participants were asked questions about the risks of eating sport-caught fish and were asked to respond based on if the consumption was ‘perfectly-safe’ (39%), ‘conditionally safe’ (25%), or involved ‘some danger’ (36%). The authors found that most anglers that had read the advisory were only somewhat familiar with its contents. It was found that 28% of those that read the advisory had changed the location in which they fished; 29%

had changed which species of fish they caught and ate; 43% changed how they cleaned fish; 38% changed which parts of the fish they consumed; 23% changed how they cook the fish; and 34% changed how much fish they consumed over a given period of time. Twenty percent of the study participants were female.

Burger and Waishwell (2001) wanted to determine if the fish consumption advisory and a supplemental fish fact sheet were understood by those who fish along the Savannah River. Eighty-nine percent of those interviewed felt that some groups of people should limit the amount of fish they eat, however, only “40% could correctly identify that pregnant women and young children were most at risk” (p.82).

In 2001, the Food and Drug Administration (FDA) recommended that pregnant women should limit their consumption of certain fish due to possible methylmercury contamination. Oken, et al. (2003) conducted a cohort study in which 2235 pregnant women were surveyed prior to the advisory (1999-2000) and then after the advisory took effect (2001-2002). Prior to the advisory, canned tuna was consumed on average of 2.9 servings per month, dark meat fish 1.3 servings per month, shellfish 1.7 servings per month, and white meat fish 1.7 servings per month. After the advisory emerged, canned tuna was consumed at 2.1 servings per month, dark meat fish 1.1 servings per month, shellfish 1.5 servings per month, and white meat fish 1.5 servings per month. The authors listed dark meat fish examples as mackerel, salmon, sardines, blue-fish and swordfish, while examples of light meat fish were never given in the study. Prior to the advisory, 15% of the women consumed greater than three fish meals per month, while 11% consumed greater than three fish meals per month after the advisory.

Bienenfeld, Golden, and Garland (2003) studied the fish advisory awareness and fish consumption patterns among those participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) services in East Harlem. The study participants consisted of 220 participants with a mean age of 27.8 years and most were Hispanic (57%) or black (39%). Females consisted of 98% of the study population. Ninety-one percent of those interviewed reported that they ate fish or shellfish. Results of those that reported eating fish or shellfish were further assessed according to the number of fish meals eaten per month.

Fifty-one responders (26%) ate fish once a month or less; 66 (33%) ate fish two to three times per month; 43 (22%) ate fish four to seven times per month; and 38 (19%) ate fish eight or more times per month (p. 351).

Among those that ate fish, 22 of the participants consumed locally caught, noncommercial fish. Knowledge of any fish advisory was reported in 12 (55%) of these participants. Of the remaining 178 participants in the study who only ate commercial fish, only 29% had knowledge of an existing fish advisory.

Jardine (2003) investigated advisory awareness and knowledge of a fish advisory in Alberta, Canada along the Athabasca River. The author used surveys, interviews, and focus groups to conduct the study. For the survey, Jardine found 66% (+9%) of those living on the Athabasca River ($n = 109$) were aware of the fish consumption advisory, which is greater than the general public living in Alberta at 45%. However, of the 66%, only 47% were aware of the actual species of fish in the advisory. In the survey, respondents were asked if they would be willing to participate in follow-up semi-structured personal interviews and focus group discussions ($n = 21$). With the information

gathered from the qualitative questions, the author found that there was a general consensus that advisory awareness was too limited or general. Many of the participants were not aware that the advisory was included in the “Alberta Guide to Sport-fishing Regulations”. Also, it was found that many of the participants were not certain as to the species of fish or which stretches of the river were sanctioned by the advisory.

In yet another Great Lakes study, Imm, Knobeloch, Anderson, and the Great Lakes Sport Fish Consortium (2005) surveyed 4,106 adults (≥ 18 years of age) through a random-digit-dial telephone survey. Of the 4,106 that were surveyed, 56% were female ($n = 2305$). Thirty percent of the women were aware of an existing federally-regulated advisory. Nineteen percent of the female’s surveyed consumed sport caught fish, while six percent consumed Great Lakes sport fish. Seventy-two percent of these women reported consuming fresh or canned tuna on a regular basis. The advisory awareness results were compared to advisory awareness results from 1993-1994. Advisory awareness in 1993 was 38% in the women surveyed. Following these results, the Wisconsin Department of Health and Family Services funded a campaign to increase the advisory awareness among women. The ‘Hook into Healthy Fish’ campaign gave coffee mugs, posters, fact cards, T-shirts, memo pads, and refrigerator magnets to WIC clinics and pediatricians offices. While the reasons were not known, eight years later (2002) the advisory awareness prevalence among women had slipped 8 percentage points to 30%. However, it was estimated that 99,000 fewer women consumed more than 35 fish meals by 2002.

In 2005, the Montana Department of Public Health and Human Services conducted a phone questionnaire as part of the Behavioral Risk Factor Surveillance System. Two questions regarding fish consumption were added to the questionnaire by the State and included:

- 1) During the past 12 months, how many meals of fish have you eaten that were caught from Montana waters by your or someone you know?
- 2) Are you aware of Montana's Sport Fish Consumption Guidelines?

Out of 2,851 women surveyed, awareness varied by age.

Of all Montanan's surveyed, those aged 18-24 ($n = 168$) were the most unaware (70.1%) of the Montana Sport Fish Consumption Guidelines. Of those aged 25-34 ($n = 378$), 66.4% were unaware, while of those aged 35-44 ($n = 560$), 61.7% were unaware. These results were also taken into context of those women who had consumed fish in the past 12 months. Based on the number of fish meals caught in Montana waters and consumed in the past 12 months, 64.9% of the women had consumed none, 24.8% had consumed 1-6 (infrequently), 2.1% had consumed 7-11 (< once a month), 3.7% had consumed 12-23 (once to < twice a month), 1.2% had consumed 24-35 (twice to < 3 times a month), and 3.2% had consumed 36+ (3 times a month or more). According to the authors, there did not appear to be a significant variation in the percentages of those unaware of the Guidelines based upon the subject's income, education, disabilities, race, or region.

Risk Awareness

Risks and Benefits

In October of 2006, the Institute of Medicine (IOM) of the National Academies prepared a report on balancing the benefits and risks of consuming seafood. According to the report, the general public benefits from the consumption of seafood due to the cardio-protection it provides through the presence of omega-3 fatty acids, eicosapentaenoic acid (EPA), and the docosapentaenoic acid (DHA) in the food. However, certain populations are at risk from contaminants, such as methylmercury, found in certain seafood. The report listed women of childbearing-age as a vulnerable population that consumes seafood and gives recommendations towards its safe eating. Of interest, the IOM committee recommends that advice regarding benefits and risks “must be based on the best available scientific information” (p.3). The empirical evidence about the benefits and risks is, however, “diverse, somewhat incomplete, and uncertain”. Arnold, Lynn, Verbrugge, and Middaugh (2005) argued that general fish consumption recommendations may actually place more harm to the public than actually eating the fish. The authors contended that with a current high prevalence of obesity, diabetes, and cardiovascular disease, the benefits of eating fish may outweigh the risks.

Risk Awareness Studies

To study the health benefits and risks of consuming sport-caught fish, Knuth et al. (2003) conducted a detailed mail questionnaire. The target population for the study included those with current fishing licenses and who fished Lake Ontario. When the risks

for eating contaminated fish were high, respondents were more likely to say “they would eat less fish”, without taking the benefit level into account (p.1189). Conversely, as the risks were considered moderate or low, the percentage of those that would eat less fish declined. Respondents felt that they would advise women of childbearing age and children to not eat fish when the risks were high, regardless of the benefits. When the risks are low, the level of benefit influenced their giving of advice. The authors suggested that the level of risk was greatly influenced by each individual’s own risk perception lifestyle. They stated that risk communication can become a problem due to advisories being voluntary and not enforced.

Anderson et al. (2004) conducted a 12-state random telephone survey of 3015 women of childbearing age. When looking at the 12 states as a whole, 87% reported eating fish within the past 12 months, while nearly 10% reported eating two or more fish meals per week over the past 12 months. Most women (71%) were aware of mercury’s toxic effects on the development of a child, while only 20% of those surveyed were aware of any state advisories. The authors also found that an increase in age and education as well as living in a household with a license holder increased the percentage of women who knew about state fish consumption advisories.

As part of the 2004 Behavioral Risk Factor Surveillance Survey in Wisconsin, Knobeloch et al. (2005) examined the percentages of women who had eaten various types of fish within the past 12 months. Women ate canned tuna (65.8%), albacore tuna (53.1%), fresh/frozen tuna, swordfish, seabass, halibut, and shark (25.1%), sportfish from Wisconsin inland waters (34.3%), and Great Lakes sport-caught fish (18.8%). In addition,

“while most Wisconsin residents had heard about the contamination of mercury in fish, less than half were not familiar with the Wisconsin Sport-Fish Consumption Advisory” (p.12).

Within the same study as reported above, Jardine (2003) wanted to determine advisory compliance in 109 people living along the Athabasca River in Alberta, Canada. The level of compliance to a fish advisory is part of the perceived risks of whether or not to adhere to the advisory. Eighty-seven percent of the participants stated that they would comply with an advisory upon becoming aware of one. The stated reasons for complying to an advisory included concerns about a potential personal health risk (68% $\pm$ 9%), concerns about the potential risk to family or others (13% $\pm$ 6%), or due to government directive (9% $\pm$ 5%). However, the study results also revealed that 22% ($\pm$ 8%) didn't or seldom ate fish. In the interview and focus groups, 14 out of the 21 participants indicated that they had already changed their fish consumption based upon the advisory. Many stated that they had stopped eating fish caught in the Athabasca River altogether due to the advisory. Participants were also asked why they felt others may not comply with the fish advisory. Recurrent themes included the following: (a) fish were needed for nutrition, (b) people didn't believe the advisory, (c) people were not aware of the advisory, and (d) an attitude that “it won't happen to me”.

Conceptual Framework

The Health Canada Decision-Making Framework for Identifying, Assessing and Managing Health Risks (Health Canada, 2000) was used as the theoretical basis for this

study. The risk communication component is a major strength of the chosen framework and is an integral part of creating healthy lifestyles. This framework is based upon the Presidential/Congressional Commission Framework for Environmental Health Risk Management (1997).

The framework suggests that when a person makes a conscious decision regarding a facet of their own health, they are taking action in health promotion. This involves a process of decision-making that involves risk communication. “The goal of effective risk communication is to ensure that there is an adequate understanding of the component elements of the risk management decision-making process by all participants” (Health Canada, 2000, p. 24). In order to accomplish this, scientific information is given to the public in terms that are best understood by all in the hopes that the public will make a well-informed decision regarding their own health. The scientific information is given “concerning the existence, nature, form, severity, or acceptability of health or environmental risks”.

The main characteristics of effective risk communication include the following four principles:

1. Provide for a two-way process
2. Tailor to the context and the participants
3. Use flexibility and adaptability to any cultural or communication differences
4. Arise from credible sources that are trustworthy.

A two-way process “involves developing an understanding of the needs of interested and affected parties, reacting to concerns and informing, consulting, and educating”. In this

sense, risk communication is also “tailored to the context” (Health Canada, 2000, p. 25) of the message and to the participants involved. Effective risk communication can be impeded by a language barrier. Language is not only communicated on an ethnic or cultural basis, but also with terms that are easily understood by all parties involved. Finally, there is a notion that effective risk communication must consist of trustworthy information from credible sources. If the information is from a credible source, the participant’s decisions are likely swayed. Lacking any of these characteristics, the message can seriously damage the decision-making process of any participant in regards to their own health. Below, Figure 1 depicts a “holistic” approach to creating a successful and effective fish consumption advisory and was adapted into this thesis with written permission from Jardine (2003).

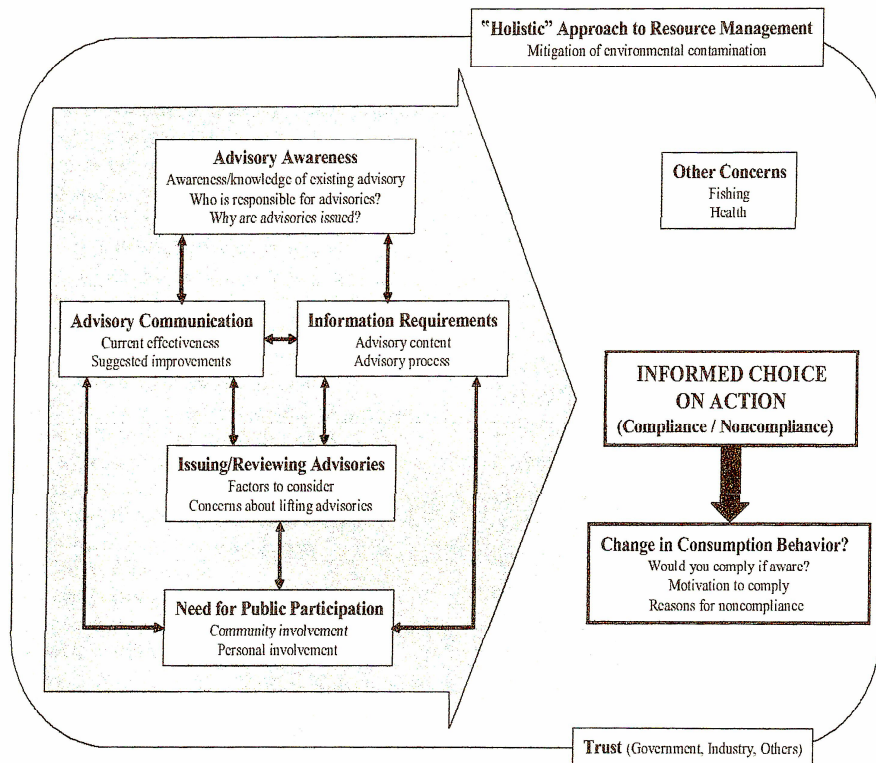


Fig.1. Algorithm of the conceptual framework adapted from Jardine (2003)

Summary

Risk communication, advisory awareness, risk awareness, and fish consumption patterns were reviewed. From the brief glimpse provided by the literature review, it can be said that risk communication regarding methylmercury poisoning is generally less than adequate when directed towards women of childbearing age (WCBA). The review also found that the percentage of WCBA possessing awareness of any fish advisory or their awareness of risk was low. The fish consumption patterns of WCBA appear to vary according to location and dietary habits. The review did not find any studies linking this subject matter with the cohort currently studied. The following three chapters will, hopefully, expand the current knowledge of protecting rural WCBA and their offspring from potential environmental threats to their health from methylmercury.

CHAPTER 3

METHODOLOGY

Introduction

The purpose of this study was to describe the risk communication status of the Montana fish consumption advisory in non-Native American women of childbearing age residing on an ‘open’ reservation. With the wide-spread dissemination of risks and advisories regarding methylmercury and fish consumption, this study was specifically aimed to investigate the following three questions.

1. What fish consumption patterns exist among the cohort?
2. Are rural non-Native women of childbearing age residing on a reservation and participating in WIC clinic services (a) aware of the Montana sport fish consumption advisory? and (b) aware of the risks associated with consuming fish contaminated with methylmercury?
3. What are the risk communication preferences among the cohort?

Design

This secondary analysis was designed to investigate if 1) the risks of consuming contaminated fish were properly communicated to women of childbearing age and 2) how the women respond to the perceived risks. This was a descriptive study that used a research generated survey to investigate the extent of risk communication in rural women of childbearing age regarding methylmercury ingestion from fish consumption.

The analysis of secondary data has recently received attention in nursing for research purposes and to improve patient outcomes (Pollack, 1999). Cho (2006), of the University of Illinois, listed the advantages of using secondary analysis. Secondary data analysis is (a) unobtrusive, (b) fast and inexpensive to collect, (c) able to avoid most data collection problems, and (d) able to provide a basis for comparison with other results and studies. With data that has already been collected, secondary analysis “can accelerate the pace of research by saving time and resources on data collection and allowing those resources to be applied to other aspects of the research process” (Magee, Lee, Giulano, & Munro, 2006, p. S54). The authors continued by stating that although the time from asking a research question to obtaining answers is shortened, “the research process remains the same” (p.S50). It is still important to construct a conceptual framework that matches the proposed research questions and the data set for secondary analysis (Pollack, 1999; Magee, et al. (2006). Additionally, there must be a match between the research questions, purpose of the study, and the primary data to protect against “threats to validity and reliability and increase the ability to generalize findings” (Magee, et al., 2006, p.S51).

According to Polit & Hungler (1999), there are disadvantages to analyzing secondary data. There is no control over the variables or the way in which questions are asked of the study participants from the initial inquiries. This can lead to “if only” problems: if only questions were asked differently, different questions were posed, or variables were measured differently (Polit & Beck, 2004, p.237). Missing data can be another disadvantage when analyzing data that has already been collected. Increasing the

likelihood of missing data occurs as the number of variables are increased and with longer spans of data collection (Pollack, 1999).

According to Magee, et al. (2006), missing data may cause important variables to become completely unavailable for analysis. When determining how to handle missing data, the researcher must decide if this has occurred randomly or non-randomly (Pollack, 1999). If the data appears to be random, there are statistical computer programs available to analyze missing data. However, “many statisticians consider missing data to be somewhat ignorable if they are random and the outcome of interest is independent from the missing data” (p.151). If the missing data is non-random, there is a possibility that it could be recovered. Otherwise, non-random missing data “may offer a serious threat to validity” (p. 151). A threat to reliability of a study may also occur when analyzing secondary data. Problems with reliability may occur “from the accuracy and specificity of the coding process for the variables, the stability of the variables over time, and the methods and timing of the data collection” (p. 148).

Sample

Using a convenience sample, women of childbearing age, enrolled in the WIC program on the open reservation, were surveyed. A total of 88 surveys were completed, with a total of 10 completed by non-Native Americans. The 10 non-Native Americans were all of White, non-Hispanic origin. Native Americans living on the reservations completed the remaining 78 surveys. This sample was chosen for the study for three distinct reasons. First, the data from this sample was already available for analysis as it

was collected during the original pilot study. Secondly, the data from this sample was not analyzed with the original pilot study. Finally, the literature was not able to provide any research regarding this sample and its ties with this subject matter.

Instrumentation

The parent survey was reviewed for content validity by the Fish Advisory Committee, two tribal health nurses, and the tribal WIC program supervisor. Prior to implementation, the parent survey was examined by the tribal elders for specific cultural meaning. The survey was adapted from the modified Anderson et al. (2004) fish advisory questionnaire; however was not tested for reliability prior to implementation. A copy of the actual survey can be found in Appendix B.

Procedure

For this thesis, the procedure consisted of a secondary analysis of the data compiled during a pilot study entitled “Methylmercury Risk and Awareness in American Indian Women of Childbearing Age” with Sandy Kuntz, PhD., RN as the principal investigator. The remaining members of the project included Wade Hill, PhD, APRN, BC, Susan King, PhD, Jeff Linkenback, EdD, and Gary Lande, MD. Funding for the original study was provided by the Center for Chronic Health Conditions in Rural Dwellers (CRCHC) and began August 1st, 2005, ended July 31st, 2006.

For the pilot study, the research team from Montana State University set out to explore the methylmercury risk and awareness in Native American women of

childbearing age living on a rural reservation. An existing survey (Anderson et al., 2004) was modified and reduced from 81 to 36 questions, including demographic characteristics. Permission was granted from the Tribal council to allow the survey at a WIC office on the reservation and data was collected for two months during the spring of 2006. Prior to the collection of data, the study was granted approval from the Montana State University International Review Board (IRB). Care was taken to avoid using any identifiable information with this vulnerable population group.

For data collection, the final version of the survey was downloaded into a software program entitled Snap and loaded onto a touch-screen computer. To assist the women who chose to participate in the survey, a tribal employee was hired as a research assistant. The research assistant's duties included a) informing clients of their right to participate in the survey, b) maintaining confidentiality of the survey participants, c) providing assistance, during the survey, to the women if needed, d) discussing and giving the participants a copy of the 'Montana Sport Fish Consumption Guidelines' brochure post survey, and e) managing the numbered incentive \$10 WalMart gift cards. Upon the completion of each survey, participants were given a \$10 gift card to WalMart for their contributions to the study.

With the close of June 2006, the data collection process came to an end. At this time, the raw data was analyzed by the pilot study research team to fulfill their objectives and discuss their findings. The raw data was also used for this secondary analysis to expand upon the risk communication knowledge of non-Native American women of childbearing age residing on an open reservation. Upon approval, from the Montana State

University IRB, the data was ready for statistical analysis. The data was analyzed in SPSS 14.0, student version, using counts, frequencies, and percentages.

CHAPTER 4

RESULTS

Introduction

The analysis of this secondary data set was conducted to guide the evaluation of the three proposed research questions. Specifically, the data analysis was designed to investigate the fish consumption patterns, advisory awareness, risk awareness, and risk communication preferences among a cohort of rural non-Native women of childbearing age residing on an open reservation and participating in WIC clinic services. The data was collected during the pilot study entitled Methylmercury Risk and Awareness in American Indian Women of Childbearing Age in which the study participants completed a 36-question survey at a local WIC office. A total of 10 non-Native women completed the survey, with the results converted from the Snap survey software to SPSS 14.0 by Dr. Wade Hill.

The data were analyzed in SPSS using counts, frequencies, and percentages to compile the results of how each question was answered in the survey. Tables and graphs were designed to visually aid the interpretation of survey results. Some questions were not analyzed if they were deemed unnecessary or extraneous to the study or contained responses too incomplete for analysis. Questions 25-36 were included to provide a data set of population characteristics for the cohort studied. All of the other questions in the survey were placed into a category according to how the question aided in helping to

answer each specific research question. The complete survey can be found in Appendix B.

Findings

Sample Description

The survey results ($n = 10$) represent a wide range of characteristics for this cohort. All of the women were white/non-Hispanic women of childbearing age (range = 18-45 years). When asked the number of women 18-45 years of age living in the household, the majority ($n = 6$) stated they had one woman of childbearing age, while there were three households that contained two; and one household that contained three women of childbearing age. Three of the women were listed as single, two as married, one as separated, and three as members of an unmarried couple. As for education, the half ($n = 5$) had completed some or all of college, while another four had attained a high school diploma. One of the participants reported their highest grade level completed was ninth. Half ($n = 5$) of the cohort were currently employed or working for pay with the majority ($n = 8$) reporting an annual household income of <\$20,000. The other two participants reported an annual household income between \$20,000 and \$34,999. Three of the women reported currently being pregnant, while four reported a plan to become pregnant within the next year. Height and weight were evenly distributed amongst the cohort. Height was reported in inches with a range of 63-69 (SD 1.71) and a majority ($n = 4$) at 66 inches. Weight was reported in pounds with a range of 145-250 (SD 32.29). Half

($n = 5$) reported that a family member (including themselves) had a Montana fishing license.

Fish Consumption Patterns

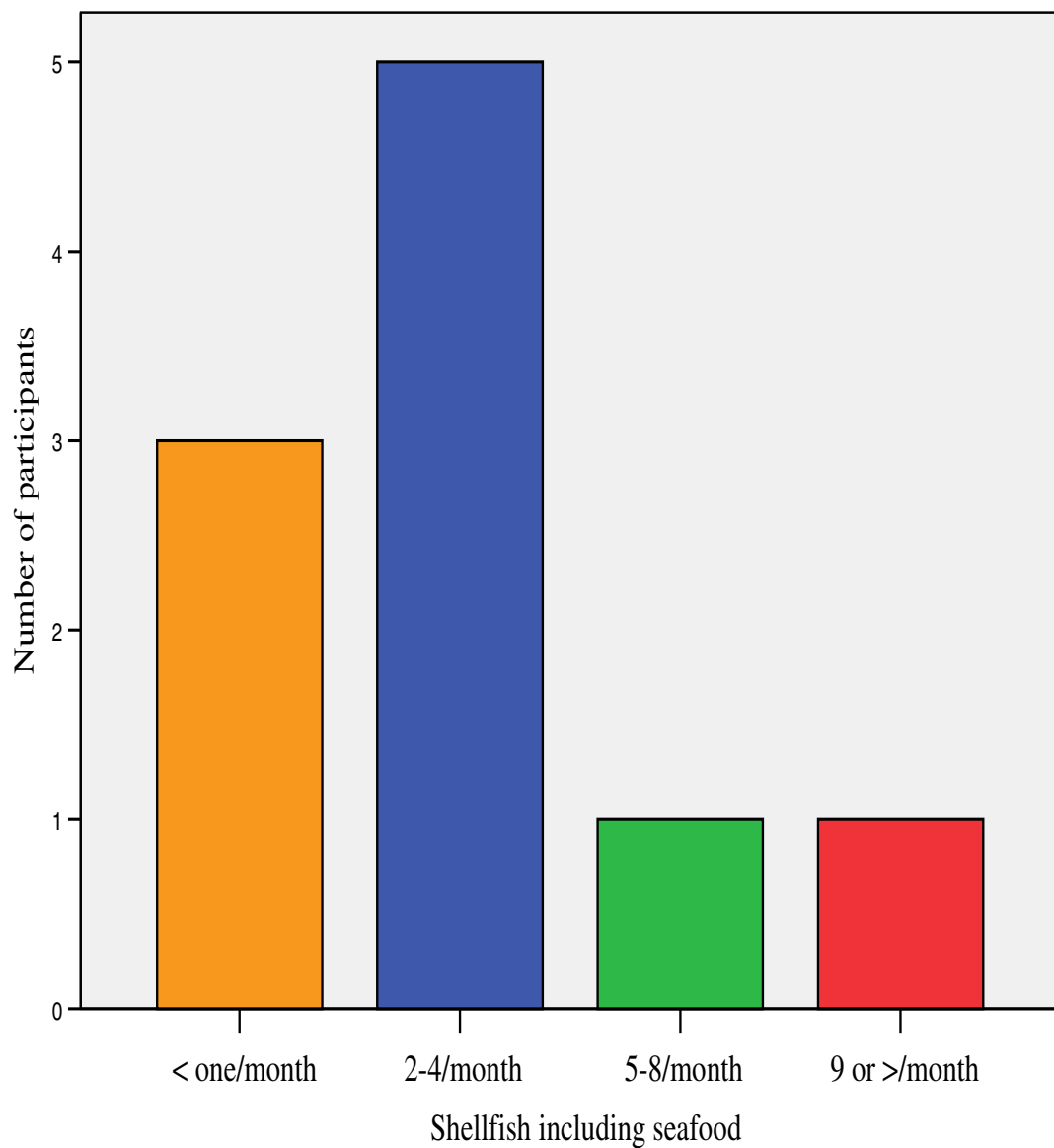
Within the last one month, half ($n = 5$) of the participants had eaten fish that was purchased from a store or a restaurant. When asked, “Do you or your family ever eat sport caught fish?”, the majority ($n = 7$) reported they had. The size of sport caught fish consumed was generally between 14-17 inches. No participant stated that they generally consumed any fish greater than 18 inches in length. During an average month, the majority ($n = 7$) of participants stated they consumed two-four fish meals, while three stated they consumed less than one.

The majority ($n = 9$) stated they had not made a decision to avoid eating fish. One participant stated they made a decision to avoid eating fish. When asked to provide reasons why people may not eat fish, the majority ($n = 8$) stated that “my family and I DO eat fish”. Two of the participants stated that they do not like the taste of fish. One participant was “afraid of not getting the bones out”. None of the participants stated that fish were not available where they live, they were allergic to fish, they were concerned about contaminants, they were vegetarians, or that fish were too expensive.

In the last 12 months, the majority had eaten shellfish including seafood ($n = 9$) and fish fillets, fish sticks, and fish sandwiches ($n = 8$). When asked if they had eaten light or albacore tuna in the last 12 months, the answers were eight and two, respectively. The number of meals per month in the last 12 months of each of these fish categories was also reported. As for the number of meals eaten of shellfish and seafood per month in the

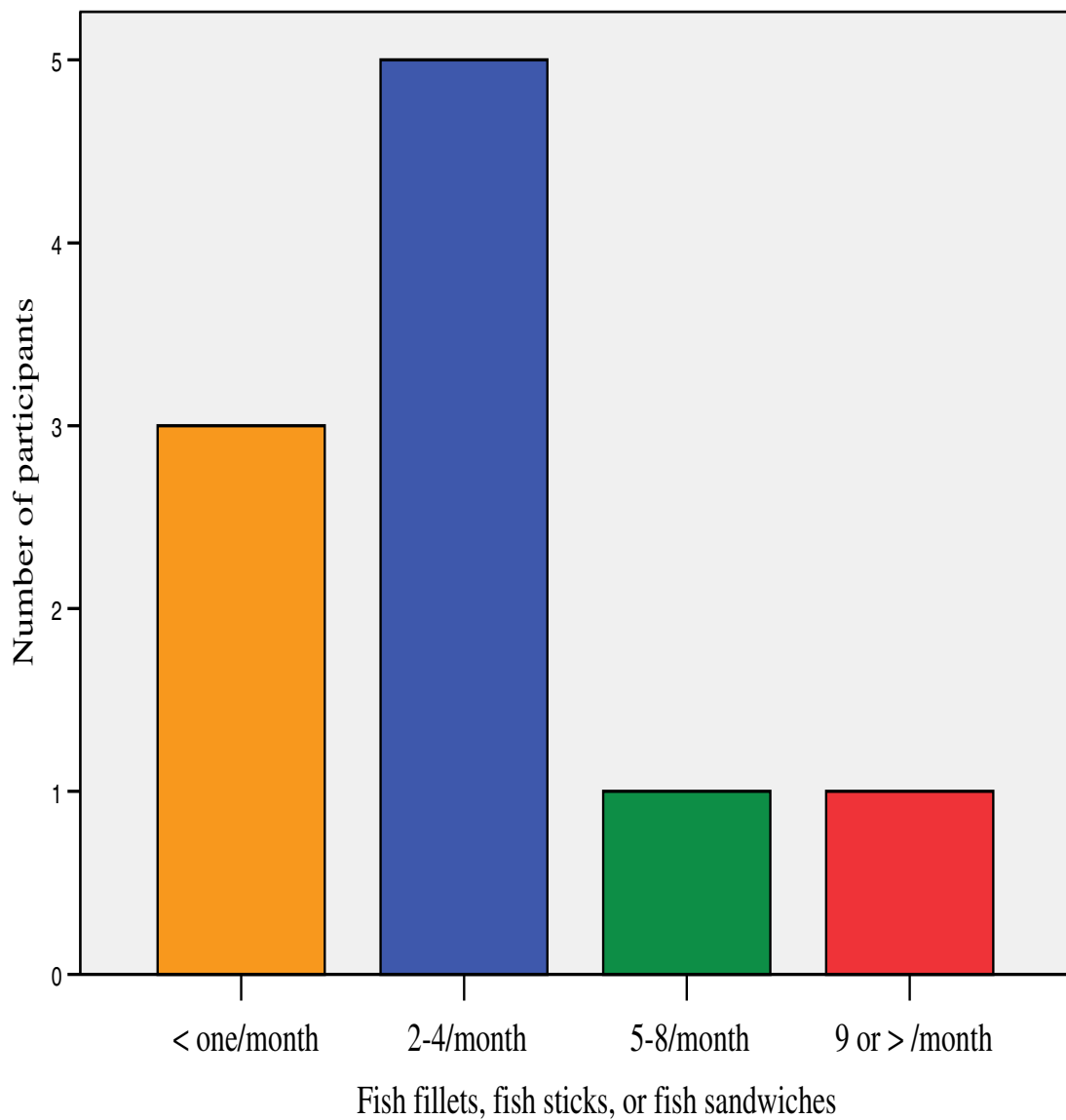
last 12 months, the majority ($n = 5$) reported eating two to four meals per month. Three had consumed less than one meal per month, while one reported consuming nine or more meals per month of shellfish and seafood. These results are also reported, below, in Figure 2.

Figure 2. Average Number of Meals Consumed Per Month



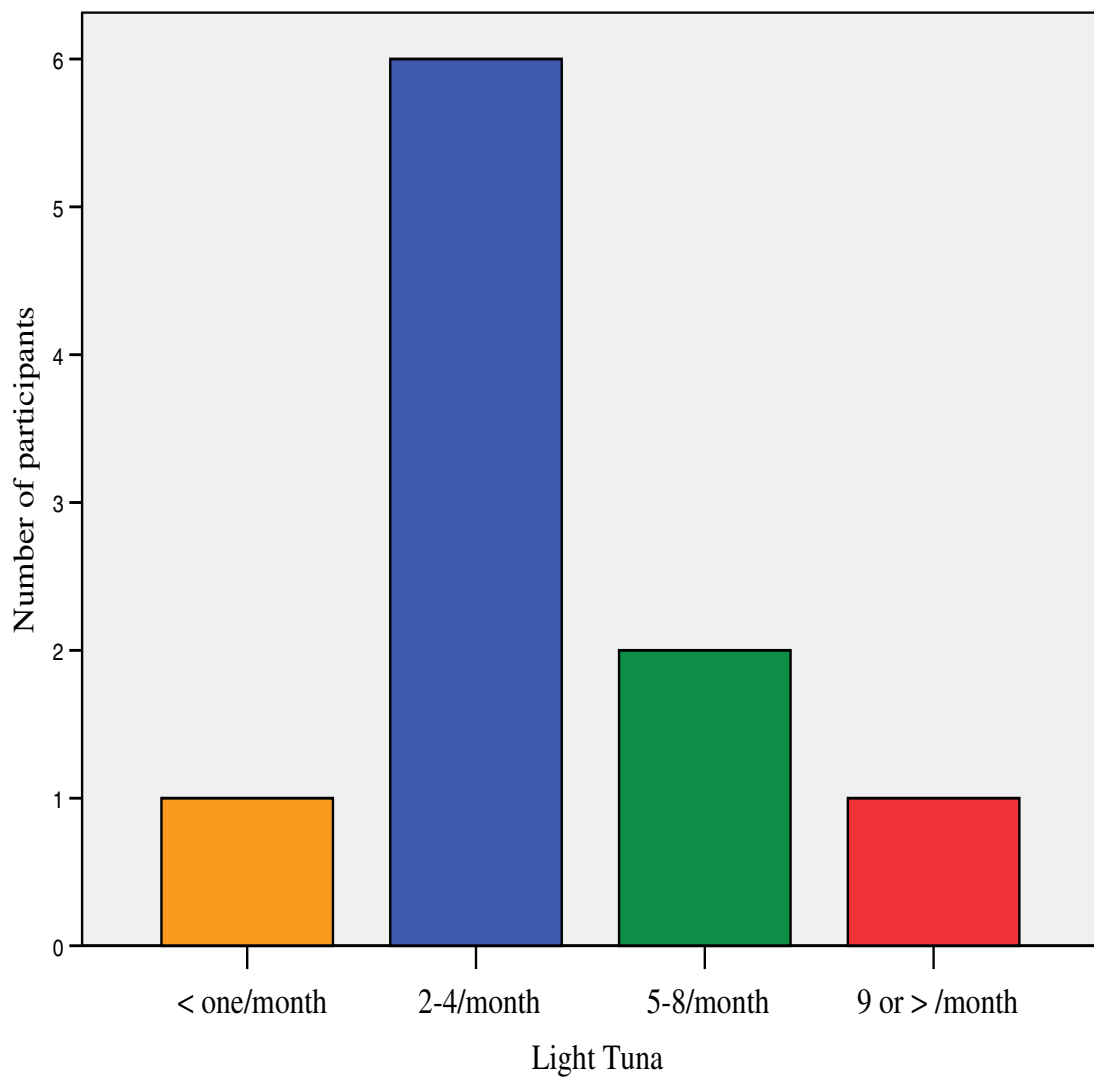
As for the fish fillets, sticks, and sandwiches, the majority ($n = 5$) reported consuming two to four meals per month in the last 12 months. Three had consumed less than one meal per month, while one reported consuming nine or meals per month of the fish fillets, sticks, and sandwiches. These results are also reported, below, in Figure 3.

Figure 3. Average Number of Meals Consumed Per Month



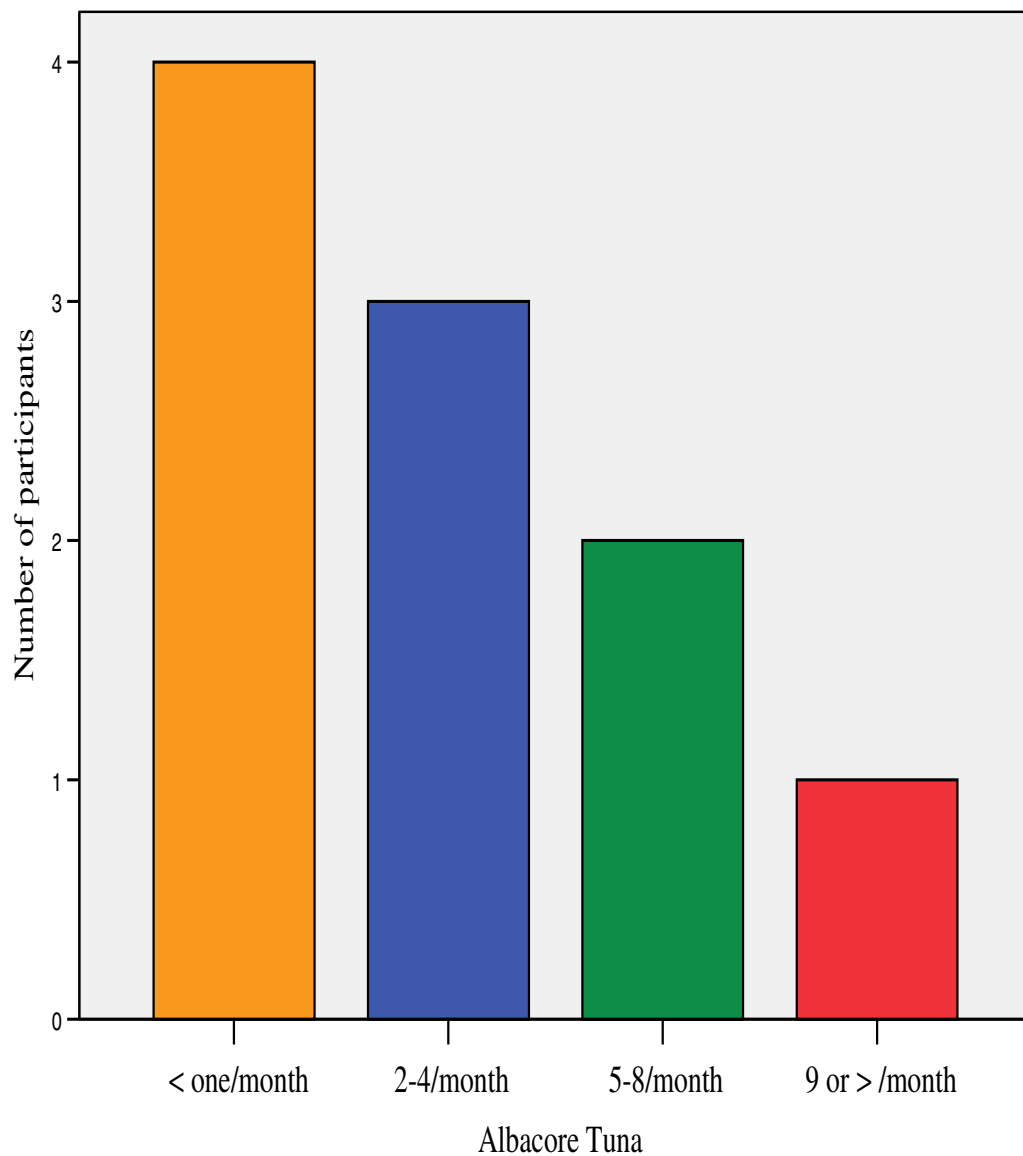
As for the light tuna, the majority ($n = 6$) reported consuming two to four meals per month in the last 12 months. One reported consuming less than one meal per month, while one reported consuming nine or more meals per month of light tuna. These results are also reported, below, in Figure 4.

Figure 4. Average Number of Meals Consumed Per Month



As for the albacore tuna, the majority ($n = 4$) had consumed less than one meal per month. Three had consumed two to four meals per month, two had consumed five to eight meals per month, and one reported consuming nine or more meals per month of albacore tuna. These results are also reported, below, in Figure 5.

Figure 5. Average Number of Meals Consumed Per Month



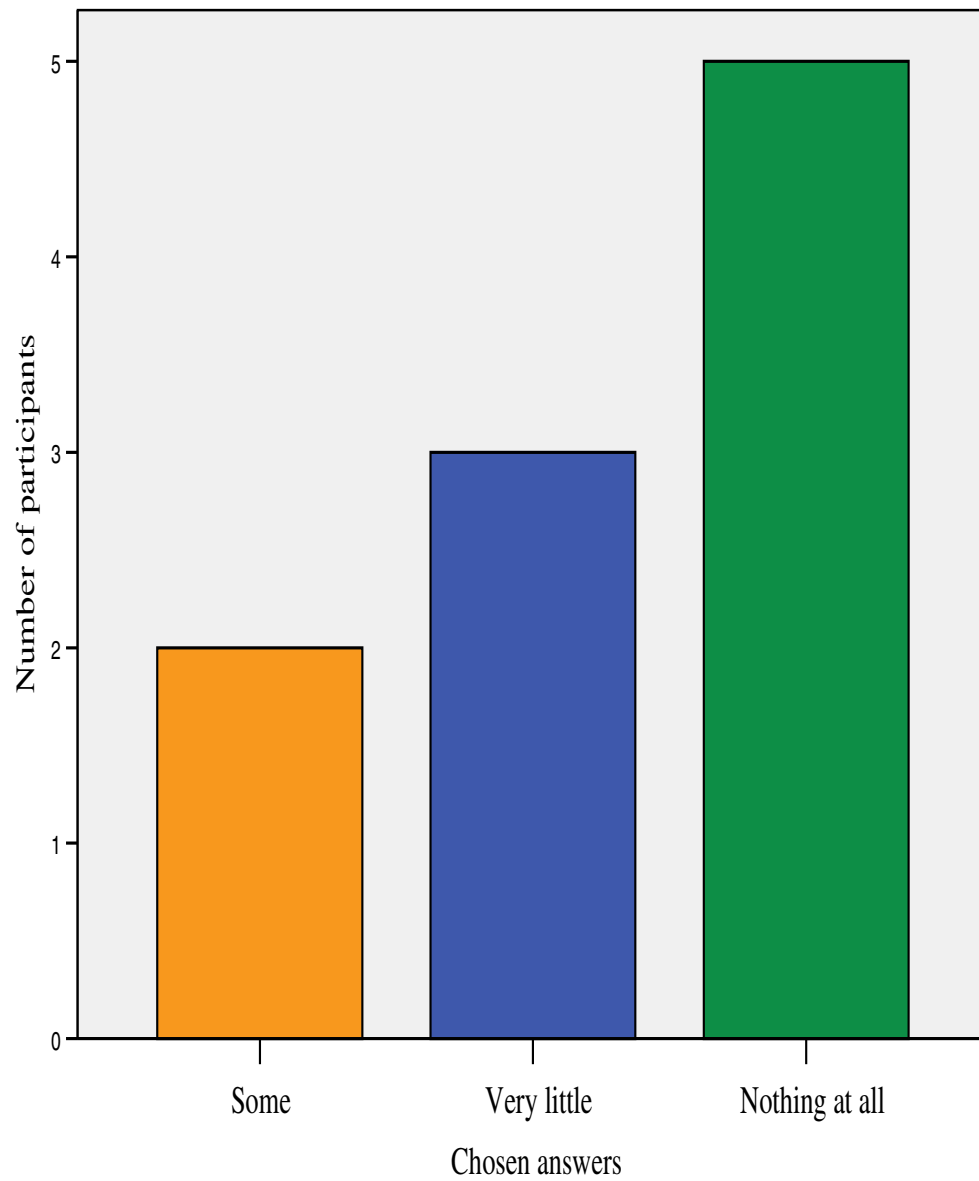
Advisory Awareness

The state of Montana as well as the reservation issue advice for eating sport caught fish possibly contaminated with mercury. When asked if they knew of such an advisory for Montana or the reservation, the majority ($n = 9$) of participants responded “No”. Only one participant out of the study sample stated that they knew of any fish advisory. This woman learned of Montana’s fish advisory at school. When asked specifics regarding how much she knew about fish species guidelines, fish size guidelines, fishing locations, and consumption frequency in the Advisory, the participant stated “Only a little”. When asked specifics regarding how often she followed the guidelines of fish species, fish size, fishing locations, and consumption frequency in the Advisory, the participant stated “Occasionally”. To conclude the advisory awareness portion of the survey, the participants were given a picture of the Montana Sport Fish Consumption Guidelines pamphlet. When asked if they had ever seen the pamphlet, the majority ($n = 9$) responded “No”.

Risk Awareness

The participants were also asked about their awareness of risk associated with the consumption of fish possibly contaminated with methylmercury. When asked about their general knowledge of mercury contaminants in fish, half ($n = 5$) stated that they knew “nothing at all”, with three reporting “very little” knowledge and one reporting “some” knowledge. These results are also displayed in Fig. 6. None of the participants stated that they knew “a lot” about this subject matter.

Figure 6. In General, How Much Do You Know About Mercury Contaminants in Fish?



The participants were then asked to answer true or false to 10 different questions regarding mercury contaminants in fish. The results are displayed in Table 1 below and

each number corresponds with the number of participants that either answered “Yes”, “No”, or “Don’t know”. The correct answers are displayed in Appendix C.

Table 1

Participant’s Knowledge Regarding Mercury Contaminants in Fish

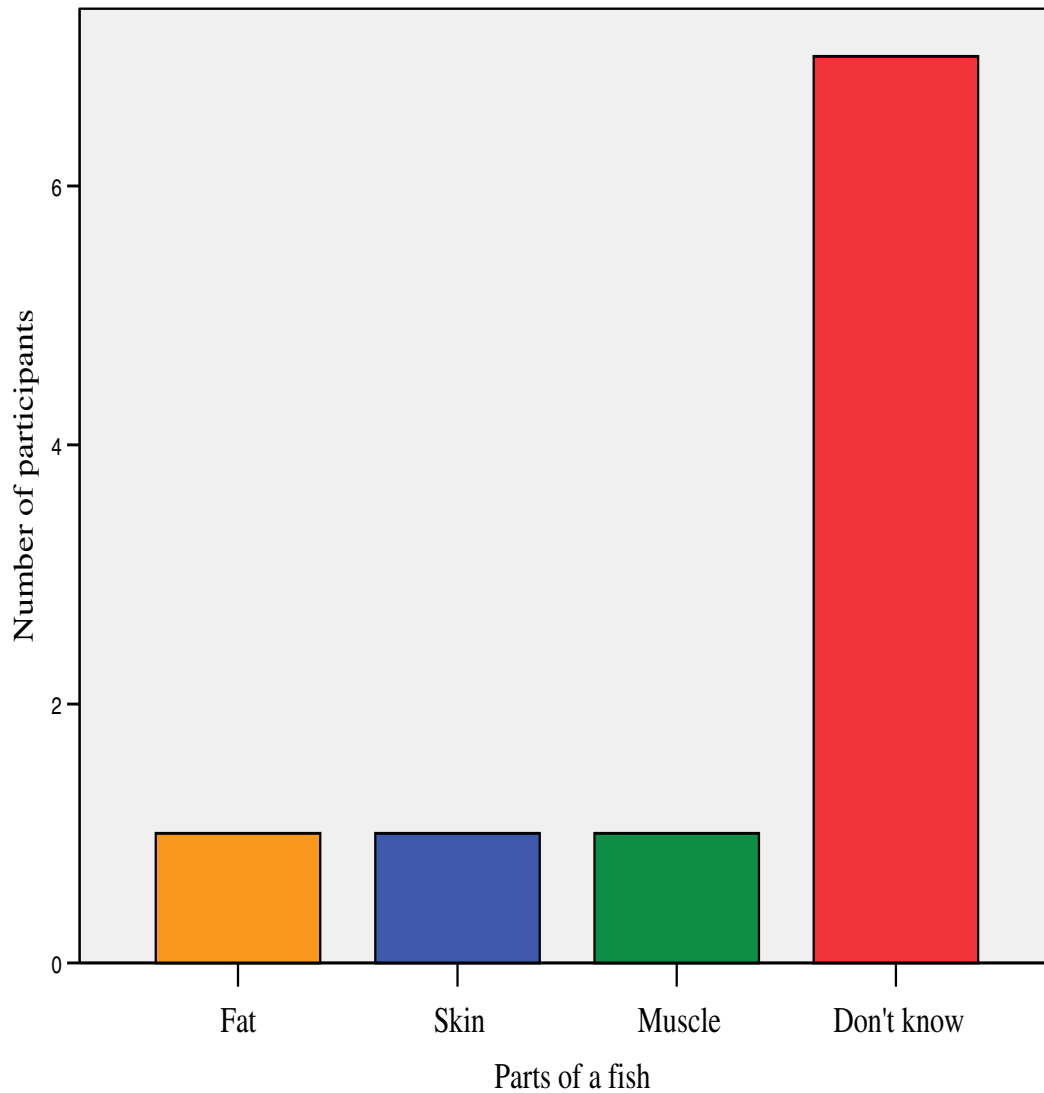
Statement	True	False	Don’t Know
Small fish have more mercury than large fish	3*	3	4
Old fish have more mercury than young fish	4	3	3
Fish that eat other fish have more mercury than fish that eat algae or plants	2	1	7
Fish that are low in fat have more mercury than fish that are high in fat	2	2	6
Exposure to mercury increases the risk of cancer	5	1	4
Exposure to mercury increases the risk of arthritis	2	3	5
Exposure to mercury harms the muscles ability to function	4	1	5
Mercury in fish can be reduced or eliminated by using proper cooking and cleaning techniques	1	5	4
Exposure to mercury harms a developing child during pregnancy	4	3	3
The human body can eliminate mercury over time	2	4	4

(* Number of participant responses)

Next, in the assessment of risk awareness, the participants were asked where they thought one would find the highest levels of mercury in fish. These results are displayed in Fig. 7

with the majority ($n = 7$) of participants stating “Don’t know”. This left one response each for fat, skin, or muscle.

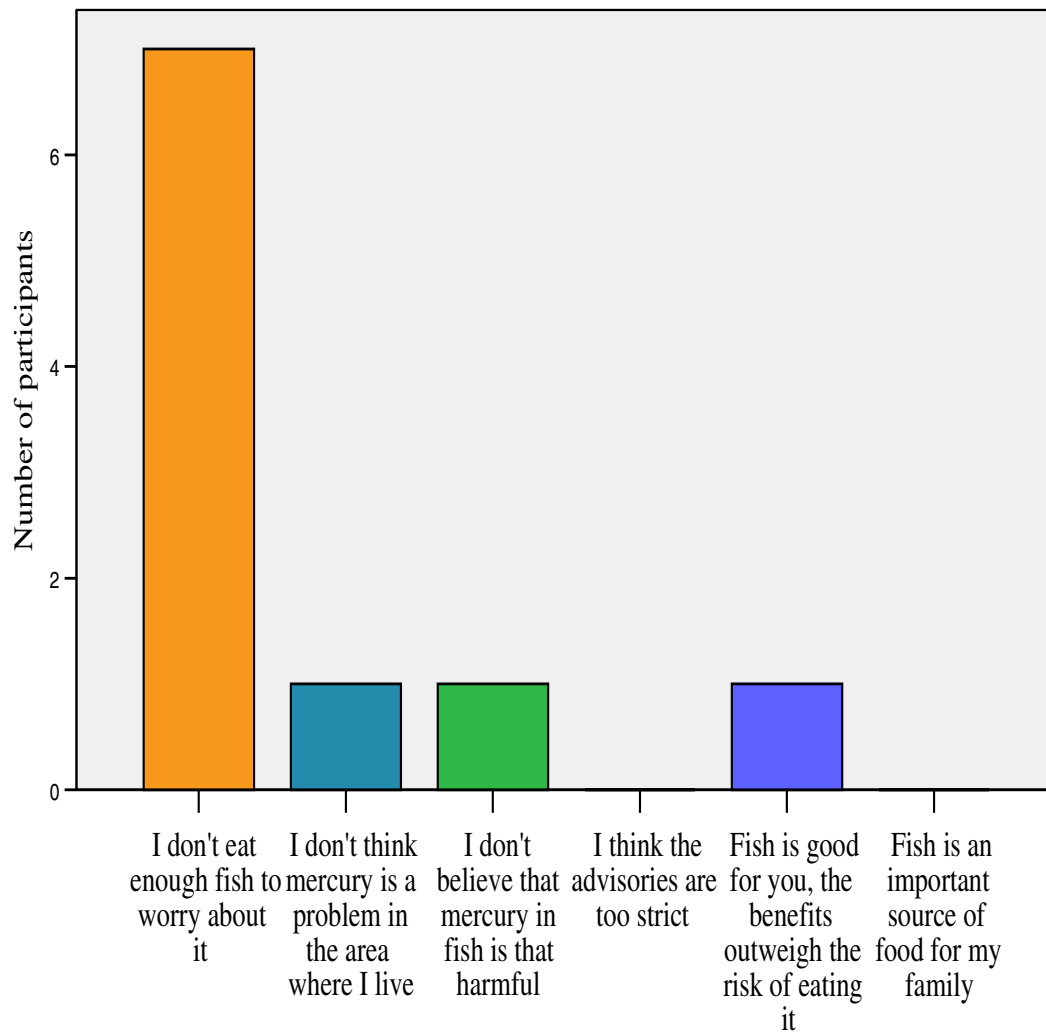
Figure 7. Participants Ideation of Where the Highest Level of Mercury in Fish Exists



The final risk awareness question asked participants why they do not always follow the recommendations in the Montana Advisory. The question gave six prompted answers and the participants were asked to check all that apply. Out of the ten

participants, seven felt that they did not eat enough fish to worry about it, while one felt that mercury is not a problem where they live. These results are also displayed in Fig. 8. In accordance, one participant didn't believe that mercury in fish was that harmful and one felt that the benefits of eating fish outweigh the risks. None of the participants felt that the advisories were too strict or that fish was an important source of food for their family.

Figure 8. Participants Response as to Why People May Not Always Follow the Recommendations in Health Advisory

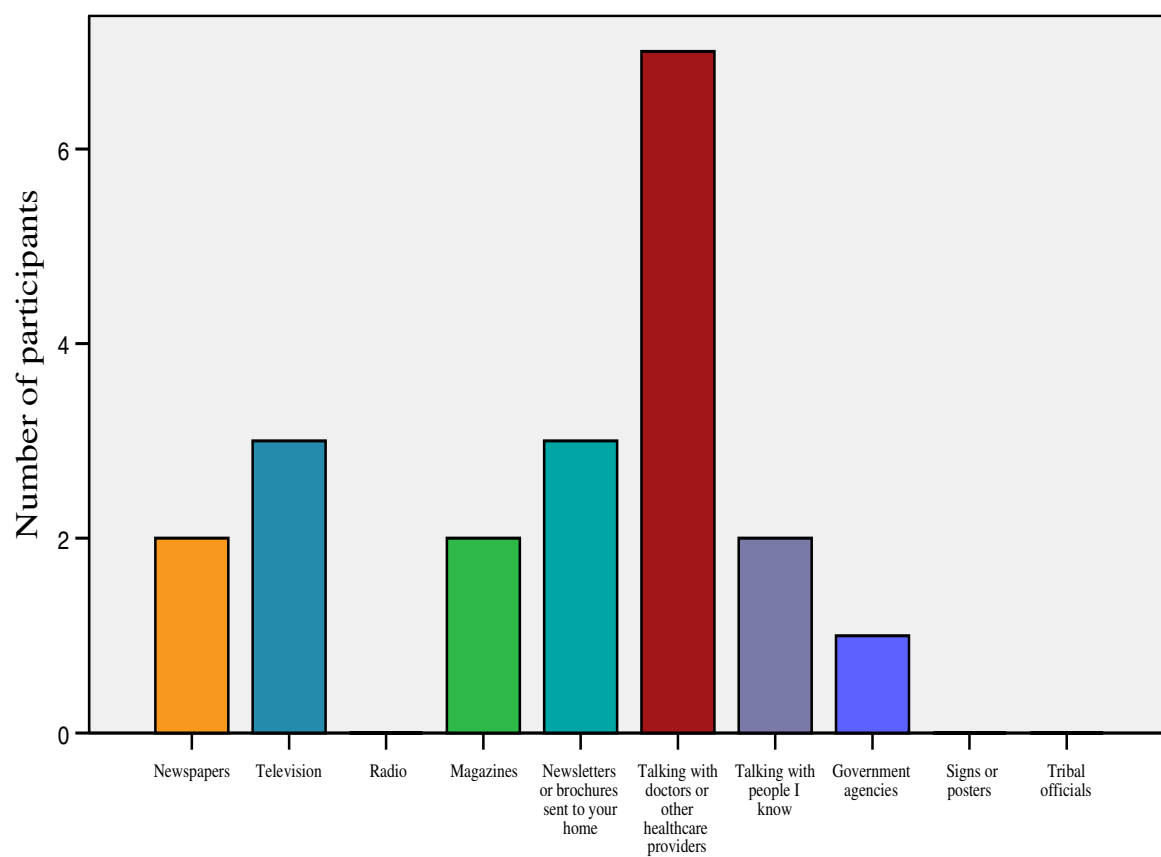


Risk Communication Preferences

To assess the cohort's preferences when receiving messages regarding risk communication, the participants were asked two separate questions. The participants were given a list of various sources and were asked to rate their usefulness in conveying health information. The majority ($n = 9$) of participants found 'talking with doctors or other healthcare providers' as "very useful". Other sources that were "very useful" included government agencies ($n = 6$), newsletters or brochures sent to the home ($n = 5$), talking with friends and relatives ($n = 4$), and tribal officials ($n = 4$). The least helpful sources of health information were radio ($n = 4$) and signs and posters ($n = 2$).

The participants were also asked to select the two most important sources of health information according to the same list of various health information sources. These results are displayed below in Fig. 9. There were a total of seven responses for "talking with a doctor or healthcare provider". This was followed by a total of three responses each for "television" and "newsletters or brochures sent to your home". "Newspapers", "Magazines", and "talking with friends and relatives" each received two responses while "government agencies" received one response. None of the participants felt that the radio, signs or posters, nor tribal officials were one of the two most important sources of health information.

Figure 9. Total Number of Participant Responses as to the Most Important Sources of Health Information



CHAPTER 5

DISCUSSION

Summary

The developing fetus and young children are considered especially vulnerable to environmental toxins. One toxin in particular, methylmercury, has been scientifically linked to adverse neurodevelopment effects, even at minute doses. Maternal consumption of contaminated fish during the prenatal period comprises the primary route of exposure to the fetus (National Resource Council [NRC], 2000). A diet that includes fish consumption is necessary to help prevent heart and other vascular diseases. However, navigating the complex risk/benefit messages associated with fish consumption can prove challenging for the average consumer. Recent research has explored this subject matter and has made conclusions regarding fish consumption and its association with possible methylmercury contamination.

During the spring of 2006, data was collected at a WIC clinic for a pilot study entitled “Methylmercury Risk and Awareness in American Indian Women of Childbearing Age”. The pilot study consisted of a 36 question survey that took place on an open reservation where non-Native Americans have the opportunity to purchase land and homes within the reservation boundaries. Of the 90 completed surveys, 10 were completed by White non-Hispanic study participants. With the wide-spread dissemination of risks and advisories regarding methylmercury and fish consumption, this study was specifically aimed to investigate the following three questions.

1. What fish consumption patterns exist among the cohort?
2. Are rural non-Native women of childbearing age residing on an open reservation and participating in WIC clinic services (a) aware of the Montana sport fish consumption advisory? and (b) aware of the risks associated with consuming fish contaminated with methylmercury?
3. What are the risk communication preferences among the cohort?

Sample Characteristics

Generally speaking, the analysis of the sample characteristics demonstrated the need to study the population. This unique cohort was found to be a targeted audience for concern and at risk for methylmercury contamination and possible transfer to their unborn fetuses and young children. This was based on their ages (all 18-45), race (all White, non-Hispanic), and pregnancy status (three were currently pregnant with four planning to become pregnant within the next year).

Fish Consumption Patterns

The majority of study participants do eat fish as a part of their diet. This finding corresponded well with the findings by Anderson, et al. (2004) and Knobeloch, et al. (2005). However, the size of sport-caught fish and meals eaten were not found to be a factor in adding to the extent of mercury contamination in the fish consumed. Generally, the larger fish and the more meals eaten increase the likelihood of methylmercury exposure. One person in the present study had made the decision to avoid eating fish altogether. The participant's reason for doing so was because she "didn't like the taste".

In the last 12 months, the majority ($n = 9$) had consumed seafood such as shrimp, lobster, clams, crab, crayfish, or imitation shellfish. During the same time period, one had eaten five-eight fish meals per month, and one had eaten nine or more fish meals per month. According to the EPA (2004) and FDA (2004) federal guidelines, the recommended allowance of most seafood products was two to four fish meals per week. If the participant's fish consumption was broken down to seafood meals consumed per week, there is a possibility that two of the participants could be reaching the pre-determined safe consumption of seafood. According to the results, it appears as though there is not a seafood consumption concern in eight of the participants. It is important to note, however, that methylmercury has the potential to accumulate gradually based on total fish and seafood consumption (Knobeloch & Anderson, 2005). When the fish consumption frequencies for the four fish and seafood products listed were added together, there was a greater concern for toxicity in the participants.

In the last 12 months, the majority ($n = 8$) had consumed fish fillets, fish sticks, or fish sandwiches. There are no federal or Montana guidelines listing the consumption of these fish products. However, there is the potential for mercury contamination for these fish products. The EPA (2004) and FDA (2004) state that fish sticks and fish sandwiches are usually low in mercury. However, as previously stated, the mercury consumed has an accumulative effect by which these fish products could add to the possible mercury toxicity in a WCBA, fetus, or young child.

In the last 12 months, the majority ($n = 8$) had consumed light tuna. During the same time period, one participant reported consuming five to eight light tuna meals per

month and one reported consuming nine or more meals per month. The EPA (2004) and FDA (2004) federal guidelines list safe tuna consumption as up to two meals per week. The research findings suggest that two of the participants could be at risk from the consumption of light tuna, especially with the consumption of other fish and seafood.

In the last 12 months, six of the participants reported eating albacore tuna. During the same time period, three participants reported consuming two to four meals per month, two reported consuming five to eight meals per month, and one reported consuming nine or more meals per month. When these meals per month were converted to meals per week, these six participants were possibly in danger of mercury contaminated from albacore tuna alone. Albacore tuna is known to contain a higher concentration of mercury than light or canned tuna. It is recommended that a WCBA consume only one meal per week of albacore tuna.

In summary, fish and seafood products were consumed by most of the study participants. The results demonstrated that the participants were possibly at an increased danger of mercury toxicity due to the number of fish and seafood meals eaten during the last one year.

Advisory Awareness

The extent of fish advisory awareness was ascertained through a series of five questions from the survey. Only one participant had any knowledge that a sport-caught fish advisory existed for the state of Montana. Additionally, this one participant stated that she knew “only a little” of the advisory and only followed the guidelines “occasionally”. This further increases the possibilities of neuro-toxicity from this

environmental toxin. These findings correspond with the findings found in the literature review (Tilden et al, 1997; Burger & Waishwell, 2001; Bienenfeld, Golden, & Garland, 2003; Imm, Knobeloch, & Anderson, 2005; Montana Department of Public Health and Human Services, 2005). The majority of WCBA were not aware of any federal or local advisories that stated safe consumption levels of fish and fish products. If a WCBA is not aware of any advisories, it is less likely that she will be able to follow any recommended federal or state guidelines. If the guidelines are not followed, there is a possible increased risk of mercury poisoning from consuming contaminated fish.

Risk Awareness

Whenever there is an advisory regarding an environmental threat to humans, there is a certain risk placed on the threat. Additionally, the risks and benefits must be weighed in order to make a conscious and sound decision regarding the threat. The health benefits of consuming fish must be weighed with the potential health risks of mercury toxicity from ingesting fish.

Most of the study participants did not have any knowledge of mercury contaminants in fish and others only knew “some” or “very little”. Regarding the true/false questions on the survey, there were no consistent correct answers from the participants and many simply stated they ‘didn’t know’ the correct answer. The correct answers for question 13 are found in Appendix C. When asked where they thought the highest levels of mercury were found in a fish, the majority ($n = 7$) stated that they ‘didn’t know’. The highest levels of mercury are found in the muscles of a fish and only one

participant reported the correct answer. However, this may have been a guess on the part of the participant.

A potential reason for the low awareness of risk was found in the answers to question 20. A majority of the participants ($n = 7$) felt that they did not eat enough fish to worry about following the recommendations of the Montana Fish Consumption Guidelines. These women felt the risk was low because they had not consumed enough fish to cause a concern. However, based on the amount of fish eaten by these participants in the past year, they could be at more risk than they originally thought. One participant stated that they did not believe that mercury contamination was a problem in the area they lived, while another felt that mercury in fish was not harmful. Yet another participant felt as though the benefits outweighed the risks of eating fish. These findings are associated with Knuth, et al (2003) who found that when the risk perceptions were moderate or low, more fish were consumed.

Risk Communication Preferences

In order to properly convey the risks of methylmercury contamination through fish consumption, the risk messages must be well received by the target populations. This involves knowing the wants and needs of WCBA as to the risk communication messages that they are most likely to consider. This involves knowing and relaying the health information sources that are helpful and important to them. It has become apparent that the cohort in the current study has not properly received any advisory or guideline recommendations.

According to the participants, talking with doctors or other healthcare providers was the most helpful in obtaining health information. This poses a challenge to all healthcare providers to make sure that health information is properly communicated to patients. In healthcare clinics, nurses and Advanced Practice Registered Nurses (APRN's) see patients who are thinking about or are going to become pregnant. During any dietary consultation or general health exam, there should be a discussion about the risks and benefits of fish consumption. Government agencies were also listed as a helpful source for obtaining health information. Currently, the Montana Fish, Wildlife, and Parks and the Montana Department of Public Health and Human Services are excellent resources for safe fish consumption. These government agencies provide information online and in pamphlets for the public. Additionally, fish consumption guidelines are free and can be found at retail stores that sell fishing licenses. As a healthcare provider, it is often difficult to discuss health concerns without the backing of scientific proof. In this case, it is necessary to utilize the precautionary principle which involves taking a safety measure whenever there is a possible link between an environmental health threat and a health effect. This approach was recommended in the reviewed literature (Healthy Canada, 2000; Statler, et al., 2004; Kriebel & Tickner, 2001).

For the 10 participants in this study, other important sources of health information included television, magazines, newsletters and brochures sent to the home, and talking with friends and relatives. Talking with friends and relatives about healthcare matters was described by Long & Weinert (2006) as an important source of information for rural residents. Additionally, with these sources, the information is brought to the WCBA

instead of them seeking the information themselves. A great deal of health information about methylmercury can be found online where the WCBA has to seek it out. This leads to a potential setback if computer access is not available to the WCBA. Risk communication messages on television, in magazines, and in newsletters and brochures may have a better chance of reaching the target audience. The risk communication messages must contain information about the risks and benefits of consumed fish. However, discussing the risks may decrease fish consumption, thereby decreasing the health benefits found in the fish as was the case in the Oken, et al. (2003) study.

To reiterate the chosen conceptual framework, the main characteristics of effective risk communication include the following four principles:

1. Provide for a two-way process
2. Tailor to the context and the participants
3. Use flexibility and adaptability to any cultural or communication differences
4. Arise from credible sources that are trustworthy (Healthy Canada, 2000).

A two-way process involves making the targeted audiences needs and wants a priority when designing risk communication messages, such as fish advisories or guidelines.

These messages should also be tailored to the learning needs and styles of WCBA. When analyzing the data, it became apparent that the cohort may have unique learning needs.

This is further discussed below in the limitations section. According to the study participants, credible sources of health information were healthcare providers and government agencies. While these sources are discussed above, it is important to reiterate their importance in relaying risk and benefit messages of consuming fish. While fish is a

necessary component of a healthy diet, it is important to consider the possible neuro-developmental effects of the environmental toxin known as methylmercury.

Limitations

Sample Size

The small convenience sample ($n = 10$) that was available for analyzing the data may not be representative of the population studied. Any participant error when completing the survey magnified the results to lessen the credibility and validity of the findings. The results could be swayed one way or the other depending on how just one or two participants answered the questions. There are twice as many White/non-Hispanic people living on this particular open reservation than Native American Indians. The pilot study had nearly eight times more Native American Indian than non-Native participants complete the survey. Although WIC clinics are open to all who qualify regardless of ethnicity, this particular clinic attracts primarily Native American women.

Pilot Study Survey

The survey in the pilot study was completed on a touch-screen computer through the use of Snap Software. A research assistant read the questions and entered the participant's answers on the computer. If the questions were not fully understood or were confusing to the participants, the results may have become skewed. In addition, the presence of the research assistant may have affected the participant responses. There were at least four instances where the results may have become skewed.

First, questions two through six of the survey asked about sport caught fish. There was not a place in the survey that defined what a sport caught fish was. It can be assumed that a sport caught fish is a fish that is caught and consumed for fun and/or sustenance by an angler, but the study participants may not have fully understood the term and answered the questions inappropriately.

Next, in Question two, the participants were asked about “1 month local fish”. This terminology may have been confusing to the study participants and may have been a reason why this question was left blank by two of the participants. The decision was made to include the non-random missing data in order to discuss the possibly confusing terminology of the question and to guide the furnishing of survey questions in the future. In this study, the non-random missing data may have threatened the content validity.

Thirdly, when re-analyzing the data, it was noted that one participant had made the decision to avoid eating fish. However, they also reported consuming seafood (2-4 meals/month), fish sticks, fish fillets, and fish sandwiches (2-4 meals/month) in the past year. This participant also stated that they had not consumed any light tuna or albacore tuna in the past one year. However, when asked about meals eaten per month, the participant reported eating light tuna (2-4) and albacore tuna (2-4).

Finally, when re-analyzing the data, it was noted that one participant reported not consuming any of the fish, fish products, or seafood listed in question 10. However, when asked specifically about meals eaten per month, the participant reported eating nine or more meals per month of each fish, fish products, and seafood. If a participant answered “no” to question 10, they should not have had the option to answer question 11 as it

would not have pertained to them. This finding may be related to the electronic skip patterns set for the survey.

Recommendations

While conclusions were able to be made from the findings of this hypothesis-generating study, there are six distinct recommendations that may guide future research on this subject matter. First, there is a need for a larger study with the same population or a similar population of rural dwellers to better understand fish consumption patterns, advisory awareness, risk awareness, and risk communication preferences in terms of mercury contaminants in consumed fish. There are numerous examples in the literature regarding mercury and fish; however, there is still a gap in the literature regarding rural WCBA and potential methylmercury exposure.

The federal and Montana advisories and guidelines list specific fish species that generally contain higher amounts of mercury. Any future studies should include questions about the consumption of specific fish species beyond the species listed in the current survey. In Montana, WCBA should avoid all lake trout, northern pike, and walleye over 15 inches in length. These species are predatory fish that tend to grow rapidly and are readily available for an angler to catch on or near the reservation.

The federal and Montana advisories and guidelines also list the portion size limits that a WCBA is safely able to consume. Future studies should include questions about the consumption of portion sizes as this could change the amount of mercury that is ingested. The Montana Sport Fish Consumption Guidelines list the safe consumption portion sizes

according to each fish species. However, the guidelines merely suggest the portion sizes for fish species and nothing about the accumulation of mercury over time in the body. For example, a WCBA can eat one, four to six ounce meal per week of lake trout and up to two, six ounce meals per week of brown trout. A WCBA may also eat up to four, six ounce meals during the same week of cutthroat trout. Add these portions together and the WCBA could possibly be exceeding the mercury threshold to dangerous toxic levels. More specific guidelines on portion sizes may reduce potential health threats.

The Montana Sport Fish Consumption Guidelines pamphlet synthesized by the Montana Department of Public Health and Human Services and the Montana Department of Fish, Wildlife, and Parks is somewhat confusing to read, understand, and apply. This is coupled with the results that demonstrated a low percentage of participants that were aware of any fish advisory or aware of any risks associated with consuming contaminated fish. A more user-friendly pamphlet may increase awareness and compliance of any fish advisory.

Prior studies have implicated the need to test for the amount of mercury within the body in WCBA and their young children. The National Health and Nutrition Examination Survey (NHANES) of 1999-2000 analyzed hair samples in U.S. children (1-5 years) ($n = 838$) and women (16-49 years) ($n = 1,726$) to determine the extent of mercury exposure. Among those that frequently consumed fish, the “hair mercury levels were three-fold higher for women and two-fold higher for the children” (McDowell, et al., 2004, p. 1165) than non-consumers. According to the NRC (2000), the mercury found in hair samples is available for weeks or months after an exposure and thus the biomarker of choice.

Another advantage to analyzing hair samples is that the testing is virtually noninvasive. Blood serum mercury levels provide an invasive biomarker for mercury exposure, although not with as great of an impact as the hair sample testing. Within the current study, the participants were asked about their willingness to provide a hair sample and blood sample to test for mercury presence in the body. Most were willing to provide a hair ($n = 8$) or blood ($n = 7$) sample to determine the extent of mercury exposure. This indicates that further testing for mercury exposure in this population may add to the knowledge of mercury contaminants in fish and the possible health threats.

Finally, any future studies that consist of this cohort may also want to survey the WCBA about any young children they have and their patterns of fish consumption. From birth through five years of age, a young child's neuro-development is rapidly evolving making them highly susceptible to mercury contaminants in fish.

REFERENCES

- American Heart Association (2000). Dietary guidelines, revision 2000: A statement for health care professional from the Nutrition Committee of the American Heart Association. *Circulation*, 102, 2296-2311.
- American Heart Association (2002, 11/18/2002). New guidelines focus on fish, fish oil, omega-3 fatty acids. Retrieved March 11, 2006' from <http://www.americanheart.org/presenter.jhtml?identifier=3006581>
- Alaszewski, A. (2005). Risk communication: Identifying the importance of social context. *Health, Risk & Society*, 7(2),101-105.
- Anderson, H., Hanrahan, L., Smith, A., Draheim, L., Kanarek, M., & Olsen, J. (2004). The role of sport-fish consumption advisories in mercury risk communication: A 1998-1999 12 state survey of women age 18-45. *Environmental Research*, 95, 315-324.
- Anderson, K.N., Anderson, L.E., Glanze, W.D. (Eds.). (1998). Mosby's Medical, Nursing & Allied Health Dictionary. (5th ed.). Mosby, St. Louis, MO.
- Arnold, S.M., Lynn, T.V., Verbrugge, L.A., & Middaugh, J.P. (2005). Human biomonitoring to optimize fish consumption advice: Reducing uncertainty when evaluating benefits and risks. *Policy, Biology, and Health*. 95(3):393-397.
- Bakir, F., Damluji, D., & Amin-Zaki, L., Murtadha, M., Khalidi, A., Rawi, A., et al. (1973). Methylmercury poisoning in Iraq. *Science*, 181, 230-241.
- Beehler, G.P., McGuinness, B.M., & Vena, J.E. (2003). Characterizing latino anglers' environmental risk perceptions, sport fish consumption, and advisory awareness. *Medical Anthropology Quarterly*. 17(1), 99-116.
- Behavioral risk factor surveillance system 2005 MT questionnaire. Retrieved on November 5th, 2006 at http://dphhs.mt.gov:8084/brfss/pdf/2005Questiionaire/MT_questionnaire2005final.pdf
- Bennett, P., Calman, K. (1999). *Risk communication and public health*. Oxford: Oxford University Press.
- Bienenfeld, L., Golden, A., & Garland, E. (2003). Consumption of fish from polluted waters by WIC participants in East Harlem. *Journal of Urban Health*, 89, 349-358.

- Burger, J. & Waishwell, L. (2001). Are we reaching the target audience? Evaluation of a fish fact sheet. *The Science of the Total Environment*, (277:77-86.
- Carrington, C., & Bolger, M. (2002). An exposure assessment for methylmercury from seafood for consumers in the United States. *Risk Analysis*, 22(4), 689-699.
- Carrington, C.D., Montwill, B. & Bolger, P.M. (2004). An intervention analysis for the reduction of exposure to methylmercury from the consumption of seafood by women of child-bearing age. *Regulatory Toxicology and Pharmacology*, 40, 272-280.
- Cho, Y. (2006). Secondary data analysis. Retrieved October 28th, 2006 from <http://www.srl.uic.edu/seminars/Analysis/2ndanalysis03-04.PDF>
- Committee on The Toxicological Effects of Methylmercury Board on Environmental Studies and Toxicology, National Research Council. (2000). Toxicological effects of methylmercury. Retrieved on March 20, 2006 at http://books.nap.edu/execsumm_pdf/9899.pdf
- Davidson, P., Myers, G. & Weiss, B., (2004). Mercury exposure and child development outcomes. *Pediatrics*, 113(4), 1023-1029.
- Environmental Protection Agency. (1997). *Mercury study Report to Congress. Volume 1: Executive Summary (No. EPA-452/R-97-003)*: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standard, and Office of Research and Development
- Environmental Protection Agency. (2004). What you need to know about mercury in fish and shellfish. Washington, DC: EPA and FDA.
- Environmental Protection Agency. (2004a). Fish advisories with links to state, territory, and tribal fish advisory programs. Retrieved March 20, 2006 from <http://www.epa.gov/ost/fish/states.htm>
- Food and Drug Administration. (2004). What you need to know about mercury in fish and shellfish. EPA-823-R-04-005. Retrieved March 27, 2006, from <http://www.cfsan.fda.gov/~dms/admehg3.html>
- Gilbert, S.G.& Grant-Webster, K.S. (1995). Neurobehavioral effects of developmental methylmercury exposure. *Environmental Health Perspectives*. 103(Suppl 6): 135-142.
- Gordis, L. (2004). *Epidemiology*. (3rd ed.). Elsevier Saunders. Philadelphia, PA.

- Hayes, J. (2005). What to tell patients about eating fish. *The Clinical Advisory*. 8(2), 335-43.
- Health Canada decision-making framework for identifying, assessing, and managing health risks. (2000). Retrieved on October 21, 2006 at http://www.hc-sc.gc.ca/ahc-asc/pubs/hpfb-dgpsa/risk-risques_cp-pc_e.html
- How mercury in fish is regulated. (2006). Retrieved March 17, 2006 from http://www.realmercuryfactos.org/about_mercury/how_regulated.hm
- Imm, P., Knobeloch, L., Anderson, H.A., & the Great Lakes Sport Fish Consortium (2005). Fish consumption and advisory awareness in the great lakes basin. *Environmental Health Perspectives*. 113(10), 1325-1329.
- Institute of Medicine of the National Academies. (October 2006). Seafood choices: Balancing benefits and risks. Retrieved November 10, 2006 from <http://www.nap.edu>
- Jardine, C.G. (2003). Development of a public participation and communication protocol for establishing fish consumption advisories. *Risk analysis*. 23(3), 461-471
- Knobeloch, L., Anderson, H., Imm, P., Peters, D., & Smith, A. (2005). Fish consumption, advisory awareness, and hair mercury levels among women of childbearing-age. *Environmental Research*, 97, 220-227.
- Knuth, B., Connelly, N., Sheeshka, J., & Patterson, J. (2003). Weighing health benefit and health risk information when consuming sport-caught fish. *Risk Analysis*, 23(6), 1185-1197.
- Kriebel, D., Tickner, J. (2001). Reenergizing public health through precaution. *American Journal of Public Health*. 91(9), 1351-1355
- Lee, H. (Ed.). (1998). *Conceptual Basis for Rural Nursing*. New York: Springer Publishing Company.
- Lee, H.J. & Winters, C.A. (2006). *Rural nursing: Concepts, theory, and practice*. (2nd ed.). New York, NY. Springer Publishing Company.
- Levine, K.J., Miller, V.D., Kamrin, M.A. & Dearing, J.W. (1999). Anglers' attitudes, beliefs, and behaviors as impacted by the Michigan fish consumption advisory. *Journal of Public Health Management Practice*, 5(6), 18-28.
- Long, K.A. & Weinert, C. (2006). Rural nursing: Developing the theory base. In Lee, H.J. & Winters, C.A. (Eds.). (2006). *Rural nursing: Concepts, theory, and practice*. (2nd ed.). New York: Springer Publishing Company

- Magee, T., Lee, S.M., Giuliano, K.K., Munro, B.. (2006). Generating new knowledge from existing data: The use of large data sets for nursing research. *Nursing Research*. 55(28), S50-S56.
- McDowell, M.A., Dillon, C.F., Osterloh, J., Bolger, P.M., Pellizzari, E., Fernando, R., et al. (2004). Hair mercury levels in U.S. children and women of childbearing age: Reference range data from NHANES 1999-2000. *Environmental Health Perspectives*, 112 (11), 1165-71.
- Montana Department of Public Health & Human Services. (2005). Retrieved March 23, 2006 from <http://www.dphhs.mt.gov/>
- Montana Department of Public Health & Human Services. (2006). Behavioral risk factor surveillance system 2005 MT questionnaire. Retrieved November 5th, 2006 from http://dphhs.mt.gov:8084/brfss/pdf/2005Questionnaire/MT_questionnaire2005final.pdf
- Montana sport fish consumption guidelines. (2005). Retrieved March 23, 2006 from <http://www.dphhs.mt.gov/fish2005.pdf>
- National Research Council. (2000). Toxicological effects of methylmercury. Washington, DC: National Academy Press.
- NINDS Neurotoxicity Information Page. (2006). Retrieved on January 4th, 2006 from <http://www.ninds.nih.gov/disorders/neurotoxicity/neurotoxicity.htm>
- Office of Environmental Health Hazard Assessment. (2006). Retrieved March 13, 2006, from <http://www.oehha.ca.gov/fish/hg/>.
- Oken, E., Keinman, K.P., Berland, W.E., Simon, S.R., Rich-Edwards, J.W. & Gillman, M.W. (2003). Decline in fish consumption among pregnant women after a national mercury advisory. *Obsterics and Gynecology*. 102(2), 346-351.
- Pflugh, K., Lurig, L., Von Hagen, L.A., Von Hagen, S. & Burger, J. (1999). Urban anglers' perception of risk from contaminated fish. *Science of the Total Environment*. 228, 203-218.
- Polit, D.F., & Beck, C.T. (2004). Nursing research: Priniciples and methods. Philadelphia, PA. Lippincott.
- Polit, D., & Hungler, B. (1999). *Nursing research: Principles and methods*. Philadelphia, PA: Lippincott.

- Pollack, C.D. (1999). Methodological considerations with secondary analysis. *Outcomes Management for Nursing Practice*. 3(4), 147-152.
- Rice, D., Schoeny, R., & Mahaffey, K. (2003). Methods and rationale for derivation of a reference dose for methylmercury by the U.S. EPA. *Risk Analysis*, 23(1), 107-115.
- Sattler, McPhaul, Afzal, & Mood in Stanhope, M., Lancaster, J. (2004). *Community & Public Health Nursing*. (6th ed.). Mosby. St. Louis, MI.
- Seafood choices: Balancing benefits and risks. (2006). *Institute of Medicine of the National Academies*.
- Smith, W.E. & Smith, A.M. (1975). *Minamata*. New York: Holt, Rinehart and Winston.
- The National Consumer Council (2002). *Running risks: Summary research into Consumers' views on risk*. (London: National Consumer Council).
- The Presidential/Congressional Commission on Risk Assessment and Risk Management. (1997). Retrieved November 12, 2006 from www.epa.gov/ncea/pdfs/riskcom/riskcom1.pdf
- Thirlaway, K.J., Heggs, D.A. (2005). Interpreting risk messages: Women's responses to a health story. *Health, Risk & Society*. 7(2), 107-121.
- Tilden, J., Hanrahan, L.P., Anderson, H., Palit, C., Olson, J., Kenzie, W.M. & the Great Lakes Sport Fish Consortium. (1997). Health advisories for consumer of Great Lakes sport fish: Is the message being received?. *Environmental Health Perspectives*. 105(12). Retrieved March 17, 2006, from <http://www.ehponline.org/members/1997/105-12/tilden-full.html>
- U.S. Census Bureau. (2000). QuickFacts. Retrieved on March 12, 2007 from <http://quickfacts.census.gov/qfd/states/30000.html>
- U.S. Health Services. (1995). Prevention report. Risk communication: Working with individuals and communities to weigh the odds. Retrieved on October 20, 2006 from <http://odphp.osophs.dhhs.gov/pubs/prevrpt/Archives/95fm1.htm>
- Wright, K. (2005). Our preferred poison. *Discover*, 26(3). Retrieved March 17, 2006, from <http://www.discover.com/issues/mar-05/features/our-preferred-poison/>
- What you need to know about mercury in fish and shellfish. U.S. Food and Drug Administration & U.S. Environmental Protection Agency, 2004.

APPENDICES

APPENDIX A

DEFINITION OF TERMS

DEFINITION OF TERMS

1. Advisory awareness, as defined by Anderson et al. (2004), states it “as a self-report of having knowledge of whether their particular state was issuing an advisory on eating sport-caught fish contaminated with mercury” (p.318). This term also applies to possessing knowledge of any advisories regarding commercially-caught and consumed fish as well.

2. Fish consumption advisories are local and federal guidelines that are “designed to inform the public regarding a) the chemical contaminants contained in some sport fish, b) education for consumers about how to reduce the risks of contamination, c) remind consumers of the health benefits of eating fish, d) present the advisory information as a guideline and not a mandate, and e) to provide consumption-frequency recommendations for childbearing-aged women” (Anderson, et al., 2004, p.316).

3. Methylmercury (MeHg) is an “environmental toxicant found in the aquatic ecosystem....that originates as inorganic mercury from anthropogenic and natural sources” (Carrington, Montwill, Bolger, 2004, p. 272). In the aquatic ecosystem, the inorganic mercury is “converted to methylmercury through bacterial activity”.

4. Neurotoxicity “occurs when the exposure to natural or manmade toxic substances alters the normal activity of the nervous system. This can eventually disrupt or even kill neurons, key cells that transmit and process signals in the brain and other parts of the nervous system. Neurotoxicity can results from exposure to heavy metals...such as mercury. Symptoms include limb weakness or numbness, loss of memory, vision, and/or

intellect, headache, cognitive and behavioral problems, and sexual dysfunction” (NINDS Neurotoxicity, 2006).

5. Precautionary Principle is discussed in Health Canada (2000), where taking a precautionary approach “emphasizes the need to take timely and appropriately preventative action, even in the absence of a full scientific demonstration of cause and effect” (p.8).

6. “Risk can be defined as the probability of an event (such as developing a disease) occurring” (Gordis, 2004, p.177). As seen on an individual basis, “risk” can be seen as a “situation that is likely to be unusual and that has significant potential for damage” (National Consumer Council, 2002). The Presidential/Congressional Commission for Environmental Health Risk Management (1997) has defined “risk” as the “probability of a specific outcome, generally adverse, given a particular set of conditions” (p. 61).

7. Risk communication, according to The National Research Council (NRC), is "an interactive process of exchange of information and opinion among individuals, groups, and institutions" (U.S. Health Services, February/March 1995). The definition includes "discussion about risk types and levels and about methods for managing risks."

8. Risk perception which “refers to the way that individuals intuitively see and judge risks. This is influenced by age, gender, level of education, region of residence, values, social, cultural, and ethical factors” (Health Canada, 2000).

9. “Rural” is a geographical region with a population density of less than 100 but more than six people per square mile (Lee, 1998, p. 301).

10. Sport-caught fish refers to fish that are caught recreationally for sport by licensed anglers in a particular State (Anderson, et al, 2004, p.316). These fish are usually consumed by the fishing license holders or by their family members.

11. A woman of childbearing age (WCBA) is a term used to describe the reproductive period in which a woman is physiologically able to conceive children. Generally, this occurs from the onset of puberty (10-14) until menopause (40-56).

APPENDIX B

METHYLMERCURY RISK & AWARENESS IN AMERICAN INDIAN WOMEN OF
CHILDBEARING AGE SURVEY

Methylmercury Risk & Awareness in American Indian Women of Childbearing Age

Q1 Please enter the initials of the first and last name of the interviewer.

Methylmercury Risk & Awareness in American Indian Women of Childbearing Age

Fish Consumption



Please tell us about the following issues related to you and your family's consumption of fish

Q2 In the last (1 month, 3 months), did you eat any fish (including fresh, canned, smoked, or frozen) purchased at a store or restaurant, or any sport caught fish.

	Yes	No
1 month purchased fish?	☐	☐
3 months purchased fish?	☐	☐
1 month local fish?	☒	☐
3 months local fish?	☐	☐

Q3 Do you or your family ever eat sport caught fish?

- ☐ Yes
☒ No

Go to Q7

Progress

Powered by **snap**

Back

Next

Methylmercury Risk & Awareness in American Indian Women of Childbearing Age

Q4 When you eat sport caught fish, are they generally...

- ☐ Small fish (less than 14 inches)
☐ Medium sized fish (15 to 17 inches)
☐ Large fish (greater than 18 inches)

Q5 What season of the year do you catch/eat the most sport caught fish

- ☐ Spring ☐ Fall
☐ Summer ☐ Winter

Q6 When you eat sport caught fish, where does the fish usually come from?

- ☐ Flathead lake ☐ Reservation streams
☐ Other reservation lakes ☐ Off the reservation

Q7 During an average month, about how many meals of fish do you eat including all types of freshwater and saltwater fish either purchased or caught in local waters?

- ☐ Less than one meal per month ☐ 5-8 meals per month
☐ 2-4 meals per month ☐ 9 or more meals per month

Q8 Have you made a decision to avoid eating fish?

- ☐ Yes
☐ No

Q9 People have different reasons for not eating fish. Please indicate if any of the following are reasons you don't eat fish. (Check all that apply)

- ☐ You don't like the taste ☐ Fish are too expensive
☐ You're allergic to fish ☐ Fish are not available where I live
☐ You're concerned about contaminants ☐ My family and I DO eat fish
☐ You're a vegetarian
 Other, please describe

Q10 In the last 12 months, have you eaten any...

Yes

No

Shellfish including seafood such
as shrimp, lobster, clams, crab,
crayfish, or imitation shellfish?
Fish fillets, fish sticks or fish
sandwiches?
Light Tuna?
Albacore Tuna?

☒	☒
☐	☐
☐	☐
☒	☒

Q11 About how many meals of each of the following did you eat per month in the last 12 months?

*Less than
one/month* *2-4/month* *5-
8/month* *9 or
more/month*

Shellfish including
seafood such as
shrimp, lobster, clams,
crab, crayfish, or
imitation shellfish?
Fish fillets, fish sticks,
or fish sandwiches?
Light Tuna?
Albacore Tuna?

☐	☐	☐	☐
☐	☐	☐	☐
☐	☐	☐	☐
☐	☐	☐	☐

Progress 

Powered by **snap**

Back

Next

Methylmercury Risk & Awareness in American Indian Women of Childbearing Age

Has the right information reached the public?



Q12 In general, how much do you know about mercury contaminants in fish?

- ☐ A lot
☐ Some

- ☐ Very little
☐ Nothing at all

Q13 Which statements are true about fish, mercury, and health?

	True	False	Don't Know
Small fish have more mercury than large fish	☐	☐	☐
Old fish have more mercury than young fish	☐	☐	☐
Fish that eat other fish have more mercury than fish that eat algae or plants	☐	☐	☐
Fish that are low in fat have more mercury than fish that are high in fat	☐	☐	☐
Exposure to mercury increases the risk of cancer	☐	☐	☐
Exposure to mercury harms the ability of muscles to function	☐	☐	☐
Exposure to mercury increases the risk of arthritis	☐	☐	☐
Exposure to mercury harms a developing child during pregnancy	☐	☐	☐
Mercury in fish can be			

reduced or eliminated by
using proper cooking and
cleaning techniques
The human body can
eliminate mercury over time

☐ ☐ ☐
☐ ☐ ☐

Q14 Where would you find the highest level of mercury in fish?

- | | |
|-------------------------------------|---|
| ☐ <i>Fat</i> | ☐ <i>Organs</i> |
| ☐ <i>Skin</i> | ☐ <i>The whole fish</i> |
| ☐ <i>Muscle</i> | ☐ <i>Don't know</i> |

Q15 Some states issue consumption advice for fish contaminated with mercury, do you know if Montana or the Flathead Reservation issues an advisory on eating sport caught fish?

- ☐ *Yes*
☐ *No*

Go to Q19

Progress 

Powered by **snap**

Back

Next

Methylmercury Risk & Awareness in American Indian Women of Childbearing Age

Q16 Where did you learn about Montana's fish advisory? (check all that apply)

- | | |
|--|--|
| ☐ TV Shows

☐ TV News
☐ Radio
☐ Magazines

☐ Newsletters/brochures sent to your home
☐ Talking to doctors/health professionals
☐ Talking with People you know | ☐ Government agencies/representatives
☐ Signs or posters
☐ WIC office
☐ Fish and game regulation book when I got my fishing license
☐ School

☐ Internet |
|--|--|

Q17 How much would you say you know about fish species and size guidelines for mercury contaminated sportfish

	<i>A lot</i>	<i>Some</i>	<i>Only a little</i>	<i>Nothing at all</i>
Fish species	☐	☒	☐	☐
Fish size	☐	☐	☐	☐
Fishing location	☒	☐	☐	☐
Consumption frequency	☒	☐	☐	☐

Q18 How often do you follow the guidelines about...

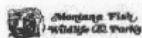
	<i>Always</i>	<i>Usually</i>	<i>Occasionally</i>	<i>Never</i>
Fish species	☐	☐	☐	☐
Fish size	☐	☐	☐	☐
Fishing location	☒	☐	☐	☐
Consumption frequency	☐	☐	☐	☐

MONTANA SPORT FISH CONSUMPTION GUIDELINES



Is my catch safe to eat?

What you need to know about mercury
and PCBs in Montana's sport fish



Q19 Have you ever seen the the pamphlet pictured above?

- ☐ Yes
☐ No

Q20 There are various reasons why people MAY NOT ALWAYS follow the recommendation in the Health Advisory. Please check any of the following reasons why you DO NOT follow the recommendations for mercury.

- | | |
|--|--|
| ☐ I don't eat enough fish to worry about it | ☒ I think the advisories are too strict |
| ☐ I don't think mercury is a problem in the area where I live | ☐ Fish is good for you, the benefits outweigh the risk of eating it |
| ☒ I don't believe that mercury in fish is that harmful | ☒ Fish is an important source of food for my family |

Methylmercury Risk & Awareness in American Indian Women of Childbearing Age

How do you get your information?



Q21 If you are looking for health information on any subject, which of the following would be most useful to you?

	Very useful	Somewhat useful	Not useful	Don't know
Newspapers	☐	☐	☐	☐
Television	☐	☐	☐	☐
Radio	☐	☐	☐	☐
Magazines	☐	☐	☐	☐
Newsletters or brochures sent to your home	☐	☐	☐	☐
Talking with doctors or other healthcare providers	☐	☐	☐	☐
Talking with people I know (relatives & friends)	☐	☐	☐	☐
Government agencies	☐	☐	☐	☐
Signs or posters	☐	☐	☐	☐
Tribal officials	☐	☐	☐	☐

Q22 From the list above, indicate what the two most important sources of health information would be for you? (select 2)

- | | |
|---|---|
| ☐ Newspapers | ☐ Talking with doctors or other healthcare providers |
| ☐ Television | ☐ Talking with people I know |
| ☐ Radio | ☐ Government agencies |
| ☐ Magazines | ☐ Signs or posters |
| ☐ Newsletters or brochures sent to your home | ☐ Tribal officials |

Q23 Would you be willing to provide a sample of your hair (about

the size of a pencil eraser) to know if you have been exposed to mercury?

- ☐ Yes
☐ No

Q24 Would you be willing to provide a blood sample to know if you have been exposed to mercury?

- ☐ Yes
☐ No

Progress 

Powered by **snap**

Back

Next

Methylmercury Risk & Awareness in American Indian Women of Childbearing Age

Please tell us about yourself



Q25 How many women (including yourself) aged 18-45 live in your household?

Q26 What is your age?

☐ Under 18

☐ 18 to 25

☐ 26 to 35

☐ 36 to 45

☐ 46 to 55

Q27 Which of the following describes your marital status?

☐ Single

☐ Married

☐ Widowed

☐ Divorced

☐ Separated

☐ Member of an unmarried couple

Q28 What is your ethnic background?

☐ American Indian/Alaskan Native

☐ Black/Non-Hispanic

☐ Asian/Pacific Islander

☐ Hispanic

☐ White/Non-Hispanic

Q29 What is the highest grade or year of school you completed?

Q30 Are you currently employed or working for pay?

☐ Yes

☐ No

Q31 Are you currently pregnant?

☐ Yes

☐ No

Q32 Do you plan on becoming pregnant in the next year?

☐ Yes

☐ No

Q33 What is the joint annual income of your family?

☐ Under \$20,000

☐ \$35,000 to \$49,999

☐ \$20,000 to \$34,999

☐ \$50,000 or more

Q34 How much do you weigh without shoes?

Pounds

Q35 How tall are you without shoes?

Feet

Inches

Q36 Does any family member (including yourself) have a Montana Fishing License?

☐ Yes

☐ No

Progress 

Powered by **snap**

Back

Save responses

Submit

APPENDIX C

QUESTION 13 ANSWER KEY

QUESTION 13 ANSWER KEY

	Correct Answer
Small fish have more mercury than large fish	False
Old fish have more mercury than young fish	True
Fish that eat other fish have more mercury than fish that eat algae or plants	True
Fish that are low in fat have more mercury than fish that are high in fat	False
Exposure to mercury increases the risk of cancer	False
Exposure to mercury increases the risk of arthritis	False
Exposure to mercury harms the muscles ability to function	False
Mercury in fish can be reduced or eliminated by using proper cooking and cleaning techniques	False
Exposure to mercury harms a developing child during pregnancy	True
The human body can eliminate mercury over time	True