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DOCTOR OF NURSING PRACTICE (DNP) PROGRAM

A DNP PROJECT

USE OF A WRITTEN HANDOUT TO IMPROVE KNOWLEDGE ON PRENATAL LEAD AND MERCURY EXPOSURE AMONG WOMEN IN AN URBAN ENVIRONMENT

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Abstract

Prenatal lead and mercury exposure is an ongoing silent disparity particularly in urban environments. The implications are costly on both individual and societal levels and consequences can be devastating for involved individuals, causing short term issues such as miscarriages and preterm birth; and long-term issues such as learning disabilities and loss of productivity. There is currently no organized effort to educate at risk populations on prenatal lead and mercury exposure and its implications. The purpose of this project was development and evaluation of effectiveness regarding written informational handouts on prenatal lead and mercury exposure targeted to pregnant and parenting women in an urban environment. The knowledge to action theory was used to guide development and implementation of handouts. The handout was distributed among a pilot group of 17 pregnant and/or parenting women in a classroom setting at an urban Women, Infants, and Children (WIC) office. Knowledge regarding concepts found in the handout about lead and mercury were assessed pre and post intervention using a pre/posttest. The results did not demonstrate a statistically significant increase in mean posttest scores. There was however a clinically significant increase in mean posttest scores. Posttest 9 scores increased; 3 remained unchanged; and 5 decreased. Findings support use of written informational handouts as part of routine women's healthcare to educate and bring awareness regarding prenatal lead and mercury exposure and in turn potentially improve fetal outcomes and healthcare/societal costs. A contribution has been made to this new area of research regarding education of prenatal lead and mercury exposure in an urban environment.

Keywords: informational handout, urban environment, parenting women, pregnant women, prenatal mercury exposure, prenatal lead exposure

Introduction

Exposure to lead and mercury has been shown to have detrimental health effects particularly among developing fetuses (Tang et al., 2016). Consequences of exposure place a substantial burden on individuals and society. Based on a rigorous review of literature, New Jersey currently lacks a policy of mandatory routine prenatal lead and mercury exposure education among pregnant and parenting women. Therefore, the proposed potential practice change includes incorporation of prenatal lead and mercury exposure handout as part of routine women's health care, subsequently increasing awareness with the goal of improving outcomes and reducing societal costs long-term.

Background and Significance

Lead

Lead is a toxic heavy metal that is found in leaded gasoline, old pipes, chipping paint, and soil/dust. It may also be found in imported items such as ceramics/pottery, cosmetics, and spices. Exposure may happen via ingestion, inhalation, or absorption through the skin such as from dust and contaminated cosmetics. Immigrants from nations where use of leaded gasoline is permitted are at higher risk of exposure as well. Ngueta, Abdous, Tardif, St-Laurent, and Levallois (2015) note that bioavailability is potent in exposure via contaminated water because of its ingestion between meals and after fasting conditions such as upon awakening. Water becomes contaminated due to eroding lead water pipes that occur as housing infrastructure deteriorates. It was not until 1986 that the United States Safe Drinking Water Act was revised to forbid use of lead containing plumbing in public water systems (Craft-Blacksheare, 2017). Thus, houses built prior to 1986 might still contain lead water pipes. Lead-based paint was prohibited in 1978, thus houses built prior to 1978 are more likely to contain some lead-based paint, which

becomes problematic when it starts chipping due to old age. Once lead is absorbed in the body, it adheres to hemoglobin, and more than 90% is deposited in the skeletal system (Craft-Blacksheare, 2017). In the blood lead has a half-life of approximately 1 month, while in the bone the half-life is about 20-30 years. Thus, conditions that cause bone demineralization such as pregnancy and lactation cause significantly increased levels in the fetus and breastfeeding infant. It should be noted that the benefits of breastfeeding outweigh the risk, unless the lead level is greater than 40 μg/dl, during which mother pumps and dumps until the level reduces to under 40 μg/dl (Craft-Blacksheare, 2017). Findings by the Centers for Disease Control and Prevention (CDC; 2010) discovered that lead easily crosses the placenta by diffusion, and increased lead levels were found in the fetal brain as early as by the end of the first trimester. Urban cities in New Jersey, including Newark continue to be disproportionately affected by lead exposure due to reasons aforementioned such as older housing stock, travel by residents to countries where products may contain lead, and overall lower socioeconomic status of the population which potentially increases exposure to hazardous housing conditions (New Jersey Department of Health [NJDOH], 2016).

Mercury

Mercury is a heavy metal primarily found in fish. Mercury is first released into the atmosphere by coal-fired power plants, waste burning, and other industrial practices and finds its way into waters by run-off or settling of airborne particles (Sathyanarayana, Focareta, Dailey, & Buchanan, 2012). It is then consumed and metabolized by fish, accumulating in its tissues. Exposure to humans mainly happens via the gastrointestinal tract due to consuming contaminated fish. Urban lands have a higher mercury content which find its way into urban waters then fish via rivers (Filippelli, Risch, Laidlaw, Nichols, & Crewe, 2015). In the United

States, mercury is said to have contaminated 43% of lakes and marshlands thus all 50 states recommend limiting consumption of locally caught fish and seafood by nursing and pregnant women and by children (Sathyanarayana et al., 2012). Newark Bay is included in the list of contaminated water bodies. It is important to note however, that limited consumption of fish low in mercury during pregnancy is encouraged and is of beneficial nutritional value to the developing fetus' nervous system due to omega-3 fatty acids. Oken et al. (2005) examined maternal fish consumption, mercury levels, and infant cognition in a United States cohort. Infants of women who consumed two or more servings of fish but had lower hair mercury levels (≤ 1.2 μg/g) had better cognition at 6 months, when compared to infants of mother who consumed less or more fish but with higher hair mercury levels.

A less common type of mercury exposure occurs via accidental spills and cultural practices such as ethnic home remedies and use of skin lightening creams. The practice of the Hispanic/Afro-Cuban religion "Santeria" using botánicas (religious supplies) which contain 9 grams of mercury packaged in gelatin capsules is a cultural practice where mercury released indoors evaporates resulting in exposure via vapors (Alison Newby, Riley, & Leal-Almeraz, 2006). Skin lightening creams are sold globally and usually targeted towards minority women of darker complexion. The United States Food and Drug Administration (FDA) set the maximum level of mercury in skin products at 1 part per million (ppm) (Zota & Shamasunder, 2017). Skin lightening creams containing mercury can contain as much as 20 ppm and are poorly regulated. A recent study in New York City by McKelvey, Jeffery, Clark, Kass, and Parsons (2010) found those with the highest urine mercury levels are foreign-born women of reproductive age from the Dominican Republic. Skin lightening creams were identified as the source of mercury exposure among populations with high levels.

Lead and Mercury Prenatally

Arbuckle et al. (2016) determined that lead and mercury easily crosses the placenta and accumulate in cord blood and are the major source of early life exposure to these metals. The study measured fetal exposure to environmental chemicals by measuring metals in maternal blood and directly measuring concentrations in cord blood and meconium. Median cord blood concentrations of lead and mercury were all significantly higher than maternal blood at first and third trimesters. The NJDOH (2016) emphasizes the developing nervous system as a sensitive mercury target, necessitating guarding this substance from vulnerable subjects such as developing fetuses and infants. In maternal blood, the mercury threshold for adverse neurodevelopmental effects is 3.4 µg/dl, while the lead threshold is 5 µg/dl (CDC, 2010). However, negative effects have been shown even with low levels of exposure.

Cost Implications

Low health literacy has significant financial consequences on the individual, society, and stakeholders. The United States Department of Health and Human Services (USDHHS; 2019) defines health literacy as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (p. 1). Low health literacy is cited as the major source of economic inefficiency in the United States (Vernon, Trujillo, Rosenbaum, & DeBuono, 2007). The cost of low health literacy to the United States economy is estimated to be between $106 billion to $238 billion annually. Per the Census Bureau's estimate, the savings that would be accomplished by improving health literacy ($106 billion to $230 billion annually) is enough to provide health insurance for every one of the 47 million Americans who lacked health insurance in 2006 (Vernon et al., 2007). Lack of action to improve health literacy will place a greater burden on future generations, with

estimated ranges from $1.6 to 3.6 trillion annually (Vernon et al., 2007). Increasing health literacy in areas of prenatal lead and mercury exposure would yield multiple benefits for society.

Based on the evidence in the ensuing paragraph, loss of productivity due to decreased intelligence and learning abilities is the major cost of prenatal mercury exposure, which amounts to $8.7 billion annually (Trasande, Landrigan, & Schechter, 2005). Sundseth et al. (2010) estimate the economic impact of mercury exposure related to productivity is estimated at $18,000 per each IQ point lost. According to the World Health Organization (2010), an economic analysis done in the United States found the economic impact of childhood lead poisoning to be $43 billion annually owing to damaged health, reduced productivity and reduced intelligence. Muening's (2009) analysis concluded that increased primary prevention/awareness efforts aimed at decreasing lead exposure among pregnant women and children would yield savings of $1.2 trillion via improvement in high school graduation rates and reduction in crime amounting to $50,000 per child annually and yield an additional 4.8 million quality adjusted life years for United States society as a whole. According to the Federal Bureau of Investigation (2016), Newark has one of the highest crime rates in the country and the state, and in 2014, the rates of both violent and nonviolent crimes surpassed every other major city in New Jersey.

Past Interventions

In the past, public health education programs have led to a decrease in lead levels in the entire United States population and subgroups of the population (Pirkle et al., 1994). Currently, the CDC (2017) spends approximately $15 million annually in programs geared towards childhood lead prevention, but not specifically prenatal lead prevention. The United States Environmental Protection Agency (EPA; 2018) funded lead prevention programs totaling approximately $17.2 million from 2000-2010. Currently no EPA grant funding for lead

prevention is awarded. The state of New Jersey had approximately $10 million in funding available for the year 2017 for county and local agencies to implement primary and secondary lead prevention (NJDOH, 2017c). Owing to the increased awareness of mercury in the environment, the New Jersey Mercury Task Force was formed in 1998 to strategically plan ways to avert mercury pollution in the state (NJDOH, 2019a). This task force has had previous success in reducing but not completely eliminating environmental mercury from emissions and waste incinerators (NJDOH, 2019a). This task force has focused more on the environmental aspect, rather than that of empowering and educating the at-risk community. Comparably, the EPA has awarded $1.4 million in grants to certain states in order to improve women and children's mercury screening and develop more efficacious fish consumption advisories (McCollum, 2012).

Needs Assessment

Nationally

Nationally, the American College of Obstetricians and Gynecologists (ACOG; 2012) currently does not recommend routine prenatal lead exposure education but rather, the recommendation is for education and screening to be tailored according to patients' risk factors such as recent immigration from high risk countries and consumption of nonfood items and lead-contaminated water. The recommendation is for those with at least one risk factor to be screened via blood and educated regarding exposure and further avoidance. The ACOG does not have guidelines regarding prenatal mercury exposure. In the United States, New York and Minnesota are the only documented states that routinely educate and screen pregnant women for risks of lead exposure via questionnaires developed by each Department of Health respectively (United States Preventive Services Task Force, 2018). New York uses a 6-question screening tool (Recommended Lead Risk Assessment Questions) recommended by the State Commissioner of

Health (New York State Department of Health, 2018). Minnesota uses a 10-question screening tool (Risk Screening Questionnaire for Pregnant Women) (Minnesota Department of Health, 2015). Mercury screening is not mandated by either state although Minnesota has done several studies on prenatal mercury exposure and issued recommendations on avoidance to the pregnant population. It should be mentioned that no validated tool exists, neither is there data available regarding the prevalence of providers who screen or educate for prenatal lead and mercury exposure (United States Preventive Services Task Force, 2018).

Statewide

In the state of New Jersey, particularly Newark, there are a plethora of resources from governmental agencies such as FDA, CDC, and EPA listed at the New Jersey Department of Health website regarding lead exposure targeted to children under the age of six, especially in light of recent lead epidemic in Newark tap waters, but few are targeted to pregnant women or fetuses. In 2016 during annual testing, 30 school buildings in Newark reported to the New Jersey Department of Environmental Protection (NJDEP) elevated lead levels in tap water, more than 15 parts per billion (ppb) which is the EPA cutoff (Mazzola, 2016). This lead to shut down of fountain water and replacement with bottled water and water coolers.

Information is also available online at the NJDOH website regarding fish consumption while pregnant as a precaution to mercury exposure, albeit it takes clicking through multiple links to get to the information. Shieh, Mays, McDaniel, and Yu (2009) found that women with low health literacy, particularly pregnant women are less likely to use the internet as a source of information. Kreps and Neuhauser (2015) state that low literacy populations communicate best when information is close, easily accessible, and familiar.

Locally

The Women, Infants, and Children (WIC) office where the project took place serves low income pregnant women, postpartum women, infants, and children up to the age of five who are at risk for nutritional deficit. Women served are of childbearing age. Supplemental nutritious foods are supplied in addition to nutrition education and counseling, breastfeeding promotion and support, immunization screening, and health care referrals (WIC Programs, 2019). There is a favorable outcome between pregnant women who participate in WIC and mean birth weight and gestational age (Baumgartel & Spatz, 2013). Not only that, but other successes include improved and enriched childhood diets and increase in the use of preventative health services. Based on current New Jersey WIC services and benefits as published at the NJDOH (2019b) website, currently no information is in place at WIC offices to educate and bring awareness the issue of prenatal lead and mercury exposure. Based on WICs documented successes, the WIC office is the right platform to implement prenatal lead and mercury education as there is potential for a positive impact among a vulnerable population known to be at the highest risk of exposure.

The WIC office serves low income pregnant and parenting women in Newark. Low health literacy has been commonly found among those with low levels of income or education (Al Sayah, Majumdar, Egede, & Johnson, 2015). Low health literacy has been correlated to worse knowledge and self-efficacy (Al Sayah et al., 2015). Nationally, nearly one half or 90 million adults have low health literacy (Nierengarten, 2018). Diverse and underserved populations are disproportionately affected by low health literacy (Nierengarten, 2018). Kumar et al. (2010) found that participants in the WIC program had significantly lower average parental health literacy scores. Thus, based on this finding, it is appropriate to assume that WIC participants in Newark have lower health literacy. Per the CDC (2018), in 2016 the majority of

WIC recipients either had no high school diploma (70%) or were high school graduates (55%). According to the latest census, approximately 73% of adults in Newark are high school graduates or equivalent, while only 13% have a bachelor's degree or higher, and 29.4% are foreign born (United States Census Bureau, 2017). Even those who have completed high school do not necessarily have an equivalent high school reading level (Ryan et al., 2014). There is a disproportion between highest grade completed and reading level. Being able to read and comprehend health information boosts the chance that patients will apply learned information, eventually improving health outcomes and reducing disparities. Those living below poverty level in Newark comprise 29.7%, nearly three times that of the state of New Jersey (10.8%) (United States Census Bureau, 2010). Newark is largely populated by minorities, with 52.4% of residents identifying as black/African-American and 33.4% identifying as Hispanic/Latino (United States Census Bureau, 2017). Minorities are more likely to have low health literacy (Al Sayah et al., 2015).

Children in Newark comprise 3.8% of the state's children; 13% in the state with the highest lead levels including levels above 20 μg/dl (NJDOH, 2016). This is a valid reason to also target parenting women at the WIC office in disseminating awareness and knowledge. Lead levels in Newark water supply can be greater than 15 ppb which is the EPA cutoff, and some water sources have recently averaged 47.5 ppb which is more than three times higher than the EPA cutoff (Mazzola, 2016; Water Quality Products, 2019).

In regard to mercury, it is estimated that each year in the United States approximately 8% of mothers and 0.6 million newborns have higher mercury levels than considered safe by regulatory agencies related to consuming contaminated fish such as eel, swordfish, raw fish, sharks, and green gland of lobsters/crabs (Somers et al., 2015). Newark Bay is a water body with

high mercury levels in Newark, necessitating the NJDOH (2018) issuing advisories for pregnant women and children regarding avoiding consumption of locally caught seafood.

There is no documented data regarding percentage of pregnant women exposed to mercury and lead in Newark. Thus, there is a need for further study. It is safe to assume that based on aforementioned risk factors, pregnant women in Newark are at significant risk of exposure through environmental and cultural factors. According to the New Jersey State Health Assessment Data (NJDOH, 2017a), Essex county is performing worse than the state average in areas of low birth weight and preterm birth. Low birthweight and preterm birth are some of the known effects of prenatal lead and mercury exposure in addition to miscarriages, decreased growth and development, impaired neurological function, learning disabilities, and antisocial behavior. These statistics make cities in Essex county, particularly Newark, especially an appropriate and necessary target.

Problem Statement/Clinical Question

There is a lack of awareness and education of lead and mercury exposure among adult pregnant and parenting women in Newark, New Jersey. The clinical question guiding this project is: Among pregnant and parenting women in an urban environment, how effective is a written informational handout in improving knowledge and awareness of prenatal lead and mercury exposure and its implications?

Aim and Objectives

The overall aim of this study is to increase knowledge and awareness regarding prenatal lead and mercury exposure via printed health information materials. The objectives of this project are to:

- develop written informational handout appropriate for low-literacy pregnant and parenting women.
- measure knowledge before and after implementation of written informational handout among pregnant and parenting women.
- provide an educational session which includes a 2-minute animated YouTube video about lead in drinking water and a fish advisory refrigerator magnet.

Review of Literature

Search Strategy

A search was conducted on CINAHL with full text using the following keywords: "((information AND dissemination)) OR ((patient AND education)) AND (handouts) OR (pamphlets) OR ((written AND materials)) OR (handouts) AND (minorities) OR (urban) OR (diverse) AND (effectiveness) OR (outcome) OR (appropriateness)". The search returned 800,000 articles which were narrowed down by selecting academic journals, scholarly/peer reviewed, years 2012 – 12/2018, English language, and adult human subjects. The following subject major headings were selected: outcome assessment, primary healthcare, and attitude to health. This returned 4,965 hits where the major headings patient education, health promotion, patient attitudes, health behavior, blacks, and communication were again selected. The final hit count yielded 525 articles which were screened, excluding 300 articles due to irrelevance to subject at hand or geographical location outside continental United States and Europe. A total of 225 articles were then screened, 17 full-text articles were assessed for eligibility, and 10 studies were included for quantitative synthesis and were critically appraised (refer to Appendix B).

Prenatal Lead Exposure and its Effects on the Fetus

Liu, Chen, Gao, Jing, and Hu (2014) evaluated infants behaviorally and neurologically at 6, 12, 24, and 36 months that were exposed to low levels of lead as measured in cord blood. Levels as low as 3.92 μg/dl were associated with psychomotor and neurocognitive deficits. Xie et al. (2013) study among pregnant women with median lead levels of 3.20 and 2.52 μg/dl found a significant negative correlation between lead levels and birth length. Hong et al. (2014) found a significantly reduced growth rate at 24 months among infants who were exposed to lead prenatally, where mean lead levels were 1.25 μg/dl. Tang et al. (2016) correlated lead in cord serum with negative birth outcomes. Increased lead levels had significant negative effect on birth length, head circumference, and gestational age. Stroustrup et al. (2016) found a relationship between prenatal lead exposure and difficult temperament.

Prenatal lead exposure has also been associated with decreased height and weight in early childhood (Renzetti et al., 2017). A literature review by Amadi, Igweze, and Orisakwe, (2017) investigating miscarriages and stillbirths in developing nations observed a connection between exposure and five heavy metals including mercury and lead. Research has shown a 180% higher risk of miscarriage for every 5 μg/dl increase in maternal lead level, while each 10 μg/dl increases risk of miscarriage by 360% (Edwards, 2013). The recent lead epidemic in drinking water in Flint, Michigan came with devastating consequences which saw fetal death rates increase by 58% and overall health at birth decrease (Grossman & Slusky, 2017). Wright et al. (2008) did the first prospective study that recognized a relationship between in utero and childhood lead exposure and adult criminal behavior with arrest rates were rising for each 5 μg/dl increase in blood lead level.

Prenatal Mercury Exposure and its Effects on the Fetus

Chen et al. (2014) studied urban minority expectant women and examined multiple heavy metals exposure including mercury. Mercury was found to be significantly higher in maternal and cord plasma and red blood cells in preterm and low birthweight infants when compared to infants of normal weight and gestational age. Vejrup et al. (2014) concluded that mercury easily crosses the placenta subsequently disrupting many steps in brain development and fetal growth. Dietary mercury exposure was correlated to low birth weight and small for gestational age infant in relation to the level of exposure. Tang et al. (2016) correlated mercury in cord serum with negative birth outcomes. Mercury in cord blood serum was significantly correlated with low birth weight. Jacobson, Muckle, Ayotte, Dewailly, and Jacobson (2015) found a relationship between poor IQ in school-age children and prenatal mercury exposure. Children who had cord mercury levels greater than or equal to 7.5 μg/dl in utero were found to be four times as likely to have an IQ below 80, which is the upper limit for borderline intellectual disability.

Written Materials to Improve Knowledge

Written materials have been shown to improve or enhance knowledge. Beg, Curtis, and Shariff (2016) report a significant improvement in knowledge of liver cirrhosis and how to manage the disease among participants who received an informational leaflet. A single educational session using written manuals and interactive discussion reduced misconceptions about traumatic brain injury immediately and subsequently at one month among ethnic minorities as demonstrated by Pappadis et al. (2017). Written materials not only improve knowledge and short-term retention, but also long term as well. Murray, Thomas, and Pollock (2017) compared verbal instruction alone with the intervention of written, patient condition specific handouts and found increased knowledge at 1 month and 3 months post intervention

regardless of age, level of formal education, and background. This promising finding supports that written materials can be effective for a variety of clientele. Written materials are effective in improving knowledge not just about benefits but also about risks. Curtis et al.'s (2016) study showed a significantly higher percentage of patients understanding medication risk factors when compared to those who received neither written information or physician counseling. Written materials should be used to reinforce verbal information which in turn increases patient satisfaction and knowledge when compared to verbal information alone (Hersh, Salzman, & Snyderman, 2015).

Written Materials and Influence on Behaviors

Written materials have an effect on behaviors. Adherence to medication improved among patients who received handouts, with glycemic control worse in those not receiving handouts as reported by Caetano, Santiago, & Marques (2018). Being knowledgeable is reassuring and empowering. This is evident in Piredda et al.'s (2016) study where use of written informational booklet increased both short- and long-term knowledge about implantable access ports and reduced physiological indicators of anxiety i.e., blood pressure and heart rate. Consumers are more likely to adhere to information stated in written materials as compared to verbal. Burke et al.'s (2018) study demonstrated that 93% of consumers who received a handout on shoulder exercises agreed that they had already started using information in the handouts to manage their shoulder pain.

Design of Written Materials

A well-designed informational handout increases the likelihood that consumers will comprehend and use the information. Tong, Raynor, and Aslani's (2014) literature review

concluded that good design principles generally improved over-the-counter label and leaflet performance/comprehensibility.

Handout design.

Printed health informational materials should be written as simply as possible to facilitate reading and comprehension. The Centers for Medicare and Medicaid Services (CMS; 2010) state that the general rule to written material should be writing as simply as possible without sacrificing meaning or distorting content, and not merely relying on readability formulas or setting goals based on reading grade levels. Relying solely on the aforementioned fail to measure ease of reading or comprehension, thus are not the best indicators of appropriateness of materials. The reading grade levels for the handout (Appendix A) as per the Flesch-Kincaid Grade Level online calculator is eighth grade. The handout was reviewed and approved by stakeholders at the Department of Health and was chosen over an alternative version due to its comprehensiveness.

When designing written materials for inner city populations, it is recommended that information be typed, not handwritten or cursive (Cowan, 2004) and that simple graphics be used to enhance text (Ryan et al., 2014). Important points should be summarized. Informational materials should contain a few bullet points along with graphics to reinforce understanding of the concept (Cowan, 2004). Only a single individual concept should be conveyed in each bullet or paragraph. Serif fonts are recommended due to their ease in reading, noticeable distinction between bold and regular versions, and easiness to read when italicized (CMS, 2010). Sans serif fonts are used for headings and subheadings because of their ease to read from a distance. Using exclusively uppercase letters is not recommended since it is more difficult to read. Active voice

is used in transmitting the message across to the reader. Using active voice also makes material more personal and simpler to read and understand (Cowan, 2004).

According to Kreps and Neuhauser (2015), the best communication channels for at-risk populations are those that are close, easily accessible, and familiar. In addition, the chosen mode of education/communication should be accessible over time to allow clients to refer back as needed or allow multiple exposures which subsequently facilitates retaining of information. Handout layout should be designed "to fit with a reader's natural and deeply ingrained way of progressing through a printed page (called "reading gravity")" (CMS, 2010, p. 12). CMS (2010) also suggests that material be appealing at first glance, and not cluttered or confusing.

The lead and mercury exposure handout (see Appendix A) summarize crucial information using bullet points and short sentences. Simple graphics are used to support the text, while emphasizing the fetus as the vulnerable subject. Subheadings are included to facilitate easy navigation between topics of need. Dark text is used on a white paper for best contrast per CMS (2010) recommendations. Spacing of text after subheadings is less than spacing after bullet points/short paragraphs to help reader associate a heading with the text that trails it. Main text in the materials are typed using uppercase and lowercase letters using serif Garamond font, size sixteen.

The handout features a one-page double sided design, which allows for organization and easy navigation through information presented. It allows for the reader to proceed reading through new material in sequences, staring with introduction to the heavy metal and concluding with avoidance. The handout features uniform color, font, and sufficient white space. A design that is clean and crisp encourages readers by making the informational materials appear easy to

read (CMS, 2010). The double sided one-page is also cost effective in regard to distribution, requiring only one page per handout.

Information included in the handouts should be accurate and up to date. This was accomplished by reviewing literature and extracting current information from governmental websites such as the New Jersey Department of Health (2017b) and the United States Food and Drug Administration (2019). Certain non-governmental organizations such as the World Health Organization (2008) and point of care medical resources such as UpToDate (2018) were utilized in gathering information as well.

Synthesis and Conclusion

The review of literature supports the concept of using an evidence-based written handout targeted to urban populations to enhance knowledge, in turn influencing behavior. This is the main goal driving the proposed project; to increase knowledge and awareness subsequently affecting self-efficacy. Using a written handout to enhance knowledge and awareness is a simple and cost-effective way of primary preventing an issue with enormous cost burdens in addition to poor health outcomes.

Theoretical Framework

The Knowledge to Action (KTA) theory guides the development and implementation of written educational materials to increase awareness on prenatal lead and mercury exposure. The theory consists of the two concepts of knowledge creation and action. For this project, knowledge creation was used to gather information for the written materials while the action concept was utilized in translating evidence. The theory's steps functions either in sequences or simultaneously and accommodates different phases being done by multiple stakeholders or groups at different points in time. An example stated in Graham et al. (2006) is researchers

focusing on knowledge creation while allocating promotion and uptake of evidence to other parties. This project focused on both concepts and required involvement of multiple stakeholders. Thus, the KTA model was ideal to influence policy makers, practitioners, patients, and bring awareness to the community.

There are eight steps involved in carrying out the action concept of the theory. The first step involves identification of a problem that needs to be addressed, which is followed by searching for knowledge or research that contains potential solutions to the problem (Graham et al., 2006). Selected research is appraised to determine its validity and relevance as part of the second step. The third step involves tailoring selected knowledge to the local context. That is, customizing knowledge based on the audience and their ideas about the values, usefulness, and appropriateness of said knowledge. It is considered a critical step in facilitating knowledge uptake. The fourth step assesses barriers that might impede or limit knowledge uptake, as well as the identification of facilitators of knowledge. Barriers to knowledge uptake are identified so that action may be taken to eliminate them.

The fifth step involves implementation of interventions to bring about awareness of the knowledge and anticipated change. Graham et al. (2006) refer to implementation as systematic efforts to encourage adoption. Interventions may be of various mediums such as educational, patient directed, or organizational. Again, selecting and tailoring knowledge to the audience and barriers identified must be done at this step ensure success. In the sixth step, use/application of knowledge is monitored. Thus, there should be a clear description of what comprises knowledge use so that it may be measured. At least three types of knowledge have been described: conceptual (changes in levels of understanding, knowledge, or attitudes), instrumental (changes in behavior or practice), and strategic use (manipulation of knowledge for profit goals).

Evaluation may be accomplished by way of questionnaires or surveys among other means as applicable. If the degree of knowledge use is found to be suboptimal, reassessing the audience willingness to use the knowledge can be helpful in determining whether suboptimality stems from lack of motivation/interest or from other factors beyond their control. New barriers may also emerge post implementation.

The seventh step involves evaluating the impact of applying the knowledge. This step is crucial for determining the desired outcome; whether the knowledge impacted health, the practitioner, or the system. Success of promoting evidence uptake will be evident during this phase. The final step involves sustaining use of knowledge. Graham et al. (2006) note that this is a relatively new but important area of knowledge translation that lacks research. With evolving times and systems, new barriers that weren't previously identified may arise requiring reuse of action phases from the beginning; a feedback loop. Ongoing monitoring and effort is required for sustenance.

Knowledge Translation Strategy

The action cycle of the KTA was used to implement written information regarding prenatal exposure to lead and mercury. The first step was identifying the problem to be addressed which is lack of lead and mercury education at among prenatal and parenting women at the urban WIC office. Scholarly research was undertaken to explore strategies of written informational materials deemed effective for the underserved populations. Simultaneously, knowledge relevant to the problem (prenatal lead and mercury exposure) was synthesized then transferred into identified method of teaching. In this project, valuable information was gathered from primary and secondary sources which were extracted into the selected mode of education; written material in the form of a handout. This corresponds to the knowledge creation concept of the

framework. Information in the handout was customized to the local population. For example, easy readability, graphics, environmental and cultural risk factors were incorporated for this urban, underserved population. This correlates with the third step of customizing knowledge to context/environment.

Barriers to using the knowledge were assessed and dealt with promptly to facilitate uptake of information. In the urban population, barriers included language, low health literacy, and cultural practices. To address the issue of language barrier, only fluent English-speaking participants were selected, information was presented at an easy readability and navigation format to facilitate comprehension, and harmful cultural practices were highlighted. The next step is implementation of interventions to bring awareness to knowledge, which was distribution of a written handout by the co-investigator. The co-investigator was available to clarify information or answer questions. Graham et al. (2006) note that interactive teaching is most effective when dealing with barriers related to attitude, cultural practices, or habits.

The next step is monitoring use of knowledge to determine whether desired effects have been achieved. In this project, conceptual and instrumental uses of knowledge were measured by way of a pre/posttest. Impact of knowledge use was evaluated by quantitative data collection of patients' knowledges. The final step is facilitating maintenance of knowledge use. Striving towards policy and guidelines change to incorporate this handout as part of routine prenatal and postnatal care, leadership and collaboration with stakeholders is crucial for sustaining knowledge use. (See Appendix C)

Methodology

This project was a quantitative quasi-experimental pilot study. The design is appropriate for this study as the goal was to succinctly determine adequacy and acceptability of educational

materials for participants (written informational handout; Appendix B). The handout was reviewed by experts at the Poison Control Center, University Hospital, and Newark Department of Health. Experts at the NJDOH reviewed and chose the handout over an alternative version. A pre/posttest was administered to participants to gauge baseline knowledge and post-intervention effect. A learning session was included after the posttest, where the participants learned more about lead in drinking water via a YouTube video and more about fish advisories from a chart by the FDA that was distributed in the form of a refrigerator magnet. No data was collected about the video or fish advisory magnet. The purpose of the aforementioned was to enhance what was in the handout and serve as an incentive for participants to show up for the study.

Setting

The study took place at an urban Women, Infants, and Children (WIC) office. (Refer to letter of agreement; Appendix D). The study was held in a classroom setting. The setting sees approximately 2,500 pregnant and parenting women per year.

Study Population

Study participants included pregnant and/or parenting women participating in WIC. Inclusion criteria included English speaking female adults ages 18 and above. Exclusion criteria included inability to read/write in the English language. Prior to the two days of the intervention, interested participants had the opportunity sign up at the WIC office until target number of approximately 20 was achieved. This small sample size is appropriate for this pilot study due to its feasibility in testing a new informational handout to determine adequacy and acceptability of educational materials for participants. According to calculations adapted from Viechtbauer et al. (2015), based on an annual population of 2,500 women, in order to detect differences in mean

test scores with an 80% confidence interval and a 0.1 probability, sample size of at least 15 is needed. Ultimate sample size included 17 participants.

Subject Recruitment

Information about the study was posted at the WIC office waiting area bulletin board by way of a recruitment flyer (Appendix E). A sign-up sheet collecting name and phone numbers of interested participants accompanied the recruitment flyer (Appendix F). Prospective participants were able to reach the co-investigator by cellphone or email as stated on the flyer. Those who signed up received telephone reminders from WIC staff prior to the day of the intervention (Appendix G), however none of the participants utilized the sign-up sheet. Those with children who wished to participate were accommodated in the WIC office has a playroom area. Parents were also allowed to attend the session with their infants. On the days of the intervention, participants were recruited by the co-investigator in the WIC waiting area by means of convenience sampling. If there was a long wait time between recruitment and intervention, participants either waited at the WIC office or returned promptly at the scheduled start of the program. The target sample size (n=20) was not achieved in one day; therefore, the study was extended for an additional one day.

Consent Procedure

On the same day of the intervention, the co-investigator obtained written consent (Appendix H) from the group of participants in the waiting room area at the WIC office. The consent process took approximately 15 minutes. The co-investigator briefly introduced self, explained study, and provided contact information. Information in the consent form was explained verbally. Participants were given ample time to review the consent and ask questions prior to their signature. Study intervention then began after consents were obtained.

Risks/Harms/Ethics

This study presented minimal risks to participants. There was potential for a sense of cultural insensitivity as certain cultural risk factors for lead and mercury exposure were highlighted in the handout. There was also potential that a participant may feel guilty for partaking in certain factors mentioned in the handout, such as eating too much fish. Referral to social work would have been provided by WIC had emotional distress occurred. There was no risk for loss of confidentiality as no identifying participant information was collected. Participant sign-up sheet stayed exclusively at the WIC office; co-investigator did not have access to it to see names and phone numbers. However, no participants signed-up, otherwise the sheet would have been shredded by WIC director at the end of the day upon conclusion of the study. The study met ethical obligations by first being submitted for approval by the Rutgers Internal Review Board (IRB) before commencement of any study activities. IRB was closed out after final DNP project presentation.

Subject Costs and Compensation

Participants did not incur any costs from participating in the study. There was however a time commitment of an hour and a half to review handout, complete pre and posttest as well as attend didactic session. Participants received a $10 Rite Aid gift card on the same day upon completion of the study as an incentive for participating. Participants received a free didactic/learning session which included a fish advisory refrigerator magnet on the same day.

Study Intervention

The intervention in the study was a written informational handout to improve awareness and knowledge of prenatal lead and mercury exposure and its implications. A pretest was administered to the participants before the handout as a baseline assessment. The co-investigator

distributed the handout to multiple small groups of approximately 3 to 5 female participants in a classroom setting. Participants were given approximately 25 minutes to read the handout. After, a posttest was distributed in the same manner. Participants were allotted approximately 10 minutes each to take the pretest and posttest. Identical pre and posttest numbers were used as a method to identify test takers. After the posttests had been collected, the co-investigator reviewed the test with the participants.

After reviewing the posttest, the learning session began during which the handout was reviewed as presented. Two concepts (one for each of the heavy metals) were expanded. An informative animated two-minute YouTube video about lead in drinking water published by the United States Government Accountability Office (2017) (Appendix I) was played on a laptop device. An in-depth fish advisory chart from the FDA (2019) (Appendix J) was reviewed and distributed to participants in the form of a 5.3”x4.3” horizontal refrigerator magnet. The following were objectives of the learning session (Appendix K):

- group will be able to verbalize at least two species of fish to avoid due to higher mercury levels.
- group will be able to verbalize at least three simple steps to minimize lead in drinking water.

There was a 10-minute allotted time for question and answer session before conclusion.

Outcomes Measured

A pre/posttest (see Appendix L) was used to measure increase in knowledge and awareness about prenatal lead and mercury exposure and its implications for the participants. The pre/posttest contained 6 identical multiple-choice questions measuring knowledge, awareness, and implications of lead and mercury exposure. Six questions were designed

according to evidence-based guidelines. When it comes to low literacy populations, tests/questionnaires should be as short as possibly sufficient to capture variables being measured (Cremers, Welbie, Kranenborg, & Wittink, 2017). There were four answer choices for each question; “I don’t know” is included as an answer option for each question to assess what participants do not know instead of having them potentially guess the correct answer. Ciochetto and Haley (1995) note the importance of boosting the chance that a participant answers “I don’t know” when the issue is unfamiliar rather than having them guess in order to capture a true reflection of knowledge/awareness. The test was created by the co-investigator based on information presented on the handout and outcomes to be measured. This tool has not been tested for reliability or validity. The reading grade level for the tool is sixth grade as determined by Flesch-Kincaid Grade Level online calculator. Per literature search, no validated/reliable tools are available for evaluating outcomes regarding this topic.

Project Timeline

Planning for the study began in December 2017 (see Appendix M). Stakeholders involved include project chair and two additional faculty serving as DNP team members. Stakeholders at the Department of Health are also involved in the project development. Meetings have been held with project chair periodically since December 2017. Regular correspondences with stakeholders at the Department of Health continue as well. Informational handouts were developed in February 2018, revised in April 2018 with final revision in February 2019. The study was submitted to the IRB in May 2019; IRB approved the project in June 2019. Implementation took place in June 2019. Data was analyzed in July 2019. Final project presentation took place in August 2019 followed by IRB closeout.

Resources Needed/Economic Considerations

Resources needed with monetary implications included printing two-sided color handouts, color copies of recruitment flyers, consents, and pre/posttests. Pens and clipboards were supplied. Participants received $10 gift cards as an incentive for participating. Participants received a fish advisory refrigerator magnet. Total cost of project was $290.00 (Appendix N).

Evaluation Plan

Data Analysis

Statistical Package for the Social Sciences (SPSS) version 25 was the software used to analyze data. Descriptive statistics were undertaken, where bivariate analysis was conducted to compare mean scores from the pre and posttests of the subjects at two points in time. The pre and post test scores are the variables that were collected, with anticipation of an increase in mean posttest scores. The data was normally distributed as per the Q-Q plot, therefore paired t-test was used to compare means.

Data Maintenance/Security

Data was stored in a password protected computer accessible solely to the co-investigator. No protected health information was collected during this study. The only participant information that was collected is the highest level of education. Data collected was deleted once statistical analysis was complete. The consents and aggregate data will be maintained for six years in a password protected flash drive stored at Division of Advanced Nursing Practice office, Rutgers School of Nursing, 65 Bergen St., Newark New Jersey.

Results

Seventeen pregnant and/or parenting women participated and completed the study (n=17). Women with elementary school education represented 5.9%, high school graduates

58.8%, Associates degree 17.6%, and Bachelor's degree or higher 17.6%. Refer to Table 1 (see Appendix O) for demographic characteristics. A paired t-test was conducted to evaluate whether a statistically significant difference existed between the mean test scores before and after reading the handout. The results of the t-test were not significant t (16) =1.61, p=0.126. This indicated that there was an increase from the pre-test (M=3.65, SD=1.11, n=17) to the posttest (M=4.24, SD=1.64, n=17) scores but not to a statistically significant degree (See figure 1, Appendix P). The mean increase was 0.59 with a 95% confidence interval (CI) for the difference between the means of 1.36 to 0.18. Refer to tables 2 and 3 (Appendix O) for detailed statistical results.

Discussion

Prenatal lead and mercury exposure are damaging to the society and individuals, particularly the developing fetus. These metals effortlessly pass through the placenta subsequently damaging the fetal nervous system. The consequences of exposure continue throughout a newborn's lifespan. There is a lack of awareness and education of lead and mercury exposure among adult pregnant and parenting women in Newark, New Jersey. A written informational handout was clinically effective in improving knowledge and awareness of prenatal lead and mercury exposure and its implications. Therefore, education and awareness are potential cost-effective means of primary prevention.

Although findings in increase in knowledge as a result of reading the handout failed to reach statistical significance, the results are clinically significant as there was an overall increase in knowledge among the majority of women, of whom most were high school graduates. Posttest 9 scores increased; 3 remained unchanged; and 5 decreased. The handout was therefore effective in increasing short-term knowledge and awareness in the low-literacy population, particularly among those with high school education.

The objectives of the study were fully achieved using the KTA theory as a guide. The informational handout for low literacy urban population was created successfully in the knowledge creation stage and transferred to written handouts. The pre/posttest aided in monitoring knowledge use, which answered the clinical question of whether the handout was effective in increasing knowledge. The fact that majority of participants (who were high school graduates) demonstrated increased posttest scores attests that the handout was appropriate for the low-literacy population. The educational session was partially achieved because most participants were inclined to the fish advisory fridge magnet than the lead YouTube video. Participants disinterested in regard to the YouTube video, a common response being "I already know about lead".

Results align with the evidence used to guide the study, in which use of written educational materials improved short term knowledge among participants albeit with statistical significance. This is evident in Piredda et al. (2016) study where patients that received information booklets had increased knowledge immediately after review regarding implantable access ports. Literature suggested that good design principles used to guide handout development increased comprehensibility, as is the case when evidence-based guidelines were used to guide handout development for low literacy populations. The educational session was well received, particularly the fish advisory refrigerator magnet. Most participants were less interested in the informative YouTube video regarding lead due to previously acquired knowledge. This might have been because the WIC office screens children for lead and educates caregivers regarding lead precautions/exposure, however not specifically targeted to pregnant women. Previous exposure to information about lead might have impacted the degree of knowledge increase

posttest; a barrier to the study's objectives. Facilitators to the study's objectives include supportive facility staff and eager clientele.

Limitations

Failure to reach statistical significance in the study might have been caused by several factors. Small sample size limits generalizability of the study to larger populations. The use of instruments and tools that were not tested for validity nor reliability might also have affected the outcome of the study. Use of convenience sampling is not the best representative of the population and has potential bias. This is a first pilot project, and so additional research is necessary to determine adequacy and acceptability of educational materials for participants and the degree of impact on knowledge.

Unanticipated Findings

There were several unanticipated findings. Participants offered positive verbal feedback on the written handout when there was not any intention to collect said information. Examples of such comments include "This is a really good handout. They (providers) don't tell us about this." And "This is an awesome handout; can I take it with me?" Parents were allowed to take the handout home. An interesting phenomenon among those with Bachelor's education or higher and elementary school education were lower posttest scores. Perhaps this might have been attributed to lower reading level among the elementary educated and English as a second language among Bachelor's educated.

Implications/Recommendations

Clinical Practice Implications

Using a handout to improve knowledge and awareness on prenatal lead and mercury exposure has been an efficient and cost-effective strategy to improve short-term knowledge.

Printing colored copies of handouts cost less than $5 and reading the handout took an extra 15-25 minutes of patient time. Urban women's health care professionals should implement educational tools into their practices. Education should occur on a routine on-going basis to emphasis urgency, meaning at each patient contact.

Healthcare Quality and Safety Implications

Increasing literacy regarding prenatal lead and mercury exposure among urban women has the potential to empower them, enabling them to take charge over their health and wellness as well as their offspring i.e. justifying avoidance of certain types of fish and skin bleaching creams while pregnant or breastfeeding. The knowledge gained regarding prenatal lead and mercury exposure using a simple handout may help with avoidance and behavior modification, which will potentially improve fetal outcomes. As a result of knowledge and awareness gained, clients may also feel confident initiating communication about the subject with their healthcare providers should they have any concerns.

Policy Implications

There is a lack of policy especially in urban/at risk environments for routine prenatal lead and mercury exposure education. The ultimate goal is creating a policy to include lead and mercury education as part of mandatory routine women's healthcare. As evidenced in the study, more than 50% of participants had increased short-term knowledge after reading the handout. As partially done in New York and Minnesota, the policy should state that all women presenting for their first preconception, prenatal, and postpartum visit be provided a handout about prenatal lead and mercury exposure and educated by their healthcare provider.

Education Implications

Prenatal lead and mercury exposure and its implications should be incorporated into nursing school curriculum, particularly maternal/newborn and women's health studies. Graduates need to be equipped with knowledge of these social determinants of health disproportionately affecting the urban areas and strategies to lessen exposure, including education.

Sustainability

Striving towards policy and guidelines change to incorporate this handout as part of routine prenatal and postnatal care, leadership and collaboration with stakeholders at the WIC is necessary for sustaining knowledge use. The WIC facility will consider continuing with education by distributing the handout to every English-speaking prenatal/parenting woman. This project has the potential to be translated to larger populations within the community and then to similar communities statewide. The informational handout will be translated to accommodate non-English-speaking populations by the NJDOH.

Dissemination and Professional Reporting

Results will be disseminated to stakeholders at the WIC, NJDOH, as well as Rutgers School of Nursing for the requirements of the Doctorate in Nursing Practice. It is intended that the results of this project would be potentially considered for submission for manuscript review in potential journals including, but not limited to *Journal of Obstetrics and Gynecology*, *Pediatrics*, and *Journal of Environmental Sciences.* Abstract would be considered for potential presentation at the National Association of Pediatric Nurse Practitioners annual conference.

Summary

This study indicates that using a handout in the urban population is effective in increasing knowledge short term. Implication for clinical practice is most important, as healthcare

professionals have access to clients and can take advantage of every encounter to educate and reeducate. The topic of prenatal mercury and lead exposure should be taught in nursing schools, so that future advanced practice nurses are sensitized to the issue and armed with ideas for reducing/eliminating exposure and closing the gap.

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Appendix A

Table of Evidence

Article #	**Author & Date**	**Evidence Type**	**Sample, Sample Size, & Setting**	**Study findings that help answer the EPB question**	**Limitations**	**Evidence Level & Quality**
1	Caetano, I., Santiago, M., & Marques, M., 2018	Randomized controlled trial	Mean age 66, 60% males, 1.7% illiterate, mean number of school years 6. N 709 n 702 Primary care offices from five regions in Portugal	After six months of intervention (distribution of brochures), the adherence to medication improved in the leaflet (brochure) group (p=0.034). Glycemic control was worse in the control group.	Interobserver bias, as there were 41 investigators involved in study. Performance bias due to non-blind study, limiting magnitude of results and drawing of conclusions.	Level I A
2	Beg, S., Curtis, S., & Shariff, M., 2016	Quasi experimental pilot study	Mean age 57.5, 29 male, 10 females. N 39	The use of an information leaflet resulted in a statistically significant improvement in knowledge of liver cirrhosis in patients on how to effectively	Small sample size. Failing to correlate improved	Level II B

			n 34 Outpatient at a community hospital in UK	manage the disease.	knowledge to improved outcomes. Convenience sampling of stable patients with cirrhosis.	
3	Piredda, M., Biagioli, V., Giannarelli, D., Incletoli, D., Grieco, F., Carassiti, M., Marinis, M., & De Marinis, M. G., 2016	Randomized controlled trial	Mean age 62y, 52% female, 40% completed high school. N 105 n 105 University hospital in Rome	Patients that received information booklet demonstrated increased knowledge about totally implantable access ports (TIAP) immediately and at 3 months post intervention than the control group. Moreover, physiological indicators of anxiety (BP, HR) decreased in the intervention groups after TIAP procedure.	Small sample size. Sample from only one hospital.	Level I A
4	Pappadis, M. R., Sander, A. M., Lukaszewska, B., Struchen, M. A., Leung, P., &	Randomized controlled trial	Mean age 37, 48% black and 52% Hispanic/Latino	A single session educational intervention using written manuals and didactics/interactive discussion was done with an aim to reduce	Selection bias due to randomly selecting participants who had participated	Level I A

	Smith, D. W., 2017		N 58 n 52 Setting included patient's homes n 50 And research center n 2	traumatic brain injury misconceptions. The intervention group showed a decrease in misconception percentages. And at 1-month follow-up, the control group reported more misconceptions than the intervention group.	in a previous study. Small sample size.	
5	Martin, P., & Tannenbaum, C., 2017	Randomized controlled trial	Mean age 74, 72% females, 25% college educated, 122 classified as mild cognitively impaired N 261 n 122 Setting in-home	Intervention by way of a brochure led to improvement in knowledge and self-efficacy, a change in beliefs, and initiation of discussions with hcp. The brochure was found effective for reducing benzodiazepines for older adults with mild cognitive impairment.	Results only generalizable to patients with mild to moderate cognitive impairment.	Level I A
6	Burke, K., Swartz Ellrodt, A., Levine, J., Adams, T., Allis, R., Macmurdie, I., & Paganoni, S., 2018	Quasi experimental pilot study	Mean age 58yrs, 94% right handed, English speaking N 23 n 16	87% of participants who received brochure about shoulder related material strongly agreed that they were likely to use the info to manage shoulder pain, and the info was easy to understand and was helpful. 93% strongly agreed	Small sample size. Educational brochure only in English.	Level II B

			ALS multidisciplinary clinic	that they had already started to use info in the brochures to manage their shoulder pain.		
7	Curtis, L. M., Mullen, R. J., Russell, A., Fata, A., Bailey, S. C., Makoul, G., & Wolf, M. S., 2016	Randomized controlled trial	mean age 53y, 76% female, 38% African American, 44% White, >50% college educated, and average of 2 chronic conditions N 141 n 122 Internal medicine clinic	Written information and physician counseling were independently associated with patient understanding of risk information. 87% of patients who received both correctly recalled medication risks compared to 40% of patients who received neither.	Small sample size. Sample from only one clinic.	Level I B
8	Murray, C., Thomas, E., & Pollock, W., 2017	Quasi experimental	Mean age 69yrs, all women, 22% college educated, 29% first language not English, 87% postmenopausal	When compared with usual care (verbal info only), the addition of a written, patient condition specific brochure increased knowledge scores at 1 week and 3 months post intervention regardless of age, level of formal education, or	Single center study. Questionnaire and patient brochure not assessed in a formal validation	Level II B

			N 121 n 58 Pessary clinic	background.	process for reliability and validity.	
9	Hersh, L., Salzman, B., & Snyderman, D., 2015	Literature review	N/A	Written materials should be used to reinforce verbal info. verbal and written information increases patient satisfaction and knowledge compared with verbal info alone.	N/A	Level V B
10	Tong, V., Raynor, D. K., & Aslani, P., 2014	Literature review	N/A	Consumer outcomes were influenced by information design; good design principles generally improved over-the-counter label and leaflet performance/comprehensibility.	Diversity in study designs, hindering adequate comparison of various study's aspects and findings.	Level V A

Appendix B

Written Handout (two-sided)

LEAD EXPOSURE DURING PREGNANCY

How it can affect you and your baby, and how to avoid it.

What is lead?

Lead is a toxic metal commonly found in pipes in older housing, paint from before 1980, house dust, old toys, soil/dirt, exhaust from small airplanes, and goods from other countries like ceramics and spices.

How does lead get into the body?

- Breathing in or swallowing dust/soil/dirt
- Drinking contaminated water
- Eating contaminated food or nonfood items
- Eating from lead-containing ceramic pottery

If a pregnant woman is exposed, lead passes from the mother to the baby through the umbilical cord. Though small amounts of lead may pass through breastmilk, breastfeeding is still best for your baby.

What are the effects of lead?

Lead is harmful to the growing brain of the baby and can cause long-lasting problems:

- Decreased brain, kidney, and nervous system function
- Reading and learning disabilities and lower IQ
- Increased antisocial and aggressive behavior
- Reduced attention span and coordination
- Decreased muscle and bone growth
- Premature birth; loss of the pregnancy at extremely high levels

How do you test for lead exposure?

Lead is checked by a blood test. If you have high lead, your baby will need to be checked after birth.

How can I protect my family from lead exposure?

- Have yourself tested for lead.
- If you live in a house built before 1978, have Newark Department of Health and Community Wellness (Newark DHCW) inspect your home and water for lead.
- Use cold water for drinking and cooking as hot water is more likely to have lead. Run the faucet for 15 seconds to 1 minute if the water has been sitting in the pipes for a while.
- Remove shoes before entering your home to prevent tracking in dust and soil and vacuum regularly.
- Wash hands, toys, and play areas regularly to remove contaminated dust or soil.
- Avoid eating nonfood items such as clay, paint chips, soil and earth.
- Avoid eyeliners from outside the country and progressive hair dyes.
- Avoid using ceramics from outside the country for food storage, cooking, and serving.
- If you live with anybody who is exposed at work, take steps to reduce bringing lead into the house.
- Block off and clean work area when renovating or move temporarily to lead-safe housing.
- Eat a well-balanced healthy diet that has vitamin C, iron, calcium, and vitamin D including fish, meats, cereals, beans, green leafy vegetables, and oranges).

For more information:

www.nj.gov/health/biomonitoring
www.state.nj.us/health/ceohs/lead
www.cdc.gov/nceh/lead/
www.partnershipmch.org/programs/leadpoisoning/
Newark DHCW – (973) 733-6400

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NJ Health New Jersey Department of Health

MERCURY EXPOSURE DURING PREGNANCY

How it can affect you and your baby, and how to avoid it.

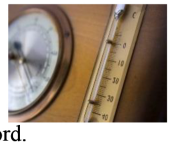
What is mercury?

Mercury is a toxic metal commonly found in fish, plants, oceans, lakes, skin lightening creams and other cosmetics, mercury thermometers, smoke from coal plants, and compact fluorescent lightbulbs.

How does mercury get into the body?

- Eating contaminated fish
- Exposing skin to spilled mercury
- Breathing mercury vapors
- Using skin lightening creams and contaminated cosmetics





If a pregnant woman is exposed, mercury passes from the mother to the baby through the umbilical cord. Though small amounts of mercury may pass through breastmilk; breastfeeding is still best for your baby.

What are the effects of mercury?

Mercury is harmful to the growing brain and can cause long-lasting problems:

- Low brain, bone, and nervous system growth
- Reading and learning disabilities and lower IQ
- Increased chance of behavioral and neurological problems
- Decreased coordination and attention span
- Kidney failure, blindness, and deafness
- Preterm birth; loss of the fetus at extremely high levels

How do you test for mercury exposure?

Mercury can be measured through blood, urine, nails, or hair. If you have elevated mercury levels, your baby will need to be checked after birth.

How can I protect my family from mercury exposure?

- Have yourself tested for mercury.
- Do not eat seafood that has high mercury levels such as sharks, swordfish, eel, raw fish, the green gland or bile of crabs and lobsters, **or *anything* caught in Newark Bay**.
- Avoid touching or breathing in any mercury containing items such as skin lightening creams, broken mercury thermometers, or broken compact fluorescent lightbulbs.
- Avoid jewelry from outside the country because it can have a mercury-containing pendant.

Eating fish is very important during pregnancy because fish have vitamins, minerals, and healthy fats that are good for your baby's growth. You can reduce exposure by eating one serving (8 oz. or about the size of the palm of your hand) of wild-caught fish with low mercury twice a week such as anchovies, sardines, shrimp, tilapia, salmon, cod, and pollock. Check the NJDEP fish advisories listed below for more.

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NJ Health New Jersey Department of Health

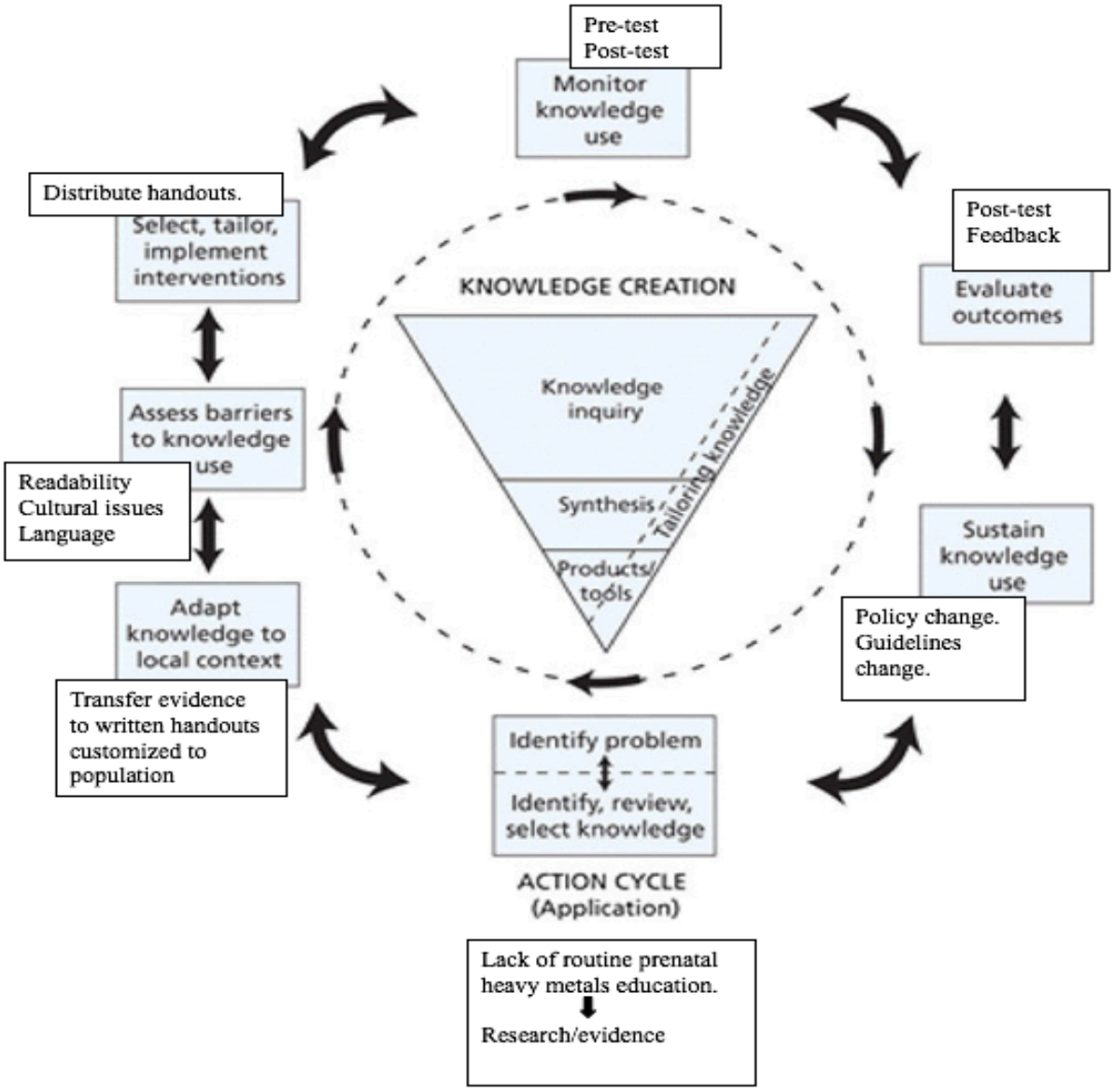
For more information:

www.nj.gov/health/biomonitoring
NJ.gov/dep/dsr/fishadvisories/2017-fish-advisories.pdf
www.cdc.gov/biomonitoring/Mercury_FactSheet.html
Poison control – 1-800-222-1222
www.nj.gov/health/workplacehealthandsafety/occupational-health-surveillance/mercury.shtml

Speak to your doctor if you have any concerns

Appendix C

Conceptual Framework



Adapted from Graham et al., 2006

Appendix D

Site Letter of Agreement

RUTGERS
New Jersey Medical School

WIC Program
Department of Pediatrics
Rutgers, The State University of New Jersey
65 Bergen St. GA-06
Newark, New Jersey 07103

Main number: (973) 972-3416
Fax: (973) 972-8977

Letter of Cooperation (Site Agreement)

Date: 01/15/2019

Re: Letter of Cooperation For New Jersey Medical School Pediatrics WIC Office

Dear Mercy Otieno,

This letter confirms that that I, as an authorized representative of Rutgers New Jersey Medical School Pediatrics WIC Program, allow the Co-investigator access to conduct study related activities at the listed site(s), as discussed with the Co-investigator and briefly outlined below, and which may commence when the Co-investigator provides evidence of IRB approval for the proposed project.

- **Research Site(s)**:
  New Jersey Medical School Pediatrics WIC office
  Stanley S. Bergen Building
  65 Bergen St., Newark NJ 07101

- **Study Purpose:**
  Determine whether written brochures are effective in improving knowledge on prenatal lead and mercury exposure among women in an urban city.

- **Study Activities:**
  Pretest (to be administered prior to handout)
  Written informational handouts
  Posttest
  Didactic

- **Subject Enrollment:**
  English speaking expectant and parenting women ages 18 and above
  Target sample size up to 20 participants

- **Site(s) Support**:
  Provide space to conduct study activities.
  Authorize site employees to identify persons who might qualify for study.

- **Data Management:**
  Pre and posttest results will be collected. No identifiable data will be collected. Highest level of education is the only participant information that will be collected. Collected data will be stored in a password protected computer to only which the co-investigator has access.

- **Anticipated End Date:** August 2019

We understand that this site's participation will only take place during the study's active IRB approval period. All study related activities must cease if IRB approval expires or is suspended. I understand that any activities involving Personal Private Information or Protected Health Information may require compliance with HIPAA Laws and Rutgers Policy.

Our organization agrees to the terms and conditions stated above. If we have any concerns related to this project, we will contact the Co-Investigator. For concerns regarding IRB policy or human subject welfare, we may also contact the Rutgers IRB (see orra.rutgers.edu/hspp).

Appendix E

Recruitment Flyer

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VOLUNTEERS NEEDED FOR A RESEARCH STUDY

Use of a Written Handout to Increase Knowledge on Prenatal Lead and Mercury Exposure

Take part in this important study.
Are you:
A parenting or pregnant woman at least age 18 years old and above?
Do you speak English?

If you answered yes, you may be eligible to participate in a research study.

The purpose of this study is to find out whether a written handout is effective in improving knowledge and awareness of prenatal lead and mercury exposure. Participants will complete a brief test before and after reading the handout. There will also be a discussion session afterwards. A $10 Rite Aid gift card will be offered to participants.

The study will take place on 6/25/2019 at:
New Jersey Medical School Pediatrics WIC office
65 Bergen Street, Newark NJ

Please call Mercy Otieno MSN APN CPNP-PC, co-investigator at (551)580-1893 for questions or more information.

V 2.0 05/30/19

Appendix F

Sign-up Sheet

If interested, please sign-up below.
You will receive a telephone reminder a day before the study.

Name	Phone Number
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Appendix G

Telephone Reminder Script

Telephone Reminder Script from WIC staff:

Greetings (participant name), this is your WIC office calling. You signed up to participate in the study “use of a written handout to increase knowledge on prenatal lead and mercury exposure”. This is a reminder that the study is taking place tomorrow at (scheduled time). Thank you and have a nice day.

Appendix H

Consent Form

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CONSENT TO TAKE PART IN A RESEARCH STUDY

TITLE OF STUDY: Use of a Written Handout to Improve Knowledge on Prenatal Lead and Mercury Exposure Among Women in an Urban Environment
Co-Investigator: Mercy Otieno, MSN APN CPNP-PC

STUDY SUMMARY: This consent form is part of an informed consent process for a research study and it will provide information that will help you decide whether you want to take part in this study. It is your choice to take part or not. The purpose of the research is to: find out if a written handout can improve knowledge about prenatal lead and mercury exposure. If you take part in the research, you will be asked to complete a short test before and after reading the handout. Your time in the study will take about 30 minutes total to read a handout and complete tests. Possible harms or burdens of taking part in the study may be feeling remorse about some things listed in the handout and possible benefits of taking part may be gaining new important knowledge. Your alternative to taking part in the research study is not to take part in it.

The information in this consent form will provide more details about the research study and what will be asked of you if you choose to take part in it. If you have any questions now or during the study, if you choose to take part, you should feel free to ask them and should expect to be given answers you completely understand. After all of your questions have been answered and you wish to take part in the research study, you will be asked to sign this consent form. You are not giving up any of your legal rights by agreeing to take part in this research or by signing this consent form.

Who is conducting this research study?
Mercy Otieno is the co-investigator of this research study. A co-investigator has the overall responsibility for the conduct of the research. However, there are often other individuals who are part of the research team.

Mercy Otieno may be reached at 551-580-1893.

The co-investigator or another member of the study team will also be asked to sign this informed consent. You will be given a copy of the signed consent form to keep.

V.2 05/30/19

Why is this study being done?
The study is being done to see if a handout is effective in improving knowledge about prenatal lead and mercury exposure.

Who may take part in this study and who may not?
Any pregnant or parenting woman age of 18 and above, who speaks and understands English may participate. Those who cannot read English are not able to participate.

Why have I been asked to take part in this study?
You represent the population this study is aimed at, which is pregnant or parenting women.

How long will the study take and how many subjects will take part?
The study will take about an hour and a half, and up to 20 women will participate.

What will I be asked to do if I take part in this study?
You will be given a 6-question pretest. After, you will then be given a one-page double-sided handout to read through. After reading the handout, you will then be given the same 6 question test to complete, also known as posttest. Then you will participate in a learning session which includes viewing a YouTube video and fish advisory refrigerator magnet. You will be given a chance to ask questions before the end of the study.

What are the risks and/or discomforts I might experience if I take part in this study?
There's a potential risk of feeling guilty if you have done things listed in the handout.

Are there any benefits to me if I choose to take part in this study?
The benefits of taking part in this study may be gaining important knowledge which you can also share with your friends and family. Otherwise, there may not be any benefits for participating in the study.

What are my alternatives if I do not want to take part in this study?
There are no alternative available. Your alternative is not to take part in this study.

How will I know if new information is learned that may affect whether I am willing to stay in the study?
During the course of the study, you will be updated about any new information that may affect whether you are willing to continue taking part in the study. If new information is learned that may affect you after the study or your follow-up is completed, you will be contacted.

Will I receive the results of the research?
In general, we will not give you any individual results from the study.

V.2 05/30/19

Will there be any cost to me to take part in this study?
No cost for you to participate.

Will I be paid to take part in this study?
You will receive a $10 gift card as a thank you for participating in the study.

Who might benefit financially from this research?
Nobody will benefit financially from this research.

How will information about me be kept private or confidential?
No identifying information about you will be collected. However, all efforts will be made to keep any collected information confidential. The information will be kept secure in a password protected computer.

What will happen to my information or biospecimens collected for this research after the study is over?

- The information collected about you for this research will not be used by or distributed to investigators for other research.

What will happen if I do not wish to take part in the study or if I later decide not to stay in the study?
It is your choice whether to take part in the research. You may choose to take part, not to take part or you may change your mind and withdraw from the study at any time.

If you do not want to enter the study or decide to stop taking part, your relationship with the Rutgers WIC Program will not change.

Any data that has already been sent to project chair Dr. Sallie Porter's office cannot be withdrawn because there may not be any identifiers with the data.

Who can I call if I have questions?
If you have questions about taking part in this study or if you feel you may have suffered a research related injury, you can call the co-investigator: Mercy Otieno CPNP-PC, at 551-580-1893 or email otienom1@sn.rutgers.edu

If you have questions about your rights as a research subject, you can call the IRB Director at:
Newark HealthSci (973)-972-3608 or the Rutgers Human Subjects Protection Program at (973) 972-1149.

V.2 05/30/19

AGREEMENT TO PARTICIPATE

1. Subject consent:

I have read this entire consent form, or it has been read to me, and I believe that I understand what has been discussed. All of my questions about this form and this study have been answered. I agree to take part in this study.

Subject Name:_____

Subject Signature:_____ Date:_____

2. Signature of Co-Investigator Obtaining Consent:

To the best of my ability, I have explained and discussed all the important details about the study including all of the information contained in this consent form.

Co-Investigator Obtaining Consent (printed name):_____

Signature:_____ Date: _____

V.2 05/30/19

Appendix I

Animated Video

GAO: Lead in Drinking Water

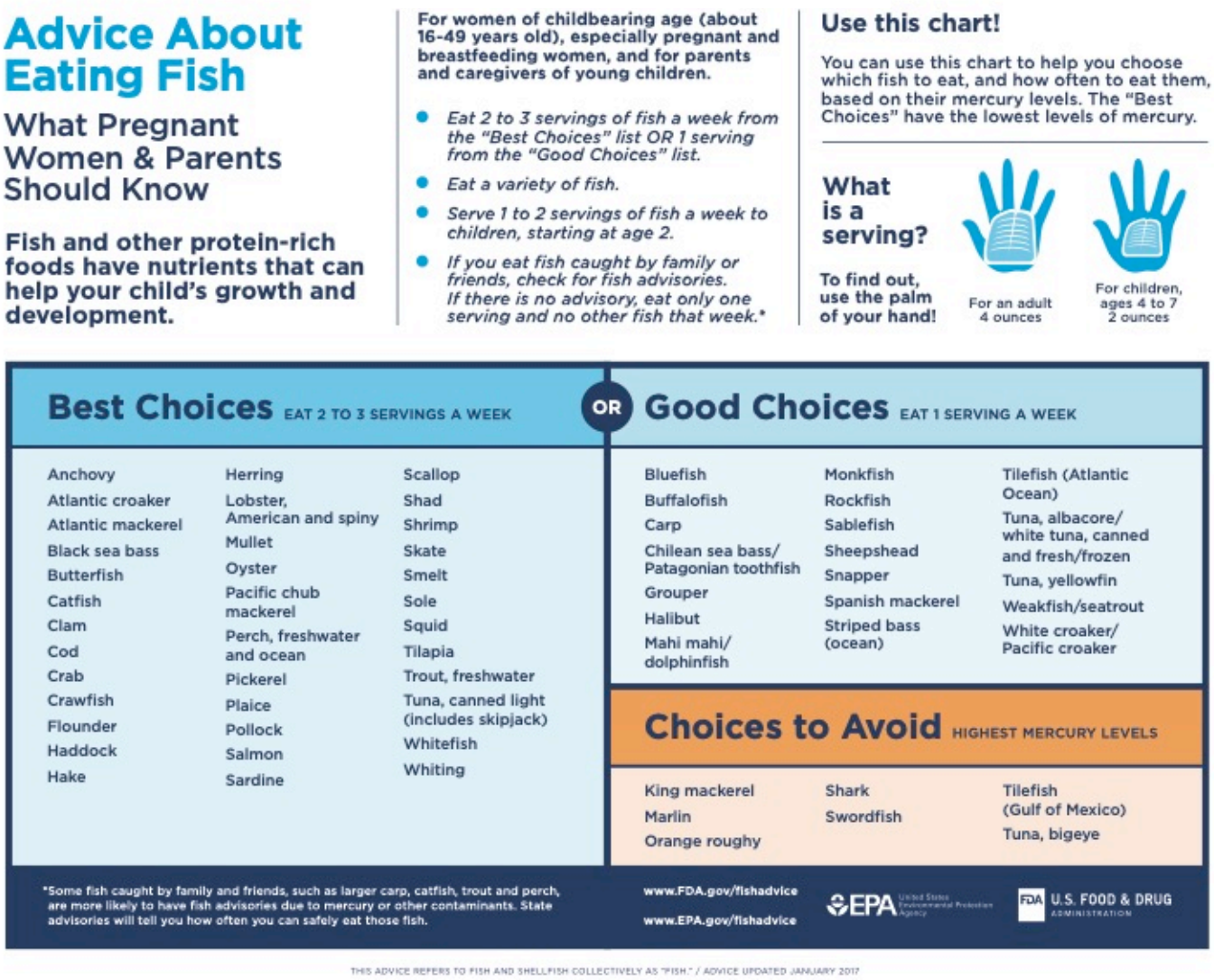
1,066 views LIKE DISLIKE SHARE SAVE ...

United States Government Accountability Office, 2017

https://youtu.be/4Ws_3R3_bdc

Appendix J

Refrigerator Magnet



Unites States FDA, 2019

Appendix K

Lesson Plan

Lesson Plan: Prenatal Lead and Mercury Exposure
Learning Objectives:

1. Participants will be able to name at least 2 species of fish to avoid due to higher mercury levels.
2. Participants will be able to name at least 3 simple steps to minimize lead in drinking water.

Total Time: 1 hour 30 minutes	Activity
15 minutes	Welcome Briefing: Purpose & Learning Objectives Consent
10 minutes	Pre-test
25 minutes	Educational Intervention: Written informational brochure (participants will self-read brochure)
10 minutes	Post-test
20 minutes	Didactic: Student investigator reviews post-test. Student investigator reviews brochure. Student investigator shows class animated 2-minute video. Student investigator distributes and review fish advisory refrigerator magnet.
10 minutes	Question & answer session

Supplies Needed:
Printed Materials: Brochure, Pretest/Posttest
Pens
Clipboards

Appendix L

Pre/Posttest

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PRETEST

1. What is lead?
   a) A color found on the rainbow
   b) Toxic metal found in things such as paint and old houses
   c) A type of food for wild animals
   d) I don't know

2. Which of the following is NOT a way to protect yourself from lead exposure?
   a) Removing shoes before entering your home
   b) Using hot tap water for cooking and drinking
   c) Eating a well-balanced healthy diet
   d) I don't know

3. Why is lead bad for a pregnant mother?
   a) It can cause the baby to be born smaller than normal
   b) It can cause learning problems later in the baby's life
   c) Both a & b
   d) I don't know

4. Why is mercury bad for a pregnant mother?
   a) It can cause high sugar in the baby
   b) It can cause the baby to be born prematurely
   c) It can cause the baby to be born without all fingers
   d) I don't know

5. How can mercury get into your body?
   a) By eating fish that have high mercury
   b) I don't know
   c) By exposing skin to spilled mercury
   d) Both a & c

6. Which of the following are ways you can protect yourself from mercury exposure?
   a) Wearing jewelry from outside the country
   b) Avoiding using skin bleaching creams
   c) Eating fish everyday
   d) I don't know

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POSTTEST

1. What is lead?
   a) A color found on the rainbow
   b) Toxic metal found in things such as paint and old houses
   c) A type of food for wild animals
   d) I don't know

2. Which of the following is NOT a way to protect yourself from lead exposure?
   a) Removing shoes before entering your home
   b) Using hot tap water for cooking and drinking
   c) Eating a well-balanced healthy diet
   d) I don't know

3. Why is lead bad for a pregnant mother?
   a) It can cause the baby to be born smaller than normal
   b) It can cause learning problems later in the baby's life
   c) Both a & b
   d) I don't know

4. Why is mercury bad for a pregnant mother?
   a) It can cause high sugar in the baby
   b) It can cause the baby to be born prematurely
   c) It can cause the baby to be born without all fingers
   d) I don't know

5. How can mercury get into your body?
   a) By eating fish that have high mercury
   b) I don't know
   c) By exposing skin to spilled mercury
   d) Both a & c

6. Which of the following are ways you can protect yourself from mercury exposure?
   a) Wearing jewelry from outside the country
   b) Avoiding using skin bleaching creams
   c) Eating fish everyday
   d) I don't know

Please check your highest level of education:

Elementary school _____
High school _____
Associates degree _____
Bachelor's degree or higher _____

Appendix M

Project Timeline

Task	Dec 2018	Jan 2019	Feb 2019	March 2019	April 2019	May 2019	June 2019	July 2019	Aug 2019
Plan, identify and meet key stakeholders including site visit.									
Literature Review.									
Proposal development and approval									
Obtain IRB approval.									
Recruit, screen and administer questionnaire									
Collect, enter and analyze data.									
Write and present results.									

Appendix N

Budget and Resources

Prenatal Lead and Mercury Exposure
Budget/Resource List

Total estimated cost	$290.00
Two-sided color handouts – 20 copies Consents – 20 copies Pre/posttests – 20 copies	$10
Recruitment flyers – 5 copies	$2
Clipboards – 20	$13
Pens – 20	$10
RiteAid $10 gift cards -20	$200
Refrigerator magnets – 20 copies	$55

Appendix O

Tables

Table 1

Demographic Characteristics of Participants

Characteristic	*n*	%
Gender		
Female	17	100
Education		
Elementary School	1	5.9
High School	10	58.8
Associates Degree	3	17.6
Bachelor's degree or higher	3	17.6

Table 2

Paired Samples Statistics

	Mean	*n*	Std. Deviation	Std. Error Mean
Pretest Score	3.65	17	1.12	0.270
Posttest Score	4.24	17	1.64	0.398

Table 3

Paired Differences

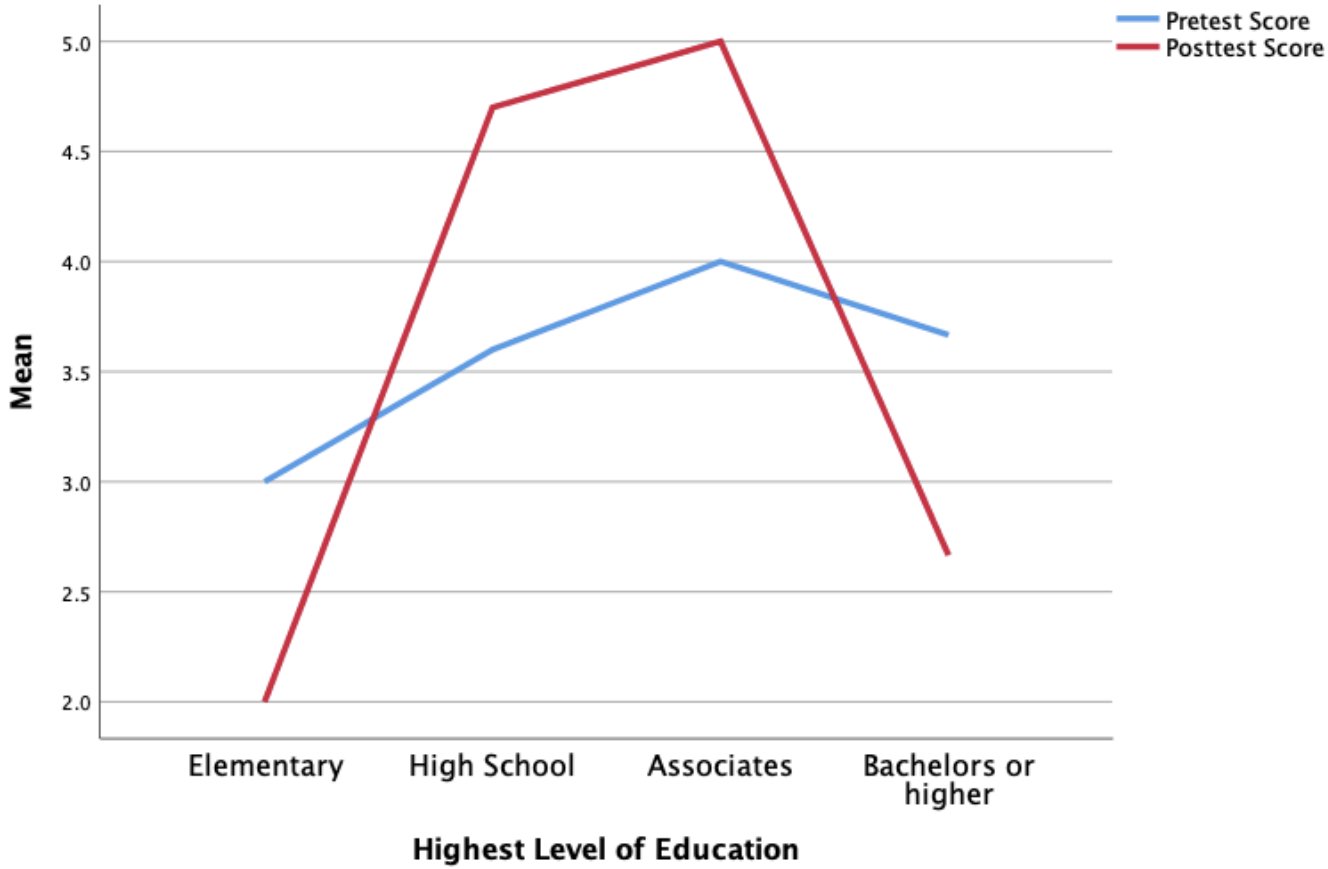
	Mean	Std. Deviation	Std. Error Mean	95% CI of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pretest score – Posttest score	-0.588	1.502	0.364	-1.361	0.184	-1.614	16	0.126

Appendix P

Figure

Figure 1

Increase in Posttest Scores



Appendix Q

PowerPoint Presentation

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Use of a Written Handout to Improve Knowledge on Prenatal Lead and Mercury Exposure Among Women in an Urban Environment

Principal Investigator: Mercy Otieno, MSN, APN, CPNP-PC
DNP Project Chair: Sallie Porter, DNP, PhD, APN, RN-BC, CPNP
DNP Team Member: Patricia Hindin, PhD, CNM, CYT 200
DNP Team Member: Tracy Vitale, DNP, RNC-OB, C-EFM, NE-BC

Introduction

- Main aim: improve knowledge/awareness of prenatal lead (pb) and mercury (hg) exposure and its implications by way of a written handout.
- Increased knowledge/awareness ~ improve fetal health outcomes & save societal and individual health care costs.
- Practice/policy ~ by incorporating prenatal pb and hg exposure handout/ed as part of routine women's health care.

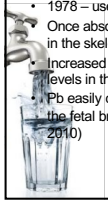
Background and Significance

- The gap: lack of routine prenatal pb and hg exposure education among pregnant and parenting women in an urban environment.
- Population affected: pregnant and parenting women in urban Newark NJ.
- What is currently happening: no documented organized effort in Newark to educate this population (NJDOH, 2019b).
- Why the audience should care: improving health literacy regarding this topic anticipated to improve knowledge, self-efficacy through individuals taking steps to minimize exposure, improving fetal outcomes and individual/societal costs long-term.

Background and Significance

- What we currently know: Pb
- Toxic heavy metal.
- Found in leaded gasoline, pb water pipes, chipping paint, and soil/dust, some imported ceramics/pottery, cosmetics, and spices. Immigrants to nations where leaded gasoline at risk.
- Exposure - ingestion, inhalation, or absorption through the skin.
- Bioavailability - potent in exposure via contaminated water due to its ingestion between meals and after fasting i.e. on awakening. (Ngueta, Abdous, Tardif, St-Laurent, & Levallois, 2015)

Background and Significance



- 1986 - U.S. Safe Drinking Water Act revised; forbid use of pb containing plumbing in public water systems (Craft-Blacksheare, 2017).
- 1978 – use of pb-based paint prohibited.
- Once absorbed in the body, adheres to hgb, > 90% deposited in the skeletal system (Craft-Blacksheare, 2017).
- Increased bone demineralization i.e. preg and lactation = sig ^ levels in the fetus and bf infant (Craft-Blacksheare, 2017).
- Pb easily crosses the placenta by diffusion; ^ levels found in the fetal brain as early as end of the first trimester. (CDC, 2010)

Background and Significance

- Relationship between in utero and childhood pb exposure and adult criminal behavior; arrest rates greater for each 5 µg/dl ^ in blood pb level. (Wright et al., 2008)
- Levels as low as 3.92 µg/dl associated with psychomotor and neurocognitive deficits (Liu, Chen, Gao, Jing, & Hu, 2014)
- 180% higher risk of miscarriage for every 5 µg/dl ^ in maternal lead level; each 10 µg/dl ^ risk of miscarriage by 360% (Edwards, 2013).
- Recent pb epidemic in drinking water in Flint - fetal death rates ^ by 58% and overall health at birth decreased (Grossman & Slusky, 2017).

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Background and Significance

- ^ levels – decreased birth length, head circumference, and gestational age. (Tang et al., 2016)
- Primary prevention/awareness efforts aimed at decreasing pb exposure among pregnant women and children - savings of $1.2 trillion (improvement in HS grad rates and reduction in crime amounting to $50k per child annually) [Muening, 2009].
- Yield an additional 4.8 million quality adjusted life years for U.S. society as a whole. (Muening, 2009)
- Economic impact of childhood pb poisoning - $43 billion annually owing to damaged health, reduced productivity and reduced intelligence (WHO, 2010).

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Background and Significance

- What we know: Hg
- Neurotoxic heavy metal primarily found in fish.
- First released into the atmosphere by industrial practices then finds its way into waters by run-off or settling of airborne particles (Sathyanarayana, Focareta, Dailey, & Buchanan, 2012).
- Urban lands - higher hg = urban waters then fish (Filippelli, Risch, Laidlaw, Nichols, & Crewe, 2015).
- Exposure to humans mainly happens via the GI tract due to consuming contaminated fish.
- In the U.S., hg has contaminated 43% of lakes and marshlands; Newark Bay is one contaminated water body.

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Background and Significance

- NJDOH (2016) - developing nervous system sensitive hg target, protect from vulnerable subjects i.e. developing fetuses and infants.
- Hg easily crosses the placenta disrupting many steps in brain development and fetal growth (Vejrup et al., 2014)
- Dietary hg exposure correlated to low birth weight and small for gestational age infant in relation to the level of exposure (Vejrup et al., 2014)
- Urban minority expectant – hg found to be sig ^ in maternal and cord plasma & RBCs in preterm and low BW infants when compared to normal weight and GA (Chen et al., 2014).

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Background and Significance

- Relationship: poor IQ in school-age children and prenatal hg exposure (Jacobson, Muckle, Ayotte, Dewailly, & Jacobson, 2015).
- Children with cord hg levels > 7.5 µg/dl in utero 4xmore likely to have IQ < 80 ~upper limit for borderline intellectual disability. (Jacobson et al., 2015).
- Loss of productivity due to decreased intelligence and learning abilities - major cost of prenatal hg exposure, $8.7 billion annually (Trasande, Landrigan, & Schechter, 2005).
- Sundseth et al. (2010) - economic impact of hg exposure related to productivity, estimated at $18,000 per each IQ point lost.

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Background and Significance

- What we need to find out:

Does implementing a written handout improve knowledge and awareness of prenatal lead and mercury exposure and it's implications among urban pregnant and parenting women?

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Needs Assessment

Nationally:

- The ACOG (2012) - does not recommend routine prenatal pb exposure education/screening, unless risk factors exists. No Hg guidelines.
- New York – routinely screens/educate all pregnant/postpartum women for pb as required Medicaid prenatal care standard. 6 question tool (Recommended Lead Risk Assessment Questions) (NYSDOH, 2018).
- Minnesota – rountinely screens/educate all pregnant/postpartum women for pb exposure using a 10 question tool (MDH, 2015).
- Hg screening not mandated, although MN has done several biomonitoring studies and published advisories re:preg/pp

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Needs Assessment

Statewide:

- Resources CDC, EPA, & FDA published online at the NJDOH re: pb exposure targeted to children < 6.
- Scarce targeted to pregnant women and/or fetuses.
- Info at the NJDOH website re: fish consumption/hg exposure while preg/breastfeeding.
- Click through multiple links to get to the information.
- Not practical for the low income/low literacy; communicates best when info is close, easily accessible, and familiar (Kreps & Neuhauser, 2015).
- Women (esp pg) with low health literacy less likely to use internet as source of info (Shieh, Mays, McDaniel, & Yu, 2009).

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Needs Assessment

Locally:

- The Women, Infants, and Children (WIC) office - serves low income pregnant women, postpartum women, infants, and children 0-5 at risk for nutritional deficit.
- Supplemental nutritious foods plus nutrition ed and counseling, bf promo and support, imm screening, and health care referrals (WIC Programs, 2019).
- Successes: better newborn outcomes, GA, childhood diets.
- Currently no information in place to educate and bring to awareness the issue of prenatal pb and hg exposure (NJDOH, 2019b).

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Needs Assessment

Locally:

- Low income correlated to low health literacy or low levels of education (Al Sayah, Majumdar, Egede, & Johnson, 2015).
- "The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (USDHHS, 2019).
- Health literacy in this population: worse knowledge and self-efficacy.
- Study by Kumar et al. (2010) - participants in the WIC program had significantly lower average parental health literacy scores.

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Needs Assessment

Locally:

- In the U.S., in 2016 highest WIC recipients either had no high school diploma (70%) or were HS grads (55%). Some college (40%) and AS (27%). (CDC, 2018)
- Children in Newark - 3.8% of the state's children yet 13% < than 6 years old with the highest levels of pb in the state, incl > 20 µg/dl (NJDOH, 2016).
- Pb levels in Newark waters can be > 15 ppb which is the EPA cutoff, some water sources recently avg 47.5 ppb, >3x higher than the EPA cutoff (Mazzola, 2016; Water Quality Products, 2019).

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Needs Assessment

Locally:

- Newark Bay - a water body with high hg levels in Newark, NJDOH (2018) issued advisories for pregnant women and children regarding avoiding consumption of locally caught seafood.
- Essex County is performing worse than the state avg in areas of low birth weight and preterm birth (NJDOH, 2017a).
- FBI (2016) - Newark one of the highest crime rates in the country and the state. In 2014, the rates of both violent and nonviolent crimes surpassed every major city in New Jersey.

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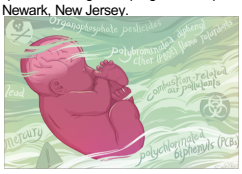
Problem Statement

- There is a lack of awareness and education of lead and mercury exposure among adult pregnant and parenting women in Newark, New Jersey.



Google Images, 2018

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Clinical Question

- Among pregnant and parenting women in an urban environment, how effective is a written informational handout in improving knowledge and awareness of prenatal lead and mercury exposure and its implications?

Google Images, 2018

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Aim & Objectives

Aim:

- Increase knowledge and awareness regarding prenatal lead and mercury exposure and its implications via printed health information materials.

Objectives:

- Develop written informational handout appropriate for low-literacy pregnant and parenting women.
- Measure knowledge before and after implementation of written informational handout among pregnant and parenting women.
- Provide an educational session which includes an animated YouTube video and fish advisory refrigerator magnet.

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Review of Literature

Search strategy

- CINAHL keywords: "(MW (information AND dissemination)) OR (MW (patient AND education)) AND (handouts) OR (pamphlets) OR ((written AND materials)) OR (handouts) AND (minorities) OR (urban) OR (diverse) AND (effectiveness) OR (outcome) OR (appropriateness)".

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Review of Literature

Written Materials to Improve Knowledge

- Significant ^ in knowledge (liver cirrhosis) and how to manage the disease among participants who received an informational leaflet (Beg, Curtis, & Shariff 2016).
- Single educational session using written manuals and interactive discussion reduced misconceptions about TBI immediately and at 1 month among ethnic minorities (Pappadis et al., 2017).
- Verbal instruction alone vs written, condition-specific handouts - ^ knowledge at 1 and 3 months post intervention regardless of age, level of formal education, and background (Murray, Thomas, & Pollock, 2017).

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Review of Literature

- Written materials should be used to reinforce verbal info ~ ^ patient satisfaction and knowledge when compared to verbal information alone (Hersh, Salzman, & Snyderman, 2015).

Written Materials and Influence on Behaviors

- Adherence to meds better among those who rec'd handouts, glycemic control worse in those not receiving handouts (Caetano, Santiago, & Marques, 2018).
- Written info booklet ^ both short- and long-term knowledge and reduced physiological indicators of anxiety i.e., blood pressure and heart rate.
- Consumers more likely to adhere to information stated in written materials. (Burke et al., 2018).

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Review of Literature

Design of Written Materials

- Good design principles generally improved over-the-counter label and leaflet performance/comprehensibility.

handout Design

- One page double-sided – organization and easy navigation.
- Graphics used to enhance text per CMS (2010).
- Cost effective.
- Uniform color, font, and sufficient white space.
- Clean and crisp - encourages readers by making the informational materials appear easy to read (CMS, 2010).

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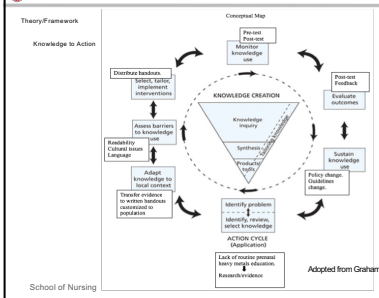

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Methodology

- Quantitative quasi-experimental pilot study.
- Setting: classroom setting at an urban WIC office serving an estimated 2,500 women annually.
- Study population: pregnant and/or parenting women participating in WIC.
  - Inclusion criteria: English speaking female adults ages 18 and above.
  - Exclusion criteria: inability to read/write in the English language.
- Convenient sampling.
- Ultimate sample size 17.

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Methodology

- Recruitment strategy: recruitment flyers posted at the WIC waiting area after IRB approval.
- Sign-up sheet maintained by WIC director for those interested prior to intervention.
- Those who signed up received telephone reminders from WIC a day before the study.
- PI recruited conveniently on day of intervention to fulfill target sample size.
- Those with children were accommodated. WIC office has playroom area.
- Parents ok to attend session with their infants.

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Consent Procedure

- On the same day of intervention, Co-I obtained consent in a classroom setting after doing the following:

Brief intro of self and study.
Purpose of study.
What the participant is being asked to do and how long it will take.
Letting participant know that they can end their participation at any time during the study without repercussions.
Benefits/risks.
Statement that participation does not impact treatment.
Confidentiality and how that will be maintained.
How long data will be held.

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Risks/Harms

- Study presented minimal risks to participants.
- Potential for a sense of cultural insensitivity.
- Potential that a participant may feel guilty for partaking in certain factors i.e. eating too much fish.
- No risk for loss of confidentiality as no identifying participant information was collected.
- Ethical obligations - approval by the IRB before commencement of any study activities.
- IRB will be closed out after final DNP project presentation.

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Cost/Compensation

- Participants did not incur any costs from participating in the study.
- Time commitment of an hour to review handout, complete pre and posttest as well as learning session.
- Participants received a $10 Rite Aid gift card on the same day upon completion of the study as an incentive for participating.
- Free fish advisory refrigerator magnet.

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Study Intervention

- The intervention: written informational handout.
- PI distributed pretest as a baseline assessment.
- Participants given the handout to self-read.
- After, posttest distributed.
- Each pre and posttest assigned an identical number ~ method to identify participants.
- After the posttests collected, PI reviewed test with participants.
- Then, learning session began where the handout will be reviewed as presented.

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Study Intervention

- Two concepts were expanded by:

-Animated 2-minute YouTube video about lead in drinking water.

-An in-depth fish advisory chart from FDA in the form of a 6"x5.5" horizontal refrigerator magnet.

- Learning session objectives:

-participants will be able to

- name at least 2 species of fish to avoid due to higher mercury levels.
- name at least 3 simple steps to minimize lead in drinking water.

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Study Intervention

Posttest outcomes measured:

- **Knowledge** and **awareness** of **prenatal pb** and **hg exposure** and **implications**.
- 6 identical multiple-choice questions r/t outcomes.
- EBG re: low lit pop: tests should be as short as possibly sufficient to capture variables being measured (Cremers, Welbie, Kranenborg, & Wittink, 2017).
- There were 4 answer choices for each question;
- "I don't know" answer option ~ assess what participants do not know instead of having them potentially guess the correct answer.
- Important in order to capture a true reflection of knowledge/awareness (Ciochetto & Haley, 1995).

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Project Timeline

- December 2017 - project planning began. Ongoing regular communication established between project chair and stakeholders at the department of health.
- February 2018 – First version of written handouts complete
- April 2018 – Second version of written handouts complete
- Jan 2019 – Third version of written handouts complete
- April 2019 – Present to project team
- May 2019 – Submit for IRB approval
- June 2019 – Implement project
- Aug 2019 – Final project presentation

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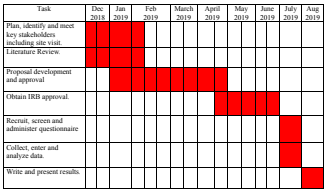
Project Timeline



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Budget/Resources

Prenatal Lead and Mercury Exposure
Budget/Resource List

Total estimated cost	$290.00
Two-sided color handouts – 20 copies Consents – 20 copies Pre/posttests – 20 copies	$10
Recruitment flyers – 5 copies	$2
Clipboards – 20	$13
Pens – 20	$10
RiteAid $10 gift cards -20	$200
Refrigerator magnets – 20 copies	$55

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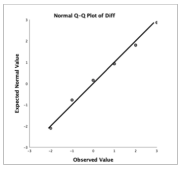
Evaluation Plan

- Data analysis: SPSS v.25.
- Descriptive statistics - bivariate analysis to compare mean scores from the pre and posttests.
- Normally distributed per Q-Q plot = paired t-test to compare means.



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Results

- N =17
- Elementary school: 5.9%, high school grads: **58.8%**, Associates degree: 17.6%, Bachelor's degree or higher: 17.6%
- Results of t-test were not significant t (16) =1.61, **p=0.126**.
- There was an increase from the pre-test (**M=3.65**, SD=1.11, n=17) to the posttest (**M=4.24**, SD=1.64, n=17) scores albeit not statistically significant.
- The mean increase was **0.59** with a 95% confidence interval (CI) for the difference between the pre/post test means of 1.36 to 0.18.

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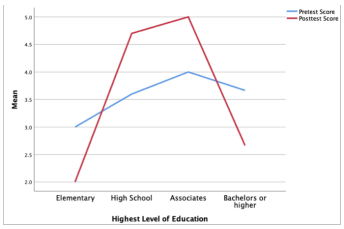
Results



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Unintended Consequences

- Participants offered positive verbal feedback on the written handout when there wasn't any intention to collect this information.
- An interesting phenomenon ~ Bachelor's education or higher and elementary school education had lower posttest scores.
- Perhaps attributed to lower reading level among the elementary educated and English as a second language among Bachelor's educated.

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Limitations

- Small sample size.
- Pre/posttest design.
- Tools and instrument not tested for reliability and validity.

(Instrument was reviewed by experts at the Poison control center, University hospital, and Newark Dept of Health.)

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Implications

- Clinical Practice - Urban women's health care professionals should implement educational tools into their practices.
- Healthcare Quality and Safety Implications - Increasing literacy re prenatal pb and hg exposure = empower consumers.
- Policy Implications - create a policy: lead and mercury education part of mandatory routine women's healthcare.
- Education Implications – education implemented at APN programs particularly women's health and maternal/child health.

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handout: Mercury

MERCURY EXPOSURE DURING PREGNANCY

How it can affect you and your baby, and how to avoid it.

What is mercury?

How does mercury get into the body?

What are the effects of mercury?

How do you test for mercury exposure?

How can I protect my family from mercury exposure?

For more information:

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Refrigerator magnet

Advice About Eating Fish

What Pregnant Women & Parents Should Know

Fish and other protein-rich foods have nutrients that can help your child's growth and development.

Use this chart!

What is a serving?

Best Choices

Good Choices

Choices to Avoid

FDA, 2019

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YouTube

- https://youtu.be/4Ws_3R3_bdc

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