PRECONCEPTION AND INTERCONCEPTION HEALTH AND ROUTINE HEALTH SERVICE USE AMONG WOMEN IN A RURAL MIDWESTERN COMMUNITY

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DEDICATION

To my family, for their unwavering support during this and countless other adventures.

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Advancement of preconception and interconception health is a key element to improve women's health as well as pregnancy outcomes. Little is known about the preconception and interconception health status of rural Midwestern populations in the United States. The primary objective of this study was to determine the preconception and interconception health status as well as behaviors of reproductive age women living in a rural Midwestern area. Secondary objectives were to quantify process measures of health care access and barriers to care, as well as determine disparities in preconception and interconception health status among women in this rural area as compared to statewide estimates. As existing national or state secondary data sources often have limitations in data derived from areas with low population densities or insufficient sample sizes to generate reliable estimates, a cross-sectional study was performed using a 34-item survey. Data were collected from February to May 2019 from 315 non-pregnant women ages 18-45 years in a rural county in northwestern Ohio. Nearly all women surveyed had at least one risk factor associated with poor pregnancy outcomes, many of which were modifiable. Nearly half of all respondents reported at least one barrier to receipt of health care services. Women in this rural county fared worse for several preconception and interconception health measures when compared to statewide estimates derived from Behavioral Risk Factor Surveillance System and Ohio Pregnancy Assessment Survey data. These findings illustrate the need for continued development of interventions to improve preconception and interconception health for rural women as

well as improved methods to capture and analyze data on important subpopulations at risk.

Brian E. Dixon, PhD, MPA, Chair

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

Preconception and interconception health are broad, interrelated terms that encompass overall health for non-pregnant women of reproductive age. Together these terms allow providers, health services researchers, as well as public health programs, to measure, monitor, and improve women's health to minimize adverse pregnancy outcomes, should pregnancy occur.[1] Preconception health refers to a woman's health prior to her first pregnancy. Interconception health focuses on the health of a woman between pregnancies.[1]

Many expert groups have recognized the importance of optimal preconception and interconception health and the need for routine provision of primary health care to identify and modify biomedical, behavioral, or social issues that may pose a risk to the health of a woman or future baby.[1-4] In addition, Healthy People 2020 contains a number of goals related to preconception health status and care. These include objectives to increase the number of women who have received preconception care services and practiced recommended preconception health behaviors.[5] As approximately half of all pregnancies in the U.S. are unintended,[6] it is important that all women of childbearing age, regardless of intent to become pregnant, have good health in order to minimize risks of poor birth outcomes.[1,2]

This is especially important as the United States (U.S.) continues to struggle with high rates of infant mortality.[7] The infant mortality rate (IMR) is calculated by dividing the number of infants born alive who die before age 12 months by 1,000 live births. The most recent data available indicate that the IMR in the U.S. in 2017 was 5.79 deaths per

1,000 live births[7] and comparison with unadjusted IMR with other Organisation for Economic Co-operation and Development countries ranks the U.S. as thirty-fourth[8] (Figure 1). Even after including only births that meet a minimum threshold of 22 weeks' gestation or 500 gram birthweight, the U.S. IMR still ranks significantly higher than comparable countries.[9]

In the U.S., significant differences are seen in the IMR among racial and ethnic groups, with IMR for infants born to African American mothers more than twice the IMR for infants born to Caucasian mothers (10.97 deaths per 1,000 live births versus 4.7 deaths per 1,000 live births, respectively).[7] There are also significant differences in IMR seen regionally in the U.S., with a concentration of high rates in the South and parts of the Midwest (Figure 2).[7] Among nine Midwestern states, seven have IMR higher than the national average (Figure 3).[7]

The provision of preconception and interconception care (that is, provision of primary health care to maintain and improve the health of women before and between pregnancies) can reduce infant mortality.[2] The importance of good preconception and interconception health is supported by the life course theory, which suggests that pregnancy is not the only period of time that impacts maternal and infant health. The life course theory brings integrates two longitudinal biomedical models, the early programming model and cumulative pathway model, with the ecological model.[10-14] The early programming model, also known as the "Barker hypothesis" (so named for British epidemiologist Dr. David Barker) or "fetal origins of adult disease," suggests that exposures and experiences during embryonic and fetal life may encode the functions of organs and systems that manifest in cardiovascular, metabolic and endocrine disease in

adult life.[14-17] The cumulative pathways model suggests that throughout life, exposures and insults gradually accumulate to create "allostatic load" on the body's regulatory processes, causing declines in health and function over time.[14,18] Lastly, the ecological model suggests that an individual's health is impacted over the life course by the interactions of one's own biological determinants with familial and social relationships, environmental contexts, and economic factors.[14]

The life course perspective synthesizes the early programming, cumulative pathway and ecological models into one conceptual framework and takes into account the biological, social, economic, and environmental factors on health and health behaviors throughout life and across generations. The framework takes into account both critical periods for intervention as well as the cumulative impacts of these factors on health.[2,12] In addition, a woman's exposure to various protective and risk factors due to these complex interactions can lead to health disparities.[13,19] Therefore, birth outcomes cannot be attributed only to maternal health status and risks during pregnancy, but to the entire life course of the mother before conception.[19] Even early prenatal care may be too late to minimize some of the risks that result in poor birth outcomes.[20] As a result, there is a need to focus on the health of women throughout their life spans, not just during prenatal and antenatal care.[12,14,21]

The clinical content of preconception care includes screening for health risks, health promotion counseling to improve modifiable behaviors, and interventions such as disease state management and vaccinations.[1] Preconception and interconception care should be provided through routine health care for all women of childbearing potential as part of primary care.[1] Therefore, it is important that women of reproductive age have

access to and use routine health services. To enable women to access and use health care, they must have adequate health care insurance coverage as well as access to family planning services, routine check-ups, and preventive health care.[22] Access to and utilization of health care resources are key in the preconception and interconception period as it enables providers and patients to identify and manage chronic conditions, maintain healthy behaviors, as well as plan for an intentional pregnancy.[22]

While it is important for all women of reproductive age to have optimal preconception and interconception health, there are subpopulations who are more vulnerable to risk factors associated with worse overall health and negative pregnancy outcomes. It is necessary to identify and address such disparities in order to achieve health equity.[23] One at-risk group are women who live in rural areas. In general, women who live in rural areas have poorer health outcomes and higher rates of harmful health behaviors, such as smoking, than women who live in urban areas.[24-27] Women who live in rural areas may have less access to health care resources and fewer health care providers available to them, especially for gynecologic and obstetric services.[24] As a result, women in rural counties may have to travel longer distances to reach health care facilities and/or experience longer wait times for appointments.[24,25] Finally, there are also relatively higher rates of poverty and barriers related to lack of transportation to access health care or purchase healthful foods that impact the health of many women who live in rural areas.[24,29]

Approximately 18 million women of reproductive age live in rural communities in the U.S.,[22] yet only three published studies have sought to examine comprehensive preconception health indicators in this population.[31-33] Two studies combined data from

the Behavioral Risk Factor Surveillance System (BRFSS) across predominantly rural counties; one focused on women living in Appalachia,[31] and the other on women living in the Mississippi River Delta.[32] A third study looked at women living in a 28-county region in central Pennsylvania, which is largely rural.[33] Each of these studies found that women living in these mostly rural areas had concerning preconception health risk behaviors, such as high rates of smoking, overweight/obesity, and physical inactivity.[31-33] However, the geographical locations of these previous studies, especially those using data from Appalachian and the Mississippi River Delta regions, may reflect the influence of unique cultural factors which may not be relevant to rural women living in other areas of the U.S. In addition, these studies did not examine other measures, such as barriers to receipt of care or having a usual source of care, which may be key determinants of health care access for women living in rural areas.

To date, there have been no published papers that examine the experiences of women in the rural Midwest. Given the high rates of infant mortality in the Midwest[7,] and the increased risks associated with poor pregnancy outcomes among rural women,[23-32] it is imperative to characterize the health and access to health care among reproductive-age women in this geographic area. In addition, most work on disparities in maternal and child health in certain Midwestern states, such as Ohio, has focused largely on race and ethnicity.[34] While it is extremely important to continue to work to close the racial/ethnic gap in infant mortality, care must be taken to not inadvertently overlook other at-risk groups in the process. While preconception and interconception health measures may be collected from rural women through the BRFSS[35] or Pregnancy Risk Assessment Monitoring System (PRAMS)[36] surveys, these existing national or state secondary data

sources often have limitations in data derived from areas with low population densities or insufficient sample sizes to generate reliable estimates specific to rural areas.

Therefore, a cross-sectional study and series of three analyses was performed to investigate the following unknown aspects of preconception and interconception health and access to health care among women of reproductive age in the rural Midwest:

1) the prevalence of health behaviors and conditions known to be associated with poor overall health and adverse pregnancy outcomes;

2) the use of routine health care and barriers to accessing such care; and

3) whether any disparities exist in preconception and interconception health indicators as compared to statewide estimates.

The study hypothesis was that women living in this rural Midwestern area have higher rates of poor preconception and interconception health indicators compared to statewide estimates and experience multiple barriers to accessing health care services. In order to measure indicators of preconception and interconception health and health care access, a survey instrument was created, containing primarily questions adapted from the BRFSS[35] and Ohio Pregnancy Assessment Survey[37] or OPAS (the statewide surveillance tool used in Ohio since 2016 in place of PRAMS) that provided standardized wording to allow for comparisons of study results with state and national data. The questions pertaining to preconception and interconception health that were included focused on chronic disease (e.g. hypertension, diabetes, obesity) and health behaviors (e.g., smoking, heavy alcohol consumption, physical inactivity) known to negatively impact a woman's health as well as pregnancy outcomes.[1,38] Process measures for preventive health care use (i.e., routine check-up in the last year), having a usual source of care, and health

insurance coverage as well as barriers to receipt of health care were also assessed because access to medical care is an essential component for good health.[39] These questions sought to quantify the exposures to various protective and risk factors that are affected by social determinants of health across the lifespan. The ultimate goal of this project was to characterize for the first time the preconception and interconception health needs among reproductive-age women living in a rural Midwestern area to determine issues to prioritize, inform the development of needed interventions, and serve as a baseline to measure the effectiveness of such interventions, key steps in the process to advancing health equity.[23]

Figure 1. United States infant mortality rate compared with other Organisation for Economic Co-operation and Development countries, 2017[8]

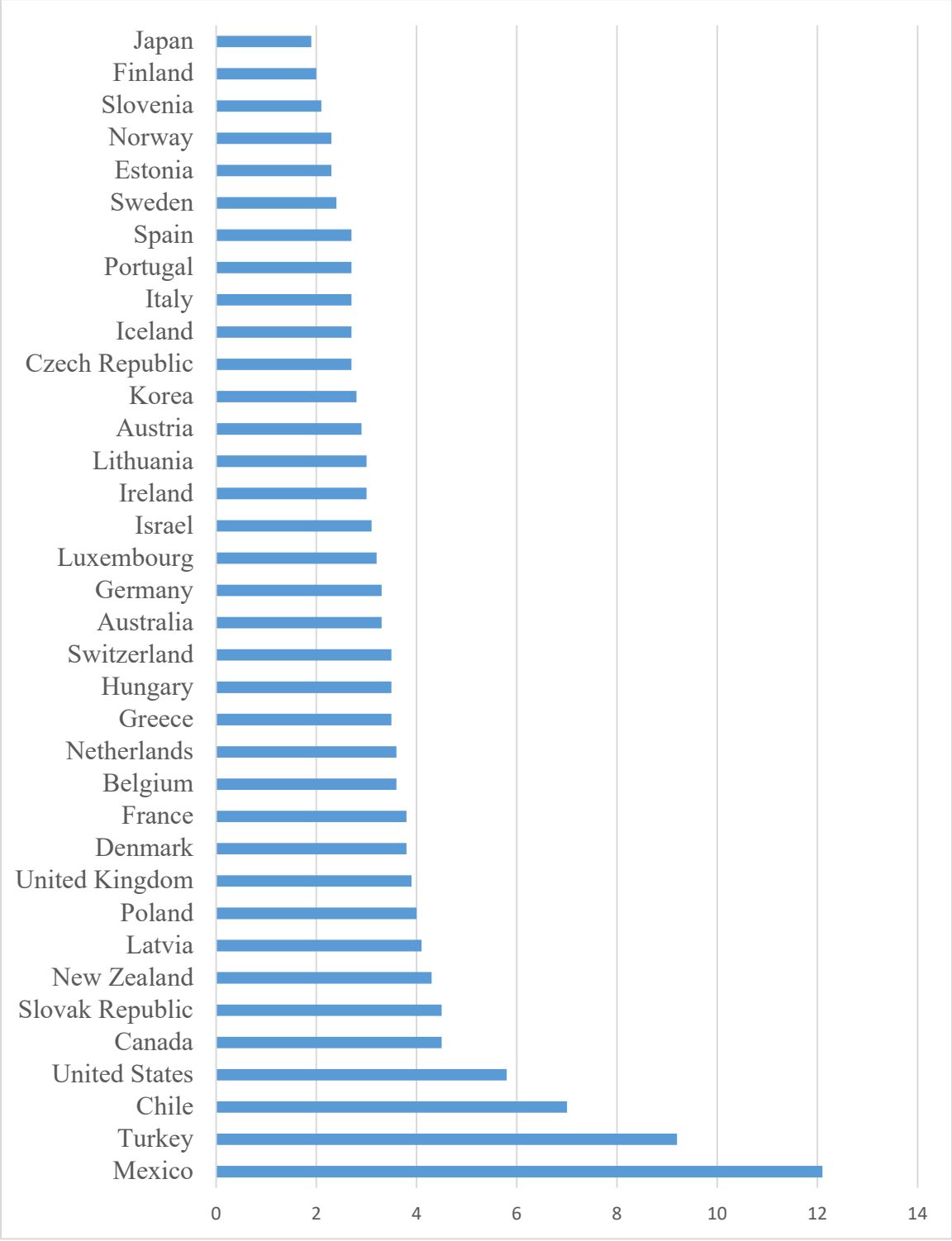
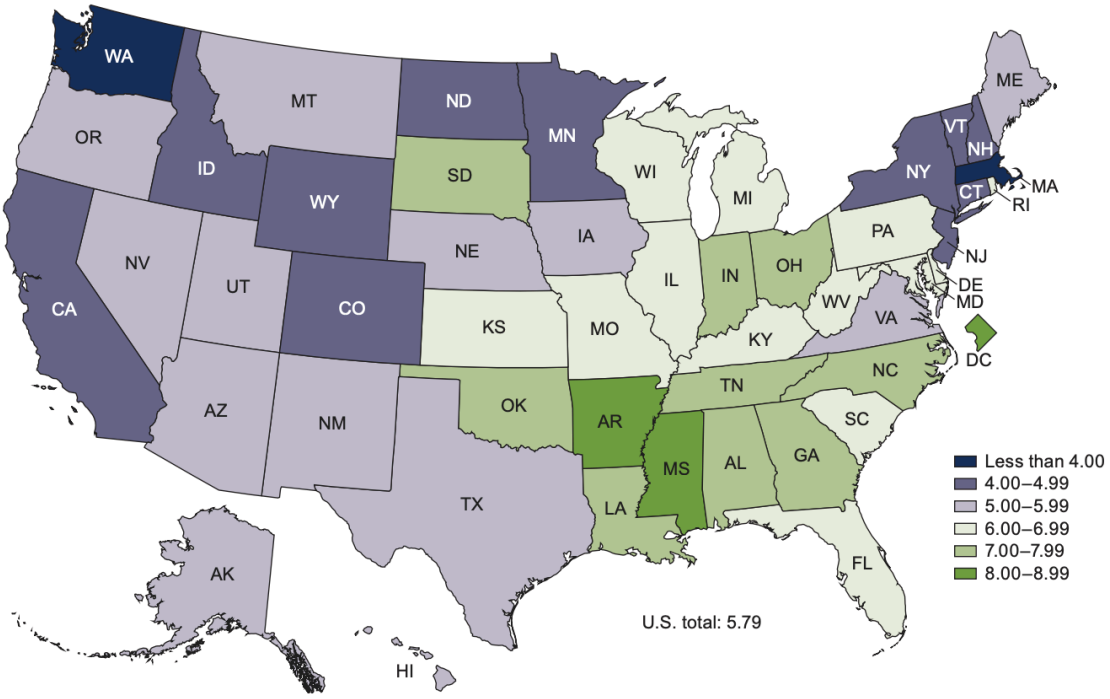
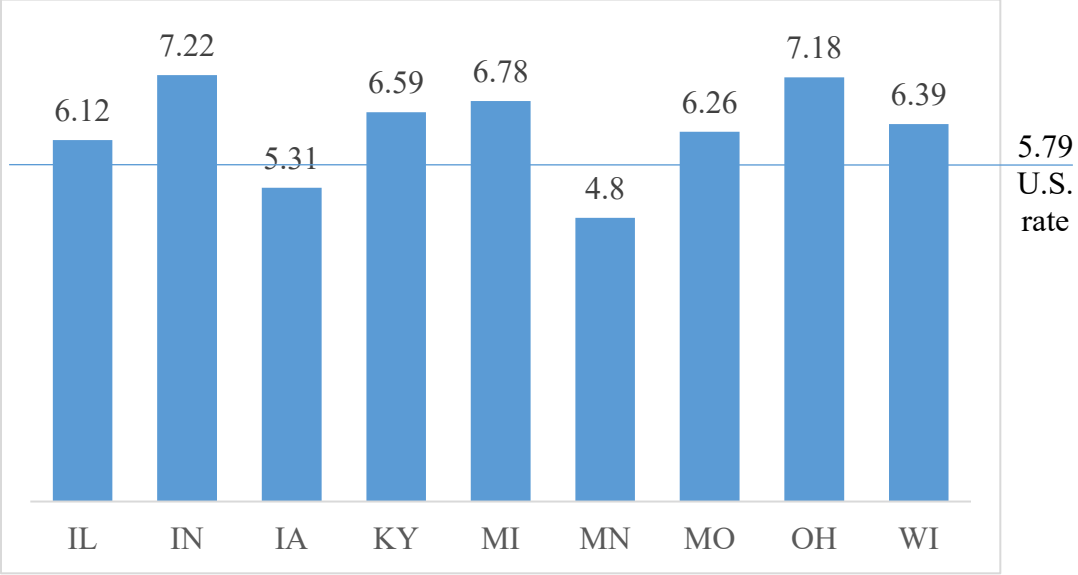


Figure 2. Infant mortality rates per 1000 live births, by state: United States, 2017[7]



Source: Ely DM, Driscoll AK. Infant mortality in the United States, 2017: Data from the period linked birth/infant death file. National Vital Statistics Reports, vol 68 no 10. Hyattsville, MD: National Center for Health Statistics. 2019. This figure is in the public domain and may be reproduced or copied without permission.

Figure 3. Infant mortality rates per 1000 live births in Midwestern states, 2017[7]



IL = Illinois; IN = Indiana; IA = Iowa; KY = Kentucky; MI = Michigan; MN = Minnesota; MO = Missouri; OH = Ohio; WI = Wisconsin

Chapter 2

PRECONCEPTION AND INTERCONCEPTION HEALTH OF WOMEN IN THE RURAL MIDWEST

Introduction

Preconception and interconception health are wide-ranging concepts that encompass overall health for non-pregnant girls and women of reproductive age. Its dual purpose is to improve women's health as well as to minimize adverse pregnancy outcomes, should pregnancy occur.[1] Preconception health refers to a woman's health prior to her first pregnancy. Interconception health focuses on the health of a woman between pregnancies.[1]

The need for good preconception and interconception health is supported by the life course theory and the recognition that even early prenatal care is too late to impact many of the risks that may adversely affect a pregnancy.[20] The life course theory is a conceptual framework that considers the interplay of biological, social, economic, and environmental factors on health and health behaviors throughout life and across generations.[2,12] This approach takes into account both critical periods for intervention as well as the cumulative impacts of these factors on health and brings together longitudinal biomedical modules, the early programming model and cumulative pathway model.[12,13] Therefore, birth outcomes cannot be attributed only to health status and risks during pregnancy, but to the entire life course of the mother before conception.[19] As a result, there is a need to focus on the health of women throughout their life spans, not just during prenatal and antenatal care.[21,40]

Many expert groups have recognized the significance of preconception and interconception health and need for routine provision of preconception and interconception care to all women through comprehensive care to identify and modify biomedical or behavioral issues that may pose a risk to the health of a woman or future baby.[1-4] The U.S. continues to struggle with high rates of infant mortality,[7] thus Healthy People 2020 contains a number of goals related to preconception health status and care, including objectives to increase the number of women who have received preconception care services and practiced recommended preconception health behaviors.[5] As approximately half of all pregnancies in the U.S. are unintended,[6] it is important that all women of childbearing age, regardless of intent to become pregnant, have good health in order to minimize risks of poor birth outcomes.[1,2]

There are subpopulations at greater risk for suboptimal preconception and interconception health status. One such group are women who live in rural areas. In general, women who live in rural areas have poorer health outcomes and higher rates of harmful health behaviors, such as smoking, than women who live in urban areas.[24-28] Women who live in rural areas may have less access to health care resources and fewer health care providers available to them, especially for gynecologic and obstetric services.[24] There are also relatively higher rates of poverty and barriers related to lack of transportation and/or long travel distances required to access health care or purchase healthful foods that impact the health of many women who live in rural areas.[14,29,41]

While women who live in rural areas have been shown to have preconception and interconception health challenges,[31-33] to-date there have been no studies that examine such health measures among women in the rural Midwestern U.S. Existing national or

state secondary data sources often have limitations in data derived from areas with low population densities or insufficient sample sizes to generate reliable estimates specific to rural areas. Therefore, a cross-sectional study was conducted to assess the preconception and interconception health status of women living in a Midwestern rural area. The primary objective of the study was to quantify the prevalence of selected evidence-based preconception and interconception health measures among rural women of reproductive age. A secondary objective was to assess interest among women in this rural area in receiving more information about preconception and interconception care and family planning.

Methods

This cross-sectional study was conducted in Hardin County, a rural county in northwest Ohio with a total population of 31,480 using a 34-item survey instrument developed to collect data pertinent to preconception and interconception health from adult reproductive-aged women (Appendix A). The following domains were included due to their potential impact on preconception and interconception health status: demographic characteristics [age; race/ethnicity; marital status; educational attainment; number of children; income]; preconception and interconception health measures (health status; weight/height; selected medical history; selected vaccine history; multivitamin/folic acid use; fruit/vegetable consumption; alcohol use [average number of drinks consumed per week; number of times in last 3 months that 4 alcoholic drinks were consumed in a 2 hour time span]; tobacco use [history of cigarette, cigar, little cigar, cigarillo, e-cigarette, vaping, other electronic nicotine product, chewing tobacco, snuff, or snus use in past two years; number of cigarettes currently smoked on an average day; current frequency of e-

cigarette, vaping, or other electronic nicotine product use]; physical activity; contraceptive use); and insurance coverage, health care access issues, and patterns of health care use. Finally, participants were asked if they were interested in additional information on how to be a healthy woman, family planning, or how to have a healthy baby; women could indicate interest in receiving additional information on more than one topic.

A number of the questions related to preconception and interconception health were adapted from the BRFSS[35] and OPAS[37] which provided standardized wording to allow for comparisons of study results with state and national data. In addition, several questions were created for the purposes of this study, including questions focused on elements of preconception care recommended by the Centers for Disease Control and Prevention (CDC), such as specific disease states that should be controlled or vaccines that should be received prior to pregnancy.[1] Likewise, questions asking women about the location of their last health care encounter and whether they were interested in more information were developed for this study.

Of the 34 survey items, eight assessed tier 1 preconception health measures. The tier 1 preconception health indicators were identified by the National Preconception Health and Health Care Initiative's Surveillance and Research work group as the highest priority measures for state surveillance of preconception health and can be used to monitor programs or activities for improving the preconception health status of women of reproductive age.[38] These measures are currently collected through BRFSS and PRAMS surveys and include: diabetes (percentage of women ever told by a health care professional that they had diabetes, excluding only during pregnancy and borderline/pre-

diabetes); hypertension (percentage of women ever told by a health care professional that they had hypertension, excluding only during pregnancy and borderline/pre-hypertension); folic acid intake (percentage of women who take a multivitamin, prenatal vitamin, or a folic acid supplement every day of the month prior to pregnancy); heavy alcohol consumption (percentage of women who had eight or more drinks in an average week during the three months prior to pregnancy); normal weight (percentage of women who are normal weight, i.e., body mass index18.5–24.9 kg/m^2); physical activity (percentage of women who participate in enough moderate and/or vigorous physical activity in a usual week to meet the recommended levels of physical activity, i.e., 30 minutes per day for 5 days of the week or more); current smoker (percentage of women who currently smoke); use of a most or moderately effective contraceptive method (percentage of women who report that they or their husband/partner were currently using a more effective contraceptive method to keep from getting pregnant, i.e., sterilization, implant, intrauterine device, or hormonal method [injectable, pill, patch, ring]).[38]

The survey instrument was assessed for face validity and pre-tested by 10 women at a community event who were randomly approached to complete the survey tool and were asked to provide feedback on whether any questions were unclear. Survey data were collected using convenience samples at various locations in Hardin County between February and May 2019. Locations where the survey was administered were purposely varied in order to ensure data were collected from all regions of the county as well as women from different socioeconomic levels. Locations included retail stores, gas stations, grocery stores, laundromats, public libraries, food pantries, gyms, elementary schools, salons, bingo and purse bingo games, General Educational Development (GED)

classes, job fairs, pregnancy resource centers, bowling alleys, community centers, community events, and community resources such as the Help Me Grow home-based family support program. The data were collected anonymously and no incentives were offered for participation. However, at a few community events, inexpensive items such as ballpoint pens were distributed to anyone who approached the table regardless of study participation.

After a woman completed the survey tool, she received a feedback form (Appendix B) informing her whether she met health goals as established by national guidelines.[38] (If a question was not answered, "not known" was selected on the feedback form.) She also received, as appropriate, verbal counseling and referral to local resources to address her these health care needs. Follow-up with the local health department, free mobile health clinic (Ohio Northern University [ONU] HealthWise Mobile Health Clinic), local community pharmacy affiliated with the mobile health clinic (ONU HealthWise Pharmacy), and/or her personal health care provider was encouraged. This followed the model proposed for preconception health services which is 1) risk identification; 2) education, and 3) intervention.[42] Women who indicated they were interested in more information on how to have a healthy baby received an additional handout (Appendix C) and verbal counseling as applicable.

Survey inclusion criteria included women ages 18-45 years who were permanent residents of Hardin County. Exclusion criteria were women who were currently pregnant and temporary residents such as female students attending ONU, the only residential college in the county. A power analysis based on the estimated number of reproductive-age women in Hardin County who currently smoke cigarettes indicated a sample size of

286 would be needed to ensure a 95% confidence level with a corresponding margin of error of no more than 5%; the target number of participants to complete the survey tool was rounded up to 300. The study was approved by the ONU Institutional Review Board, which also allowed an additional 15 respondents' data to be included in the analysis.

Data analyses were performed using Microsoft Office Excel 2019 (Redmond, WA) and IBM SPSS 25 (Armonk, NY). Descriptive statistics were used to characterize the population, and prevalence of the tier 1 preconception health measures were calculated. Chi-square or Fisher's exact test was used as appropriate for very small cell sizes to identify associations between selected demographic characteristics and health measures as well as interest in more information. Participants were further categorized according to reproductive age (younger: 18-34 years; older: 35-45 years), marital status (married; not married), number of children (none; one or more), education (less than college; college graduate or greater), and insurance coverage (any, including private insurance [group or individual], Medicaid, or TRICARE; none) consistent with previous literature.[31-33] Logistic regression was performed to determine variables associated with daily folic acid use, normal weight, sufficient physical activity, or currently smoking cigarettes. These four measures were chosen because of the importance of these health behaviors for a woman's health, regardless of childbearing intent or ability, and potential opportunity for intervention. The following variables were mutually adjusted in the model: age, marital status, having at least one child, education, and health insurance coverage. Age was included as a continuous variable; all other variables were included as categorical variables as described above. Multicollinearity of the independent variables was assessed through evaluation of collinearity diagnostics including variance inflation

factors and tolerance values. Statistical significance was determined *a priori* as $p \leq 0.05$ (two-sided). Cases with missing data were excluded from the analysis.

Results

Of the 430 women meeting inclusion criteria who were approached to take the survey, 320 chose to participate, resulting in a response rate of 74.4%. Analysis of participants' zip codes showed that women from across the county were included in the study (Table D-11). Of the 320 participants, 315 completed at least 80% of the survey and comprised the study group. Two hundred twenty-six participants (71.7%) completed the tool in its entirety; 55 (17.5%) skipped only one of the questions, most commonly the question asking annual income. Most participants completed the survey within five to seven minutes.

Table 1 shows the demographic characteristics of the 315 study participants. Participants' mean age was 32.0 years (standard deviation 7.86 years) and 96.5% were white, non-Hispanic. This demographic profile was consistent with the demographic composition of Hardin County[43] (Table E-13). The majority of study participants were married (53.0%), had at least one child (73.7%), and had at least a high school education (94.9%). Just over half of the participants (52.6%) reporting having private health insurance from their own job or the job of a husband/partner; the remainder reported having private health insurance from parents (5.7%), health insurance from the Ohio Insurance Marketplace or HealthCare.gov (5.4%), Medicaid (22.9%), TRICARE (1.0%), or having no coverage (11.1%).

The preconception and interconception health measures of participants can be seen in Table 2. Nearly one-fifth (16.8%) reported their health status to be fair or poor. The majority of women were either overweight (23.2%) or obese (41.9%). The following medical conditions were reported: type 1 or 2 diabetes (2.5%), hypertension (14.9%), thyroid problems (11.7%), and epilepsy (1.9%). Only 37.8% of respondents reported receiving a flu vaccine in the last year. Nearly 68% of respondents reported use of a most or moderately effective contraceptive method.

Only about a quarter of women reported taking folic acid daily as either a supplement or multivitamin (26.3%), and the majority of women reported eating only one or two servings of fruit and vegetables a day (79.0% and 73.3%, respectively). Less than a quarter (23.5%) of respondents reported meeting recommended levels of physical activity.

About 31% of women reported current use of cigarettes, and 10.2% reported current use of e-cigarettes, vaping, or other electronic nicotine products. Seventeen women (5.4%) reported current use of both cigarettes and electronic nicotine products. Eight women who reported current electronic nicotine product use reported cigarette use in the past two years but no cigarette use now. Almost 32% of respondents reported drinking at least one alcoholic beverage per week. Nearly the same percentage reporting binge drinking at least once in the past three months, although 11.4% of women who reported an episode of binge drinking reported not drinking any alcohol in an average week.

In addition, the total number of tier 1 preconception health risk factors (type 1 or 2 diabetes, hypertension, not taking folic acid daily, heavy alcohol use, abnormal weight,

insufficient physical activity, smoking cigarettes, and not using effective contraception) assessed per women was counted. Only five women (1.6%) reported no tier 1 preconception health risk factors. Thirty-three women (10.5%) reported one tier 1 preconception health risk factor; 69 (21.9%) reported two tier 1 preconception health risk factors; 125 (39.7%) reported three tier 1 preconception health risk factors; 61 (19.4%) reported four tier 1 preconception health risk factors; and 22 (7.0%) reported five tier 1 preconception health risk factors.

Statistically significant differences were also seen among certain subpopulations of women for six of the eight tier 1 preconception health measures (Table 3). Reproductive age was significantly associated with normal weight ($p=0.033$) and effective contraceptive use (0.003). Marital status was significantly associated with folic acid intake ($p=0.021$), current smoking ($p=0.008$), and effective contraceptive use ($p=0.017$). Having at least one child was significantly associated with current smoking ($p<0.001$) and effective contraceptive use ($p<0.001$). Having less than a college education was significantly associated with normal weight ($p=0.009$) and current smoking ($p<0.001$). Any insurance coverage was significantly associated with the greatest number of tier 1 preconception health measures (folic acid intake [$p=0.029$], normal weight [$p=0.001$], physical activity [$p=0.044$], and current smoking [$p=0.005$]).

Four logistic regression analyses were performed to determine variables associated with daily folic acid use, normal weight, sufficient physical activity, or smoking cigarettes (Table 4). The overall models were weak but significant when all five independent variables were entered for three of the health behaviors: daily folic acid use, normal weight, and current smoking. Women who were married (OR=2.20) or had any

insurance coverage (OR=3.37) had significantly higher odds of reporting daily folic acid intake; women with at least one child had significantly lower odds of reporting daily folic acid intake (OR=0.46). Women with a college education or greater (OR=2.79) or any health insurance coverage had significantly higher odds of reporting a normal weight (OR=7.16); as age increased, odds of reporting normal weight significantly decreased (OR=0.95). Women who were married (OR=0.42), had a college degree or greater (OR=0.16), or had any health insurance coverage (OR=0.32) had significantly lower odds of reporting cigarette use, while women with at least one child had significantly higher odds of reporting cigarette use (OR=5.06). The overall model for physical activity was not significant when all five independent variables were entered; however, having any insurance coverage remained significantly associated with lack of sufficient physical activity (OR=0.43).

Women were also asked if they would like additional information. Eighty-three women (26.3%) reported wanting more information on how to be a healthy woman; 34 women (10.8%) reported wanting more information on family planning; and 25 women (7.9%) reported wanting more information on how to have a healthy baby. More unmarried women were interested in information about how to be a healthy woman than married women ($p=0.044$). Younger women (ages 18-34 years) were more interested in information about family planning ($p<0.001$) and how to have a healthy baby ($p<0.001$) than older women; similar trends were seen among women who reported having no children compared to those who reported having one or more children ($p=0.004$ and $p<0.001$, respectively). There were no significant differences in the interest for more information based on education or insurance coverage.

Discussion

This cross-sectional study revealed overall poor preconception and interconception health status as well as unhealthy behaviors among women 18-45 years living in Hardin County, including hypertension (14.9%), current cigarette use (31.1%), insufficient physical activity (76.5%), lack of daily folic acid use (73.7%), and being overweight or obese (65.1%). Ninety-eight percent of women reported at least one tier 1 risk factor for poor preconception and interconception health. Overall, the responses revealed that these women were at risk for poor health, and poor birth outcomes should they become pregnant. Given that most of these are modifiable risk factors, the findings illustrate the need for the development of clinical and public health interventions to improve health and health behaviors for women in this rural area, and may be applicable to women living in other rural Midwestern areas as well. These interventions should be delivered as part of comprehensive women's care supporting preconception health, health through pregnancy, and postpartum/interconception health.[44-46]

Certain subpopulations had a significantly higher prevalence of risk factors, which could be used to better target clinical or public health interventions. The logistic regression models provide insight into associations for four important health measures (folic acid intake, normal weight, physical activity, and smoking) that can significantly influence pregnancy and birth outcomes.[1] These four measures also highlight the impact of health behaviors across the lifespan and the dual purpose of preconception and interconception care: to improve the health of women, as well as the outcome of any pregnancy they may choose to have. Obesity, lack of physical activity, and tobacco use are the leading causes of preventable deaths in the U.S.[47] Folic acid is often taken in the

form of a multivitamin; supplementation of a woman's diet with vitamins and minerals like folic acid and calcium may not only prevent birth defects but is also important for prevention of diseases later in life such as osteoporosis, respectively.[48] Therefore, these behaviors are important for all women, including those have not had children or have finished childbearing.

Policies and programs that enable healthy behaviors and improve knowledge are essential to improving the overall health and well-being of women.[46] Therefore, it is important to consider the systems and social structures in rural areas that impact preconception and interconception health and behaviors.[20,24,49] Factors beyond clinical health should be recognized through a comprehensive life course approach that takes into account unique challenges faced by rural women. Social determinants that impact rural residents, including income and transportation, are associated with poor health outcomes and health disparities.[50] Those living in rural areas have risks for health disparities due to geographic isolation, lower socioeconomic status, and limited access to health care providers.[24,30]

Lower educational achievement in rural areas affects health literacy,[30] which is also associated with poor health outcomes and disparities. Individuals with lower health literacy may be less likely to ask questions or request additional information in health care encounters.[51] In this study, more women indicated interest in receiving more information about "how to be a healthy woman" (26.3%) rather than "how to have a healthy baby" (7.9%). Previous literature has suggested that women may be more interested in preconception health services when framed as "women's health," "women's health management," or "healthy lifestyles" rather than "preconception care," especially

for women who are not planning a pregnancy in the near future.[52] For this population, "women's health" was the term that generated the most interest and should be emphasized in future programs.

This study is the first to quantify preconception and interconception health measures for a population of women living in the rural Midwestern U.S. Strengths of the study include the high response rate as well as the very high percentage of respondents who answered all or almost all of the questions; additionally, survey responses were collected from across the entire county. The preconception and interconception health measures examined are known indicators of overall health. This study identified health risks that can be prioritized and addressed through health promotion, screening, and/or appropriate interventions to improve women's health and minimize the risk for adverse pregnancy and birth outcomes.

Three published studies have examined preconception health measures among primarily rural women in the U.S. Two of these studies combined data from the BRFSS across predominantly rural counties; one focused on women living in Appalachia,[31] and the other on women living in the Mississippi River Delta.[32] A third study looked at women living in a 28-county region in central Pennsylvania, which is largely rural.[33] Each of these studies found that women living in these mostly rural areas had concerning preconception health behaviors, such as high rates of smoking, overweight/obesity, and physical inactivity.[31-33] However, the geographical locations for these studies, especially those using data from Appalachian and the Mississippi River Delta regions, may reflect the influence of unique cultural factors which may not be relevant to rural women living in other areas of the U.S. such as the rural Midwest.

There are several limitations of this study. First, this study did not include female residents of Hardin County younger than 18 years of age. The survey tool was not validated for use in a rural population; however, many of the items used for the instrument were taken from well validated tools used in both rural and urban populations. Not all health domains were included and the questionnaire did not assess all preconception health risk factors; notably, data on food security and mental health issues such as chronic stress, trauma, or depression were not collected. While these are important factors that could impact overall health of the women and birth outcomes, they were not the focus of this study. Data were self-reported which may have resulted in recall errors or social desirability bias, which could result in an underestimation of certain measures (e.g., smoking and alcohol use); in addition, prevalence of chronic conditions such as diabetes or hypertension may also be underestimated as they are often undiagnosed and diagnosis relies on use of the health care system. This is a common and well-known limitation of survey-based studies and the impact of the potential under-reporting should be considered in drawing conclusions. Sampling error might have occurred as a convenience sample was used rather than a random sample and non-response error may also be possible; both of these potential errors could affect the validity and reliability of the data. However, the survey methodology attempted to mitigate the impact of sampling error by purposefully administrating the survey in different areas of the county and in different settings. Since most of those asked to participate in the survey agreed to fill out the form, self-selection bias was expected to be minimal. These data may not be generalizable to women living in other rural areas outside of the Midwestern U.S., especially given the lack of racial and ethnic diversity in

Hardin County. Finally, some of the observed proportions were larger than 25%; therefore, the margin of error might be greater than 5% given the sample size.

Future research should examine additional preconception and interconception health measures that were not collected in this study. As the independent variables included in the logistic regression models were only weakly or modestly associated with the outcomes of interest, future studies may help identify other predictors of healthy behaviors in rural female populations. Additionally, research should be conducted to determine whether there are any disparities in preconception health among women in the rural Midwest as compared with other regions of the U.S. Future studies should also examine the underlying factors that influence women's interest to receive more information about preconception health and reasons for lack of interest. It is important to determine what types of messaging may better resonate and the most appropriate times and ways to engage women through comprehensive medical care and via channels outside of the health care system.[44,53]

Despite the limitations of this study, these results provide data on region-specific preconception and interconception health needs among exclusively rural women. These data help to identify areas of focus for future programs or policies. Furthermore, such baseline data are necessary to study trends and the impact of interventions over time.

Conclusion

Women living in a rural, Midwestern area reported poor preconception and interconception health status such as hypertension (14.9%) and engaging in unhealthy behaviors including cigarette use (31.1%), insufficient physical activity (76.5%), lack of daily folic acid use (73.7%), and being overweight or obese (65.1%). Ninety-eight

percent of women reported at least one risk factor for poor preconception and interconception health. Policies and programs should be developed to address these health issues in order to improve women's well-being as well as pregnancy and birth outcomes for women who live in rural areas.

Table 1. Demographic characteristics of study participants

	n (%) or mean ± SD
Age, years	32.0 ±7.86 years
18-24	66 (21.0%)
25-34	116 (36.8%)
35-45	133 (42.2%)
Race/ethnicity	
White, non-Hispanic	304 (96.5%)
Black, non-Hispanic	2 (0.6%)
Asian	2 (0.6%)
Two or more races	2 (0.6%)
White, Hispanic	5 (1.6%)
Marital status	
Married	167 (53.0%)
Divorced	34 (10.8%)
Separated	14 (4.4%)
Never married	74 (23.5%)
Member of an unmarried couple	26 (8.3%)
Number of children	
None	80 (25.4%)
1 or more	232 (73.7%)
Missing	3 (1.0%)
Education	
Some high school	16 (5.1%)
High school graduate	120 (38.1%)
Some college	107 (34.0%)
College graduate	72 (22.9%)
Health insurance	
Private health insurance from my job or the job of my husband/partner	165 (52.4%)
Private health insurance from my parents	18 (5.7%)
Health insurance from the Ohio Health Insurance Marketplace or HealthCare.gov	17 (5.4%)
Medicaid	72 (22.9%)
TRICARE or other military health care	3 (1.0%)
None	35 (11.1%)
Missing	5 (1.6%)

SD = standard deviation
Percentages may not total 100 due to rounding

Table 2. Preconception and interconception health measures reported by study participants

	n (%)
Self-reported health status	
Excellent	17 (5.4%)
Very good	113 (35.9%)
Good	131 (41.6%)
Fair	52 (16.5%)
Poor	1 (0.3%)
Missing	1 (0.3%)
BMI classification[a]	
Underweight (BMI of <18.5 kg/m^2)	8 (2.5%)
Normal weight (BMI of 18.5 to <25 kg/m^2)	94 (29.8%)
Overweight (BMI of 25.0 to <30 kg/m^2)	73 (23.2%)
Class 1 obese (BMI of 30 to < 35 kg/m^2)	57 (18.1%)
Class II obese (BMI of 35 to < 40 kg/m^2)	38 (12.1%)
Class III obese (BMI of 40 kg/m^2 or higher)	37 (11.7%)
Missing	8 (2.5%)
History of selected medical conditions	
Diabetes*	28 (8.9%)
Type 1 diabetes	3 (1.0%)
Type 2 diabetes	5 (1.6%)
Gestational diabetes (diabetes while pregnant)	23 (7.3%)
Don't know	3 (1.0%)
Missing	1 (0.13%)
High blood pressure (hypertension)	47 (14.9%)
Don't know	2 (0.6%)
Missing	1 (0.3%)
Thyroid problems	37 (11.7%)
Don't know	6 (1.9%)
Missing	1 (0.3%)
Epilepsy (seizures)	6 (1.9%)
Don't know	3 (1.0%)
Missing	1 (0.3%)
Flu vaccine in the last year	119 (37.8%)
Don't know	6 (1.9%)
Missing	2 (0.6%)
Family planning methods*	
Abstinence	19 (6.0%)
Withdrawal	26 (8.3%)
Natural family planning	6 (1.9%)
Condoms	38 (12.1%)
Hormonal contraception (oral, injectable, patch, vaginal ring)	65 (20.6%)

Long-acting reversible contraception (IUD or implant)	29 (9.2%)
Tubes tied or blocked	83 (26.3%)
Vasectomy	36 (11.4%)
Other (free text box) Hysterectomy Unable to become pregnant	 5 (1.6%) 4 (1.3%)
None	32 (10.2%)
Desiring pregnancy	24 (7.7%)
Don't want to use birth control	9 (2.9%)
Worried about side effects from birth control	3 (1.0%)
Problems paying for birth control	1 (0.3%)
Husband/partner does not want to use birth control	2 (0.6%)
Other (free text box) Lesbian	 1 (0.3%)
Missing	18 (5.7%)
Folic acid supplement or multivitamin use	
0 days a week	174 (55.2%)
1-3 days a week	39 (12.4%)
4-6 days a week	19 (6.0%)
7 days a week	83 (26.3%)
Servings of fruit	
0 servings per day	42 (13.3%)
1-2 servings per day	249 (79.0%)
3-4 servings per day	20 (6.3%)
5 or more servings per day	4 (1.3%)
Servings of vegetables	
0 servings per day	21 (6.7%)
1-2 servings per day	231 (73.3%)
3-4 servings per day	63 (20.0%)
5 or more servings per day	0 (0%)
Physical activity (30 minutes or more)	
Less than 1 day a week	45 (14.3%)
1-2 days a week	93 (29.5%)
3-4 days a week	103 (32.7%)
5 or more days a week	74 (23.5%)
Cigarette smoking	
Any cigarettes in the last 2 years	115 (36.5%)
Current use	
None	217 (68.9%)
1-20 cigarettes (<1 pack) on an average day	83 (26.3%)
21-40 cigarettes (1-2 packs) on an average day	15 (4.8%)
E-cigarettes, vaping, or other electronic nicotine products	
Any use in past 2 years	47 (14.9%)
Current use	
None	283 (89.8%)

1 day a week or less	11 (3.5%)
2-6 days a week	7 (2.2%)
Once a day	3 (1.0%)
More than once a day	11 (3.5%)
Alcohol use	
0 drinks a week	214 (67.9%)
1-3 drinks a week	85 (27.0%)
4-7 drinks a week	12 (3.8%)
8-13 drinks a week	0 (0.0%)
14 or more drinks a week	3 (1.0%)
Missing	1 (0.3%)
Binge drinking (4 alcoholic drinks or more in a 2-hour time span)	
0 times in last 3 months	215 (68.3%)
1 time in last 3 months	52 (16.5%)
2 or 3 times in last 3 months	36 (11.4%)
4 or 5 times in last 3 months	6 (1.9%)
6 or more times in last 3 months	6 (1.9%)

BMI = body mass index
percentages may not total 100 due to rounding
*participants could select >1 answer
[a]BMI was calculated from self-reported height and weight and then classified for each participant per the Centers for Disease Control and Prevention BMI definitions

Table 3. Prevalence of selected tier 1 preconception health measures[a] by demographic characteristics

	Diabetes n (%)	Hyper-tension n (%)	Folic acid intake n (%)	Heavy alcohol use n (%)	Normal weight n (%)	Sufficient physical activity n (%)	Current smoker n (%)	Effective contraception n (%)
Total sample	8 (2.5%)	47 (14.9%)	83 (26.3%)	3 (1.0%)	94 (29.8%)	74 (23.5%)	98 (31.1%)	213 (67.6%)
Reproductive age								
Younger: 18-34 years	2 (1.1%)	21 (11.7%)	48 (26.4%)	2 (1.1%)	63 (35.4%)	43 (23.6%)	52 (28.6%)	107 (71.8%)
Older: 35-45 years	6 (4.6%)	26 (19.7%)	35 (26.3%)	1 (0.8%)	31 (24.0%)	31 (23.3%)	46 (34.6%)	106 (86.9%)
p-value	0.074	0.050	0.991	1.000	0.033*	0.948	0.255	0.003*
Marital status[b]								
Not married	3 (2.1%)	22 (15.2%)	30 (20.3%)	3 (2.0%)	49 (34.3%)	35 (23.6%)	57 (38.5%)	91 (72.2%)
Married	5 (3.0%)	25 (15.0%)	53 (31.7%)	0 (0.0%)	45 (27.4%)	39 (23.4%)	41 (24.6%)	122 (84.1%)
p-value	0.728	0.960	0.021*	0.104	0.195	0.951	0.008*	0.017*
Number of children								
None	0 (0.0%)	7 (9.0%)	26 (32.5%)	0 (0.0%)	26 (33.8%)	20 (20.5%)	11 (13.8%)	35 (59.3%)
1 or more	8 (3.5%)	39 (16.9%)	57 (24.6%)	3 (1.3%)	67 (29.5%)	53 (22.8%)	85 (36.6%)	176 (83.8%)
p-value	0.209	0.090	0.166	0.572	0.484	0.695	<0.001*	<0.001*
Education								
Less than college	7 (2.9%)	40 (16.7%)	60 (24.7%)	3 (1.2%)	63 (26.8%)	53 (21.8%)	93 (38.5%)	159 (77.6%)
College or greater	1 (1.4%)	7 (9.7%)	23 (31.9%)	0 (0.0%)	31 (43.1%)	21 (29.2%)	5 (6.9%)	54 (81.8%)
p-value	0.687	0.149	0.220	0.347	0.009*	0.196	<0.001*	0.463
Insurance coverage[c]								
None	2 (6.3%)	8 (24.2%)	4 (11.4%)	0 (0.0%)	2 (6.1%)	13 (37.1%)	18 (51.4%)	19 (70.4%)
Any	6 (2.2%)	39 (14.2%)	79 (28.7%)	3 (1.1%)	89 (33.1%)	60 (21.8%)	78 (28.4%)	192 (79.7%)
p-value	0.199	0.131	0.029*	1.000	0.001*	0.044*	0.005*	0.263

[a]These eight indicators are among ten tier 1 preconception health indicators identified by the National Preconception Health and Health Care Initiative's Surveillance and Research work group for state surveillance

[b]Marital status – Not married (divorced; separated; never married; part of an unmarried couple) / Married

[c]Insurance coverage – None (no insurance coverage) / Any insurance coverage (private insurance, group or individual; TRICARE; Medicaid)
* $p<0.05$ based on X^2 tests of associations or Fisher's exact test (for very small cell sizes) between preconception health measures and demographic characteristics

Table 4. Odds ratios and 95% confidence intervals for selected demographic characteristics and health measures

	Folic acid intake OR, 95% CI	Normal weight OR, 95% CI	Sufficient physical activity OR, 95% CI	Current smoker OR, 95% CI
Age[a]	1.00 (0.96, 1.04)	0.95 (0.91, 0.99)*	1.01 (0.97, 1.05)	1.02 (0.98, 1.06)
Marital status[b] (not married, *ref)*	2.20 (1.21, 3.97)*	0.66 (0.37, 1.18)	0.93 (0.52, 1.68)	0.42 (0.24, 0.75)
Number of children[c] (none, *ref)*	0.46 (0.23, 0.93)*	1.45 (0.72, 2.93)	0.97 (0.47, 2.03)	5.06 (2.06, 12.43)
Education[d] (less than college degree, *ref)*	0.99 (0.53, 1.85)	2.79 (1.49, 5.21)*	1.61 (0.84, 3.06)	0.16 (0.06, 0.42)
Insurance coverage[e] (none, *ref*)	3.37 (1.13, 10.05)*	7.16 (1.65, 31.13)*	0.43 (0.20, 0.93)*	0.32 (0.14, 0.73)
p-value	0.007	<0.001	0.274	<0.001
R^2	0.074	0.130	0.031	0.259

OR = odds ratio; CI = confidence interval
*statistically significant at $p<0.05$
[a] Age – continuous variable
[b]Marital status – Not married (divorced; separated; never married; part of an unmarried couple) / Married
[c]Number of children – None / One or more
[d]Education – less than college degree / college graduate or greater
[e]Insurance coverage – None (no insurance coverage) / Any insurance coverage (private insurance, group or individual; TRICARE; Medicaid)
ORs mutually adjusted via logistic regression for age, marital status, number of children, education, and insurance coverage

Chapter 3

ROUTINE HEALTH CARE UTILIZATION AMONG REPRODUCTIVE-AGE WOMEN RESIDING IN A RURAL MATERNITY CARE DESERT

Introduction

It is important for women to have access to comprehensive primary care, as well as specialty care as needed, throughout their lifespan. These services include preventive care, chronic disease management, mental and behavioral health care, family planning, preconception care, maternity care, postpartum care, and care throughout menopause.[44,46] However, women in the U.S. often face challenges in finding access to health care and health insurance or experience fragmented, incomplete care.[12,46,54]

Those living in rural areas are especially vulnerable, as they are likely to be affected by social determinants of health such as lower socioeconomic status, lack of health insurance, and lack of transportation. These challenges, coupled with geographic isolation resulting in longer travel distances to health care facilities, may result in barriers to receiving timely care.[24,25,30,55-57] Rural residents also have higher rates of unhealthy behaviors and fewer options to obtain healthy foods.[24,29,58] These cumulative effects are especially significant for women of reproductive age, for whom the resultant health disparities increase the risk of poor pregnancy outcomes.[1,24,59]

Compounding these difficulties, many U.S. women in rural areas, especially those in counties designated as "noncore" in the National Center for Health Statistics Urban-Rural Classification Scheme as the most rural areas,[60] find themselves living in a maternity care desert.[61] A maternity care desert is a county in which access to maternity

health care services is absent.[61] In recent years, numerous obstetric units across the U.S. have closed. While such closures have occurred in both urban and rural areas, they are much more common in rural areas. From 2004 to 2014 alone, 179 rural counties lost hospital-based obstetric services (due to either a hospital closure or obstetric unit closure),[62] leaving less than half of all rural counties with a hospital-based obstetric service and straining areas that already had a limited health care workforce.[59-67] As a result, women in rural counties may have to travel long distances to reach facilities that provide obstetric services[24,61,63,65] and/or experience long waiting times for appointments.[61] Closures of obstetric units not only affect access to care, but may also affect outcomes including preterm births[68] and perinatal mortality,[24,59,69] and may exacerbate the disparities in pregnancy outcomes seen along race/ethnicity, socioeconomic, and geographic lines.[7,24,70] This is particularly concerning, as the U.S. continues to struggle with high infant mortality and maternal mortality, with the latter's rates nearly doubling in the past 25 years.[7,22]

It is estimated that more than 5 million women in over 1000 counties across the U.S. live in maternity care deserts, having no hospital offering obstetric care and no obstetric providers in their counties.[61] An additional 10 million women live in areas with limited access to maternity care, a composite measure examining the availability of obstetric care and ability to access that care through health insurance coverage.[61] Even though there are a great number of women potentially impacted, to date there have been no published studies characterizing access and barriers to routine health care utilization in these areas. It is important that women of reproductive age have access to and use routine health services.[22] Women must have adequate health care insurance coverage as

well as access to family planning services, routine check-ups, and preventive health care to promote optimal health and birth outcomes.[22] Access to and utilization of health care resources are key before and between pregnancies to enable providers and patients to identify and manage chronic conditions, address unhealthy behaviors, and plan for an intentional pregnancy, potentially mitigating risks for both mother and baby.[22] Therefore, the objective of this study was to quantify process measures of health care access (receipt of preventive care and usual source of care), barriers (system-level and individual-level), and characteristics associated with routine health care utilization use among reproductive-age women living in a maternity care desert.

Methods

A cross-sectional study was conducted in Hardin County, a noncore rural county in northwest Ohio which has been classified as both a Primary Care Health Professional Shortage Area by the Health Resources and Services Administration[71] and a maternity care desert by the March of Dimes[61] (Figure 4). Data were collected between February and May 2019. Inclusion criteria included non-pregnant women ages 18-45 years who were permanent residents of Hardin County. The survey instruments were anonymously completed from a convenience sample of individuals at locations across Hardin County including retail stores, grocery stores, gas stations, food pantries, public libraries, elementary schools, gyms, laundromats, salons, bowling alleys, bingo and purse bingo games, General Educational Development (GED) classes, job fairs, pregnancy resource centers, community centers, community events, and community resources such as the Help Me Grow home-based family support program. These locations were intentionally

selected to ensure data were collected from all parts of the county and from women of varied socioeconomic status. While there were no incentives offered, at a few community events inexpensive items such as ballpoint pens were given away regardless of survey participation. The study was approved by the Ohio Northern University Institutional Review Board.

Questions regarding health care utilization and access were included in a broader self-reported survey measuring preconception and interconception health status. Demographic characteristics collected included age, location of residence, race/ethnicity, marital status, occupational status, educational attainment, and number of children. Health status (excellent; very good; good; fair; poor) and insurance coverage (uninsured; private insurance from her job, partner's job, or parents; health insurance from the Ohio Health Insurance Marketplace or Healthcare.gov; Medicaid; TRICARE or other military health care) was also collected. Two additional questions were adapted from the BRFSS questionnaire as process measures for routine health care utilization.[35] The first, "Do you have one person you think of as your doctor or health care provider?" was used to measure whether the patient has a regular source of care.[72] The second, "About how long has it been since you last visited a doctor for a routine check-up?" was used to measure use of preventive care.[73,74] Information regarding barriers to access were also collected as an indirect method to describe access,[39] with a question adapted from the OPAS.[37] "In the past year, have any of the following kept you from having an appointment with a doctor?" was followed by five choices (lack of health insurance; inability to get an appointment; lack of transportation; too many things going on; unable to take time off of work) along with a free text box to capture other reasons not listed; participants could

select more than one barrier. Finally, the type of practitioner seen in the participants' last health care encounter and the location of that encounter were recorded.

Descriptive statistics were used to characterize the population. Frequency of health care utilization and reported barriers was calculated. Barriers, including those written in the free text box, were categorized consistent with previous literature as system-level (transportation, lack of health insurance, financial issues, no source of care, inability to get an appointment, doctor out of network), provider-level (distrust), or individual-level (too many things going on, unable to take time off from work, lack of childcare).[74] Participants' location of residence was classified using Rural-Urban Commuting Areas (RUCA) codes.[75]

Chi-square or Fisher's exact tests were used as appropriate to identify associations between selected demographic characteristics and receipt of preventive care, having a usual source of care, and barriers to accessing health care. Women were categorized by age group (younger: 18-34 years; older: 35-45 years), marital status (married; not married), number of children (none; one or more), education (less than college degree; college graduate or greater), employment (currently employed for wages or self-employed; homemaker, student, out of work, unable to work), and insurance coverage (any, including private insurance [employer or non-group], Medicaid, or TRICARE; none), consistent with previous literature.[31-33,74] Answers to questions regarding health care utilization were categorized consistent with previous literature.[74] Participants who indicated having one or more than one person they considered as their doctor or health care provider were considered as having a usual source of care. Participants were considered to have received preventive services in the past year if they responded that it

was within the past year that they saw a doctor for a routine check-up. Participants who reported any barriers preventing an appointment with a doctor in the past year were categorized as having at least one barrier.

A logistic regression analysis was conducted to determine variables associated with having a routine check-up in the past year. The following variables were mutually adjusted in the model: age, marital status, having at least one child, education, employment, health insurance coverage, and number of barriers. Age and number of barriers were included as continuous variables; all other variables were included as categorical variables as described above.

Data analyses were performed using Microsoft Office Excel 2019 (Redmond, WA) and IBM SPSS 25 (Armonk, NY). Statistical significance was determined *a priori* as $p \leq 0.05$ (two-sided). Cases with missing data were excluded from the analysis.

Results

Three hundred fifteen women meeting the inclusion criteria participated in the study. Table 5 shows the demographic characteristics of study participants. The participants' mean age was 32 years and 96.5% were white, non-Hispanic, consistent with the general residential Hardin County population (Table E-13). Most study participants were married (53.0%), had at least one child (73.7%), had at least a high school education (94.9%), and were currently employed for wages (69.5%). Self-reported health status was as follows: excellent (5.4%), very good (35.9%), good (41.6%), fair (16.5%), and poor (0.3%). The majority (74.0%) of participants' residences was classified as RUCA code 7 (small town core); about 6% lived in areas classified as

RUCA code 8 (small town, high commuting) and nearly 20% in RUCA code 9 (small town, low commuting) (Table D-11).

Table 6 shows the reported utilization and barriers to health service use reported by the sample. Eleven percent of respondents reported having no health insurance coverage. Nearly 64% of women reported having one person they considered as their health care provider; an additional 20.0% reported having more than one. About three-fourths of the participants reported having seen a doctor or other health care provider in the past year; the percentage was highest among women with Medicaid coverage (81.7%) and lowest among those with non-group coverage (58.8%); the difference was not statistically significant (p=0.136).

About half of participants reported at least one barrier to utilizing health care services, with 37.9% reporting at least one individual-level barrier and 24.0% reporting at least one system-level barrier. Thirteen percent of women reported at least one individual-level and one system-level barrier simultaneously. Free-text responses in the "other" response box included a provider-level barrier (distrust of doctors); system-level barriers like financial barriers (high deductible health plan, not wanting to pay out-of-pocket costs, and other cost concerns), not having a doctor, and doctor being out of network; and individual-level barriers like needing a babysitter and feeling like they didn't need to see a doctor.

A little over half of participants indicated that their last health care encounter was in Hardin County. About 37% reported that their last health care encounter was outside of Hardin County, and 9% left this question blank. The average distance traveled for the

last health care encounter was 27 miles roundtrip, with 12 women indicating their last health care appointment was over 100 miles roundtrip from their residential address.

Table 7 shows associations between selected demographic characteristics and health care utilization. More women without a child indicated that they did not have at least one person they thought of at their health care provider compared to women who had at least one child ($p=0.049$); significant differences were also seen among women with no insurance coverage compared to any insurance ($p<0.001$). Married women more often reported having a routine check-up in the past year than unmarried women ($p=0.036$). RUCA code classification of location of residence was not significantly associated with usual source of care ($p=0.856$) or routine check-up in past year ($p=0.127$). Being unmarried ($p<0.001$), having no children ($p=0.012$), being currently employed ($p=0.021$), and having no insurance coverage ($p=0.012$) were significantly associated with reporting at least one barrier. RUCA code classification of location of residence was not significantly associated with reporting at least one barrier to receiving care ($p=0.153$).

Results of the logistic regression analysis to examine factors associated with having a routine check-up in the past year are presented in Table 8. The overall model was weak, but significant when all seven variables were entered ($p=0.024$; $R^2=0.081$). After controlling for these variables, routine check-up in the past year remained inversely associated with number of barriers (OR=0.73, 95% CI=0.56-0.95; $p=0.019$).

Discussion

These data reveal that many reproductive-age women living in a maternity care desert face challenges in accessing health service use. Timely receipt of preventive health care and having a usual source of care were reported by the majority of participants, yet gaps existed including 17% of participants reporting no usual source of care and 25% reporting no routine check-up in the past year. Even larger gaps were seen among certain subgroups, with more than 40% of women without health insurance reporting no usual source of care and more than 40% with non-group health coverage reporting no routine check-up in the past year. Half of all participants reported at least one barrier to utilizing health care services, and an increasing number of barriers was significantly associated with preventive health service use even after controlling for selected demographic characteristics.

Additionally, about 37% of respondents indicated that they had to travel outside of the county for their last health care encounter. Travel to reach a health care provider may be costly and difficult for women living in rural areas. As a result, women living in rural areas may postpone or forego care, or may rely on providers who lack advanced training (e.g., substituting local primary care providers for specialists), resulting in unmet health care needs.[57]

Although access to medical care does not assure good health, it is an essential component.[22] Health services and systems should be integrated or linked across the lifespan for optimal health, with needed services or supports available during critical or sensitive periods.[1,12,40] It is important to provide continuity of care and to link health services with other services and supports such as educational and social services.[12] In

addition, health insurance coverage is a key aspect of making health care accessible. While Ohio is a Medicaid-expansion state, the data from this study show that a number of women are still uninsured and the lack of coverage is associated with not having a usual source of care. In addition, coverage does not necessarily translate into utilization of services,[76] especially if out-of-pocket costs remain high. Therefore, it is necessary to expand access to comprehensive, affordable insurance coverage.[1,61] Policy interventions are needed at the local, state, and federal levels to strengthen the health care system and societal structures that support women and families in the U.S.[1,12,59,63]

While there are a few primary health care facilities in Hardin County, some have restricted hours and/or not all are open each day of the week. A free mobile health clinic has started in the county, providing limited secondary preventive care services such as diabetes and hypertension screening as well as disease state management to patients on certain days of the month;[77] uptake among reproductive-age women has been minimal to date. Some sources of care, such as the family planning clinic at the local health department, have recently closed. Such challenges are not unique to Hardin County, and the experiences of women living this area may provide insight regarding routine health care utilization for other rural, female populations living in maternity care deserts, as this study is the first to characterize such a population. Other strengths of this study are that survey responses were collected from all parts of the county and that there were not many missing responses on the surveys.

A limitation of this study is that routine health care utilization was assessed as part of a longer survey, which was not powered on these particular questions; as a result, the study may be subject to type 2 error. Results may not be representative of all

reproductive-age women in Hardin County due to the use of a convenience sample, although the survey methodology attempted to mitigate the impact of sampling error by purposefully administrating the survey in different areas of the county and in different settings. Data were self-reported which may have resulted in recall errors. In addition, these data may not be generalizable to women living in other rural areas outside of the Midwestern U.S., especially given the lack of racial and ethnic diversity in Hardin County. The survey tool did not assess all types of health care services or possible barriers was not validated for use in a rural population; however, many of the items used for the instrument were taken from well-validated tools used in both rural and urban populations.

Based on the findings of this initial study, future research on this topic is warranted. Given that significant variation existed among certain groups pertaining to use and barriers of routine health care, additional studies should be performed to better understand these differences and identify if other differences exist. As the number of barriers women reported were associated with receipt of preventive care, research should comprehensively examine barriers and expand the number and types of barriers studied. The present survey used a standardized question from OPAS which only lists selected system-level and individual-level barriers impeding a postpartum visit. Statewide surveys such as the OPAS or PRAMS should add choices regarding system-level barriers to care that may be especially relevant to women living in maternity care deserts, for example listing barriers around geographic proximity to providers and/or travel time to usual source of care. In addition, more individual-level barriers (such as stigma or privacy concerns) and provider-level barriers (such as those focused on culture and trust)

should be included. Finally, one-fifth of all maternity care deserts are located in an urban area.[61] Studies should be undertaken with reproductive-age women living in urban maternity care deserts to better understand their access to routine health services, as well. It will be important to know the specific issues around health care access and barriers to care in different populations in order to develop necessary interventions specific to their needs.

Conclusion

This is the first study to examine routine health care utilization and barriers to care among reproductive-age women living in a maternity care desert. Gaps existed, including 17% of participants reporting no usual source of care and 25% reporting no routine check-up in the past year. Half of participants reported at least one barrier to accessing health care, and women who reported more barriers were less likely to report receipt of preventive care in the past year. Policies and programs need to be developed to close these gaps and maximize opportunities for optimal health among reproductive-age women.

Figure 4. Distribution of obstetric and non-obstetric hospitals in Hardin County, Ohio and contiguous counties

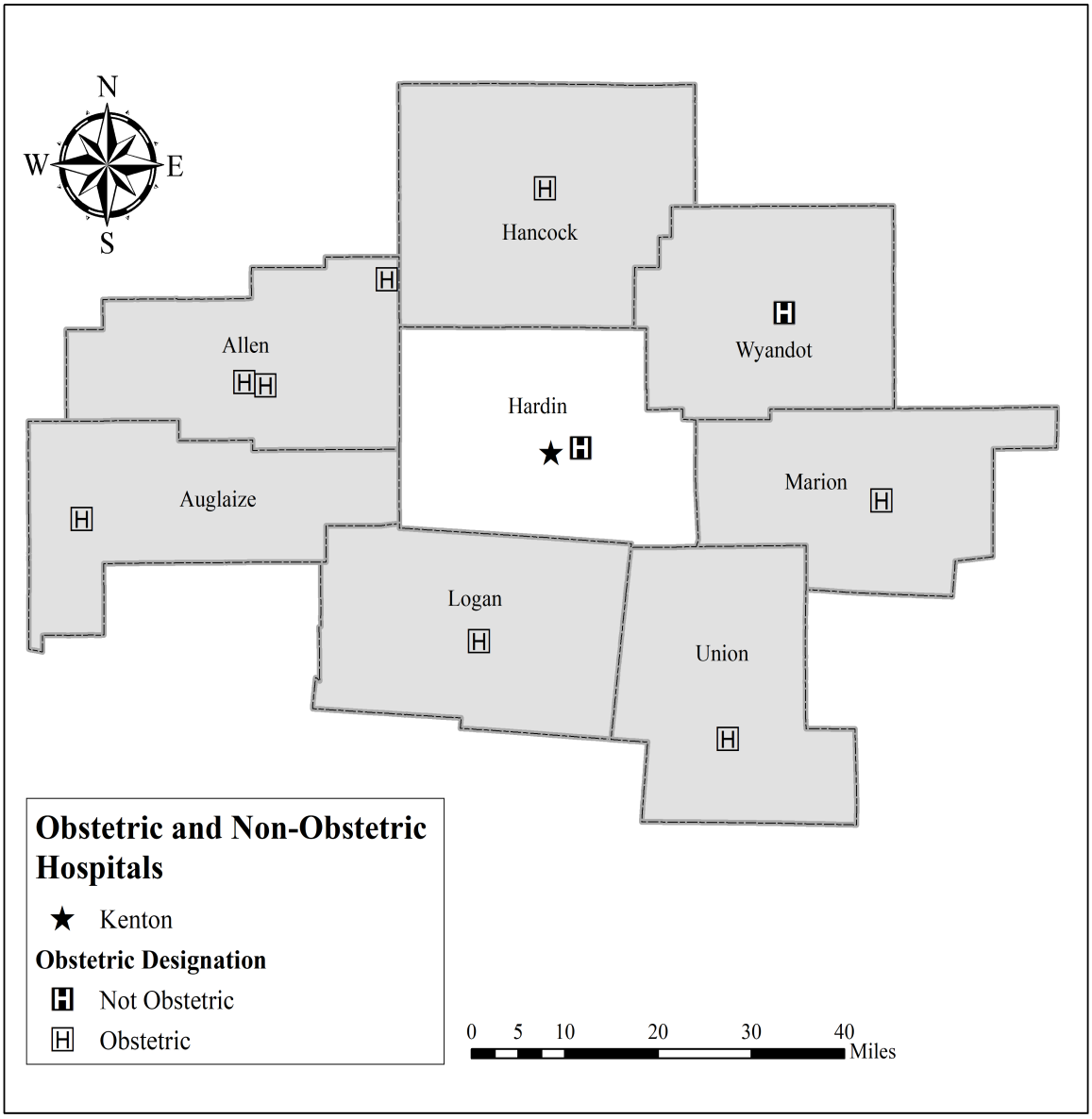


Table 5. Study participants' profile

	n (%) or mean ± SD
Age, years	32.0 ±7.86 years
18-24	66 (21.0%)
25-34	116 (36.8%)
35-45	133 (42.2%)
Race/ethnicity	
White, non-Hispanic	304 (96.5%)
Black, non-Hispanic	2 (0.6%)
Asian	2 (0.6%)
Two or more races	2 (0.6%)
White, Hispanic	5 (1.6%)
Marital status	
Married	167 (53.0%)
Divorced	34 (10.8%)
Separated	14 (4.4%)
Never married	74 (23.5%)
Member of an unmarried couple	26 (8.3%)
Number of children	
None	80 (25.4%)
1 or more	232 (73.7%)
Missing	3 (1.0%)
Education	
Some high school	16 (5.1%)
High school graduate	120 (38.1%)
Some college	107 (34.0%)
College graduate	72 (22.9%)
Occupation	
Employed for wages	219 (69.5%)
Self-employed	23 (7.3%)
Homemaker	31 (9.8%)
Student	12 (3.8%)
Out of work less than 1 year	13 (4.1%)
Out of work 1 year or more	4 (1.3%)
Unable to work	11 (3.5%)
Other (not specified)	2 (0.6%)

SD = standard deviation

Percentages may not total 100 due to rounding

Table 6. Health care access, utilization, and barriers reported by study participants

	n (%)
Health insurance coverage	
Private health insurance from my job or the job of my husband/partner	165 (52.4%)
Private health insurance from my parents	18 (5.7%)
Health insurance from the Ohio Health Insurance Marketplace or HealthCare.gov	17 (5.4%)
Medicaid	72 (22.9%)
TRICARE or other military health care	3 (1.0%)
None	35 (11.1%)
Missing	5 (1.6%)
Do you have 1 person you think of as your doctor of health care provider?	
Yes, only one	200 (63.5%)
More than one	63 (20.0%)
No	45 (14.3%)
Don't know	5 (1.6%)
Missing	2 (0.6%)
Length of time since routine check-up with a doctor	
Within the past year	235 (74.6%)
Within the past 2 years	43 (13.7%)
Within the past 5 years	19 (6.0%)
5 or more years ago	9 (2.9%)
Don't know	6 (1.9%)
Missing	3 (1.0%)
Barriers preventing an appointment with a doctor in the past year*	
System-level barriers	
No health insurance to cover the cost of the visit	45 (14.3%)
Unable to get an appointment when needed	34 (10.8%)
No transportation to get to the clinic or doctor's office	15 (4.8%)
Individual-level barriers	
Too many things going on	86 (27.3%)
Could not take time off of work	72 (22.9%)
Other (free text response) System-level No doctor Doctor out-of-network Financial (out-of-pocket costs) Provider-level Don't trust doctors Individual-level Need babysitter Don't need to see a doctor	 2 (0.6%) 1 (0.3%) 4 (1.3%) 1 (0.3%) 2 (0.6%) 2 (0.6%)
Missing	17 (5.4%)

Total number of reported barriers preventing an appointment with a doctor in the past year	
0	140 (44.2%)
1	91 (28.9%)
2	41 (12.9%)
3	19 (6.0%)
4	2 (0.6%)
5	5 (1.6%)
Missing	17 (5.4%)
Type of health care provider seen in last health care encounter	
Doctor, nurse practitioner, or physician assistant during an office visit	247 (78.4%)
Emergency room/hospital visit	27 (8.6%)
Pharmacist	4 (1.3%)
Dentist	17 (5.4%)
Optometrist or ophthalmologist	3 (0.9%)
Missing	17 (5.4%)
Last health care encounter in Hardin County	
Yes	174 (55.2%)
No	115 (36.5%)
Missing	27 (8.6%)

percentages may not total 100 due to rounding
* participants could select >1 answer

Table 7. Utilization and barriers of health care use by demographic characteristics

	Consider at least one person as a doctor or health care provider	Routine check-up within the past year	At least one barrier preventing an appointment with a doctor
Total sample	263 (83.4%)	235 (74.6%)	158 (50.2%)
Reproductive age			
Younger: 18-34 years	146 (81.1%)	128 (71.5%)	94 (55.%)
Older: 35-45 years	117 (88.0%)	107 (80.5%)	64 (50.4%)
p-value	0.102	0.070	0.434
Marital status[a]			
Not Married	119 (81.0%)	102 (69.9%)	97 (68.3%)
Married	144 (86.7%)	133 (80.1%)	61 (39.1%)
p-value	0.163	0.036*	<0.001*
Number of children			
None	61 (77.2%)	57 (72.2%)	51 (64.6%)
1 or more	200 (86.6%)	176 (76.5%)	104 (48.1%)
p-value	0.049*	0.437	0.012*
Education			
Less than college degree	202 (83.8%)	181 (75.4%)	123 (54.1%)
College graduate or greater	61 (84.7%)	54 (75.0%)	34 (49.3%)
p-value	0.854	0.943	0.477
Employment[b]			
Not currently employed	57 (82.6%)	53 (76.8%)	27 (40.9%)
Currently employed	204 (84.3%)	180 (74.8%)	131 (57.0%)
p-value	0.736	0.719	0.021*
Insurance coverage[c]			
None	19 (55.9%)	22 (64.7%)	25 (73.5%)
Any	241 (87.6%)	209 (76.3%)	131 (50.6%)
p-value	<0.001*	0.142	0.012*
Self-reported health status			
Poor/Fair	42 (79.2%)	42 (80.9%)	26 (55.3%)
Good/Very Good/Excellent	220 (84.9%)	192 (74.1%)	131 (52.4%)
p-value	0.303	0.312	0.713

[a]Marital status – Not married (divorced; separated; never married; part of an unmarried couple) / Married
[b]Employment – Not currently employed (homemaker; student; out of work less than 1 year; out of work greater than 1 year; unable to work) / Currently employed (employed for wages; self-employed)
[c]Insurance coverage – None (no insurance coverage) / Any insurance coverage (private insurance, employer or non-group; TRICARE; Medicaid)
* $p<0.05$ based on X^2 tests of associations or Fisher's exact test between health care access and utilization metrics and demographic characteristics

Table 8. Odds ratios and 95% confidence intervals for selected participant characteristics and routine health care utilization

	Routine check-up within the past year OR (95% CI)
Age[a]	1.01 (0.97, 1.05)
Marital status[b] (not married, *ref)*	1.79 (0.96, 3.36)
Children[c] (no children*, ref*)	0.88 (0.42, 1.85)
Education[d] (less than college degree, *ref)*	0.70 (0.34, 1.44)
Employment[e]	1.08 (0.53, 2.17)
Insurance coverage[f] (none, *ref*)	2.01 (0.91, 4.44)
Number of barriers[g]	0.73 (0.56, 0.95)*

OR = odds ratio; CI = confidence interval
[a]Age – continuous variable
[b]Marital status – Not married (divorced; separated; never married; part of an unmarried couple) / Married
[c]Children – No children / one or more children
[d]Education – less than college degree / college graduate or greater
[e]Employment – Not currently employed (homemaker; student; out of work less than 1 year; out of work greater than 1 year; unable to work) / Currently employed (employed for wages; self-employed)
[f]Insurance coverage – None (no insurance coverage) / Any insurance coverage (private insurance, employer or non-group; TRICARE; Medicaid)
[g]Number of barriers – continuous variable
*statistically significant at $p<0.05$
ORs mutually adjusted for insurance coverage, marital status, education, having children, age, and number of barriers; p-value=0.024; $R^2=0.081$

Chapter 4

PRECONCEPTION AND INTERCONCEPTION HEALTH DISPARITIES AMONG WOMEN LIVING IN THE RURAL MIDWESTERN UNITED STATES

Introduction

Preconception and interconception health are comprehensive terms that entail the overall health of women of reproductive age before or between pregnancies. Advancement of preconception and interconception health is a key element to improve women's health and pregnancy outcomes.[1,78] Preconception and interconception health indicators include modifiable risk factors such as smoking, alcohol use, and healthy weight as well as chronic diseases associated with adverse pregnancy outcomes.[1] As about 45% of all pregnancies in the U.S. are unintended,[6] all fertile women, regardless of their plans to become pregnant, should have good preconception and interconception health.[1]

Preconception and interconception health are supported by the life course theory and the recognition that pregnancy is not the only period of time that impacts maternal and infant health. The life course theory brings together longitudinal biomedical modules, the early programming model, and cumulative pathway model.[12,13] This conceptual framework takes into account the biological, social, economic, and environmental factors that affect health as well as health behaviors throughout life and across generations, considering both cumulative effects and critical periods for intervention.[2,12] Therefore, birth outcomes cannot be attributed only to health status and risks during pregnancy, but to the entire life course of the mother before conception.[19] Even early prenatal care may too late to minimize some of the risks that result in poor

birth outcomes.[20] As a result, there is a need to focus on the health of women throughout their life spans, not just during prenatal and antenatal care.[21,40]

A woman's exposure to various protective and risk factors due to the complex interactions across social determinants of health can lead to health disparities.[13,19] It is important to identify the disparities that exist in preconception and interconception health among various populations so that interventions targeted to community needs can be developed or modified to achieve health equity.[23,79-81] Data show that in the U.S. infant mortality rates increase as urbanization levels decrease,[82] and women who live in rural areas generally have poor health outcomes, high rates of harmful health behaviors such as smoking, and difficulties accessing health care services, transportation, and healthful foods.[24,25,29,31,41] However, only two studies have looked at preconception health disparities among primarily rural women in the U.S.[31,32] One study used data from the BRFSS to compare preconception health indicators among women in Appalachian and non-Appalachian counties in 13 U.S. states.[31] The other utilized BRFSS data to compare preconception health indicators for women living in 14 Mississippi Delta counties to women in the remainder of Mississippi, Delta states, and non-Delta states.[32] It was found that women living in Appalachian or Mississippi Delta areas had concerning preconception health indicators, such as high rates of smoking, overweight/obesity, and physical inactivity.[31,32] However, the Appalachian and the Mississippi River Delta regions have unique cultural factors that may not be relevant to rural women living in other areas of the U.S.

No studies have assessed geographic disparities in the prevalence of preconception and interconception health indicators among reproductive age women in

the rural Midwestern U.S. Therefore, the objective of this study was to identify disparities in preconception and interconception health indicators reported among rural reproductive-age women compared to the general population of reproductive-age women in a Midwestern state.

Methods

To address some of these gaps in research, this study compared the prevalence of selected preconception and interconception risk factors among women living in Hardin County, Ohio, to the results collected throughout all of Ohio through the BRFSS and OPAS surveys. Because existing national or state secondary data sources often have limitations in data derived from areas with low population densities or insufficient sample sizes to generate reliable estimates specific to rural areas, a cross-sectional study was conducted in Hardin County in 2019 to assess the preconception and interconception health status of reproductive-age women. Hardin County is a rural county in northwest Ohio, designated as "noncore" in the National Center for Health Statistics Urban-Rural Classification Scheme indicating the most rural county type.[60] Data were collected from all regions of the county (Table D-11), and locations were varied to ensure women from all socioeconomic levels were reached (Table D-12). Convenience samples were utilized at retail stores, gas stations, grocery stores, laundromats, public libraries, food pantries, gyms, elementary schools, salons, bingo and purse bingo games, General Educational Development (GED) classes, job fairs, pregnancy resource centers, bowling alleys, community centers, community events, and community resources such as the Help Me Grow home-based family support program to reach non-pregnant women ages 18-45

years who were permanent residents of Hardin County. The data were collected anonymously and no incentives were offered for participation. However, at a few community events, inexpensive items such as ballpoint pens were distributed regardless of study participation.

The data collected through the cross-sectional study were compared to data collected in Ohio through the 2017 BRFSS and OPAS surveys. The BRFSS is an ongoing survey of noninstitutionalized adults (aged ≥18 years) in the U.S. that is conducted by state and territorial health departments with assistance from the CDC. BRFSS is an important source of self-reported data on health risk behaviors, chronic health conditions, and preventive health services. Women participating in the study may be pregnant, and a survey question assesses pregnancy status. A multistage sampling design on the basis of random-digit dialing methods is used to create a representative sample in each reporting area. Trained interviewers administer the BRFSS questionnaire via landline and cellular telephones using a computer-assisted telephone interviewing system. Additional details on BRFSS methods are available on the BRFSS website (http://www.cdc.gov/brfss).[83] OPAS is the statewide surveillance tool used in Ohio since 2016 in place of the CDC PRAMS. OPAS is a stratified mixed collection mode random survey that collects self-reported data from residential women with a recent live birth in Ohio. OPAS monitors selected maternal behaviors, conditions, and experiences that occur before, during, and shortly after pregnancy. Sampling methods are employed to ensure results are representative of resident women who gave birth in Ohio. Sampled women are contacted approximately 2 to 4 months after delivery and can participate by completing a mailed survey, online survey, or telephone survey. More information on

OPAS methods can be found on the OPAS website (https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/ohio-pregnancy-assessment-survey-opas).[84]

Data from thirteen questions collected through the cross-sectional study in Hardin County were compared to data received through the BRFSS or OPAS studies. Five questions assessed demographic characteristics (age, race, educational attainment, marital status, and employment) and one question assessed self-reported health status (excellent, very good, good, fair, or poor). Seven questions were from a list of ten tier 1 preconception health indicators developed by National Preconception Health and Health Care Initiative's Surveillance and Research work group.[38] These indicators can be used by states for surveillance and benchmarking of preconception health status among women of reproductive age, evaluation of program effectiveness, and assessment of program development needs to improve maternal and infant outcomes. These measures are currently collected through the BRFSS and OPAS surveys but reliable estimates specific to each Ohio county cannot be calculated. Therefore, the Hardin County study survey instrument used wording consistent with BRFSS and OPAS questions when possible to allow for direct comparisons; however, not all ten tier 1 preconception health indicators were measured in the Hardin County study. The seven measures that were included and could be compared to statewide estimates assessed diabetes (percentage of women ever told by a health care professional that they had diabetes, excluding only during pregnancy and borderline/pre-diabetes); hypertension (percentage of women ever told by a health care professional that they had hypertension, excluding only during pregnancy and borderline/pre-hypertension); normal weight (percentage of women who

are normal weight using calculated body mass index18.5–24.9 kg/m^2 using self-reported height and weight); folic acid intake (percentage of women who take a multivitamin, prenatal vitamin, or a folic acid supplement every day of the month prior to pregnancy); current smoker (percentage of women who currently smoke); heavy alcohol consumption (percentage of women who had eight or more drinks in an average week during the three months prior to pregnancy); and use of a most or moderately effective contraceptive method (percentage of women who report that they or their husband/partner were currently using a more effective contraceptive method to keep from getting pregnant, i.e., sterilization, implant, intrauterine device, or hormonal method [injectable, pill, patch, ring]).

Data analyses were performed using Microsoft Office Excel 2019 (Redmond, WA) and IBM SPSS 25 (Armonk, NY). Data regarding age and race/ethnicity were collected in all three studies; comparisons between the BRFSS and Hardin County datasets as well as the OPAS and Hardin County datasets were performed using two-sample t-tests and chi square goodness of fit tests, respectively. BRFSS data were used for comparison of three demographic characteristics (educational attainment, marital status, and employment), two tier 1 preconception health indicators (overweight/obesity and current cigarettes use), and general health status (fair or poor). OPAS data were used for comparison of five tier 1 preconception health indicators (type 1 or 2 diabetes, hypertension, daily folic acid use, heavy alcohol consumption, and current use of effective contraception). Answers to these questions were coded as dichotomous variables (yes/no), and binomial tests were used to compare the proportion of responses to specific questions from the Hardin County study to the expected values from the

BRFSS or OPAS studies. Cases with missing data were excluded from the analysis. Statistical significance was determined *a priori* as $p \leq 0.05$ (one-sided). The study was approved by the Ohio Northern University Institutional Review Board.

Results

The demographic characteristics of each of the three study populations are provided in Table 9. Three-hundred fifteen non-pregnant women aged 18-45 years (mean age 32.0 years) completed the Hardin County survey. There were 1,610 women aged 18-45 years (mean age 31.3 years) in the BRFSS dataset; 4.0% were pregnant at the time of the survey. The OPAS dataset comprised 5,377 women with a recent live birth aged 13-52 years (mean age 29.5 years). Participants in the Hardin County study were significantly older than participants in the OPAS and BRFSS studies. Consistent with county demographics (Table E-13), respondents to the Hardin County survey were less diverse than respondents to the statewide surveys. Among respondents to the Hardin County survey, 96.5% were non-Hispanic white; 0.6% were non-Hispanic black; 1.2% were non-Hispanic other; and 1.6% were Hispanic. The BRFSS respondents were 75.7% non-Hispanic white; 13.8% non-Hispanic black; 6.5% non-Hispanic other; and 4.0% Hispanic. OPAS respondents were 71.1% non-Hispanic white; 16.5% non-Hispanic black; 6.8% non-Hispanic other, and 5.6% Hispanic.

Nearly 17% of women in the Hardin County survey reported their overall health status as "fair" or "poor" compared to about 14% in the BRFSS survey ($p=0.073$). A significantly lower percentage of respondents in the Hardin County survey reported having a college degree than in the BRFSS survey (22.9% and 27.6%, respectively;

p=0.033). About 53% of respondents to the Hardin County survey reported being married, while about 41% of respondents to BRFSS reported the same (p<0.001). Nearly 70% of respondents to the Hardin County survey reported being employed for wages, compared to nearly 60% of respondents to the BRFSS (p<0.001).

The prevalence of the tier 1 health indictors collected in the Hardin County survey and the results of binomial test comparisons are provided in Table 10. Binomial tests indicated that Hardin County survey respondents had significantly greater health risks than the statewide population in regard to the percent who were overweight or obese (66.8% vs. 58.7%; p=0.002), had hypertension (15.1% vs. 5.1%; p<0.001), or currently used cigarettes (31.1% vs. 22.7%; p<0.001). A significantly higher proportion of Hardin County survey respondents indicated use of permanent contraception methods (tubal ligation: 27.9% vs 9.4%, p<0.001; vasectomy: 12.1% vs. 4.3%, p<0.001). Daily use of a multivitamin or folic acid supplement (26.3% vs. 33.1%; p<0.001) and heavy alcohol consumption was less often reported among respondents to the Hardin County survey (1.0% vs. 4.8%; p<0.001). There was not a statistically significant difference in reported prevalence of type 1 or 2 diabetes (2.6% vs. 3.2%; p=0.335).

Discussion

These results indicate a need to better explore potential differences in preconception and interconception health based on geographic region, as statewide estimates may obscure variation among subpopulations. Although maternal, infant, and child health rank as a top ten concern among rural health experts,[25] few studies have sought to examine preconception and interconception health disparities among women

living in predominantly rural areas.[31,32] Consistent with these previous studies, women in the rural Midwest had a high number of preconception and interconception health concerns. Women in this rural county fared worse than the state on several preconception and interconception health measures. They had a significantly higher prevalence of unhealthy indicators including being overweight or obese, having hypertension, and smoking cigarettes. In addition, a lower prevalence of daily multivitamin, folic acid supplement, or prenatal vitamin use was reported. These disparities indicate rural women are more vulnerable to several risk factors associated with poor pregnancy outcomes. In addition, these preconception and interconception health indicators are indicators of overall good health. Women in rural Midwestern counties such as Hardin County may be falling behind the rest of Ohio and other regions in the U.S. for certain health indicators and may need focused individual and community-based interventions to address social determinants of health and facilitate healthier behaviors.

Compared to other states, Ohio ranks near the bottom in overall infant mortality and African-American infant deaths.[85] In Ohio, most work on disparities in maternal and child health has focused on race and ethnicity with emphasis on nine urban counties that receive targeted resources through the Ohio Equity Institute (OEI) to address racial disparities in birth outcomes.[34] While it is extremely important to continue to work to close the racial/ethnic gap in infant mortality, care must be taken to not inadvertently overlook other at-risk groups in the process. Rural/urban geographic disparities in birth outcomes must also be addressed to achieve health equity. Data show that across the U.S. infant mortality rates increase as urbanization levels decrease; infant mortality in rural counites is 6% higher than in small and medium urban counties and 20% higher than in

large urban counties.[82] However, infant mortality rates are not reported for Hardin County and five other Ohio counties due to small numbers and unstable estimates. Therefore, data from similar rural counties should be pooled to look for potential disparities. Since Ohio is a large state that encompasses several distinct geographical areas, a more regional approach to data collection and analysis looking at rural areas, Appalachian areas, and urban areas and may help to identify important subgroups at risk who are being overlooked with current data reporting. The approach used for the current study may also be used in other states that have similar geographic variations in their population.

There are several strengths to this study. This study represents the first time preconception and interconception health disparities were characterized for women living in the rural Midwestern U.S. In addition, this study provides updated statewide estimates of preconception and interconception health status, as the most recently published statewide prevalence data on preconception health indicators in Ohio used data that are now ten years old.[86] These data also serve as a baseline that can be used to evaluate the impact of interventions to improve maternal and infant health across the state.

There are several limitations to this study. First, the data from the Hardin County survey were collected in 2019 and were compared to 2017 OPAS and BRFSS datasets, which were the most currently available at the time of the analysis. However, it is not likely that the difference in years would introduce a bias since these measures tend to change rather slowly. Respondents to the Hardin County survey were not currently pregnant, whereas the OPAS dataset comprises women with a recent, live birth and the BRFSS dataset had a small percentage of women who were currently pregnant. This

difference might impact some responses for certain questions. For example, daily folic acid use may have been higher among respondents to OPAS as some women in that survey may have planned their pregnancy. Each of the three surveys also relied on self-reported data, which may have led to errors due to recall or social desirability; prevalence of diabetes or hypertension may also be underestimated as they may be undiagnosed. This is a common and well-known limitation of survey-based studies and the impact of the potential under-reporting should be considered in drawing conclusions. There are also limitations inherent in the Hardin County and OPAS surveys due to their data collection methods. The data collected in Hardin County utilized a convenience sample; although the survey was purposefully administrated in different areas of the county and in different settings to minimize the impact of sampling error, there could be limitations in the validity and reliability of the data. While the demographic composition in Hardin County is similar to some contiguous rural counties and rural counties in contiguous Midwestern states, results may not be generalizable to other rural areas of the country, especially those that are more racially diverse. OPAS data are collected from women who have had a live birth, and may not represent health indicators among women who had a miscarriage or stillbirth or among women who have never been pregnant. However, in spite of these limitations, BRFSS and PRAMS/OPAS data are routinely used to characterize preconception health indicators for women of reproductive age and were considered the best available sources of statewide estimates to use for comparison purposes.

Additional studies should further examine preconception and interconception health disparities among women in rural areas, especially in areas of high rates of poor

birth outcomes. Additional indicators, such as food security and mental health issues such as chronic stress, trauma, and depression should also be assessed. Surveys such as BRFSS and PRAMS/OPAS should employ sampling strategies to generate reliable estimates specific to rural counties or, if this is not possible, data from similar counties or regions should be combined to increase the sample size for analysis.

Having such region-specific data on preconception and interconception health will inform interventions that can be targeted to these populations to optimize health and birth outcomes. These improvements can also help to reduce disparities in poor health outcomes by addressing disparities in preconception and interconception risk factors.[19,87] The types of interventions delivered in a particular region should be based on local epidemiology, available resources, and concurrent efforts.[81] Understanding the pathways through which rural women are at risk for adverse pregnancy outcomes is necessary to provide optimal care for this population. Health care providers and public health professionals should focus on areas of greatest need in specific communities. For example, in this sample of rural women, reported higher rates of smoking and relatively lower rates of heavy alcohol use; thus, interventions focusing more on tobacco use cessation and prevention and less on heavy alcohol use would be reasonable. However, reducing any high-risk behavior would be beneficial to the residents in rural areas. Resources should be placed on the areas of highest priority for a particular region based on studies such as the current one. System-level changes will require cooperation and integration across various organizations, and high-quality data must be continually available to monitor changes over time.

Conclusion

When compared to statewide estimates, a significantly higher proportion of women living in a rural area of Ohio reported preconception and interconception health risk factors including being overweight or obese (66.8%), having hypertension (15.1%), smoking cigarettes (31.1%), and not taking a multivitamin or folic acid supplement every day (73.7%). There is a need for interventions to be developed and implemented to address these risk factors for poor pregnancy outcomes for women in rural areas and eliminate geographic disparities to achieve health equity.

Table 9. Comparison of study participants' demographic characteristics

	Dataset		
	Hardin County	BRFSS	OPAS
n	315	610	5377
Study population	Women 18-45 years; non-pregnant	Women 18-45 years; 4% currently pregnant	Women 13-52 years; recent live birth
Age, mean ± SD	32.0 ± 7.86 years	31.1 ± 8.15 years p-value=0.036	29.5 ± years p-value<0.001
Race/ ethnicity	non-Hispanic white=96.5% non-Hispanic black=0.6% non-Hispanic other=1.2% Hispanic=1.6%	non-Hispanic white=75.7% non-Hispanic black=13.8% non-Hispanic other=6.5% Hispanic=4.0% p-value<0.001**	non-Hispanic white=71.1% non-Hispanic black=16.5% non-Hispanic other=6.8% Hispanic=5.6% p-value<0.001**

BRFSS = Behavioral Risk Factor Surveillance System; OPAS = Ohio Pregnancy Assessment System
*p-values (one-sided) <0.05 based on two-sample t-test comparing Hardin County dataset to BRFSS dataset and Hardin County dataset to OPAS dataset
**p-values (one-sided) <0.05 based on X^2 goodness of fit test comparing Hardin County dataset to BRFSS dataset and Hardin County dataset to OPAS dataset

Table 10. Comparison of selected tier 1 preconception and interconception health indicators[a] among women in Hardin County and statewide survey results

Measure	Prevalence		p-value
	Hardin County n=315[b]	Ohio (source) n BRFSS=1610[b] n OPAS =5377[b]	
Overweight or obese	66.8%	58.7% (BRFSS)	0.002*
Pre-pregnancy diabetes (type 1 or 2)	2.6%	3.2% (OPAS)	0.335
Pre-pregnancy hypertension	15.1%	5.1% (OPAS)	<0.001*
Current smoker	31.1%	22.7% (BRFSS)	<0.001*
Daily folic acid intake	26.3%	33.1% (OPAS)	0.006*
Heavy alcohol consumption	1.0%	4.8% (OPAS)	<0.001*
Current use of effective contraception[c]			
Hormonal contraception (oral, injectable, contraceptive patch, or vaginal ring)	21.9%	47.2% (OPAS)	<0.001*
Long-acting reversible contraception (IUD or implant)	9.8%	7.8% (OPAS)	0.126
Tubes tied or blocked	27.9%	9.4% (OPAS)	<0.001*
Vasectomy	12.1%	4.3% (OPAS)	<0.001*

BRFSS = Behavioral Risk Factor Surveillance System; OPAS = Ohio Pregnancy Assessment System

[a] These seven indicators are among ten tier 1 preconception health indicators identified by the National Preconception Health and Health Care Initiative's Surveillance and Research work group for state surveillance

[b] Cases with missing data excluded from denominator

[c] Respondents could select >1 option

*p-value (one-sided) <0.05 based on binomial test comparing Hardin County dataset to BRFSS dataset or Hardin County dataset to OPAS dataset

Chapter 5

CONCLUSIONS

Key findings from three analyses of data obtained through a cross-sectional study of reproductive-age women living in a rural Midwestern area were as follows. First, nearly all women in the study reported one or more preconception and interconception health risk factors. Of particular concern due to the high prevalence among rural women in this sample were hypertension, lack of daily folic acid supplementation, being overweight/obese, insufficient physical activity, and current smoking. Health insurance coverage was the demographic characteristic most often associated with these health indicators. In addition, only about one-fourth of participants reported wanting more information on how to be a healthy woman, and only a few reported a desire for more information on how to have a healthy baby.

Gaps in access to and utilization of preventive health care were also reported, with about a quarter of respondents indicating they had not had a routine check-up in the past year. Half of all respondents reported at least one barrier to a doctor's appointment in the past year, and an increasing number of barriers was significantly and inversely associated with preventive health service use. Employment was not significantly associated with that outcome, consistent with a previously-published study of reproductive-age women in 28 largely rural Pennsylvania counties in which a multivariate regression analysis modeling health service utilization showed employment to not be significantly associated with having had a routine check-up in the past year.[88] The question assessing employment was adapted from the BRFSS survey;[35] however, the question may not be adequate as written as it does not assess whether the respondent

works full-time (versus part-time) or the type of employment (e.g., service industry, blue collar, white collar), which may be factors influencing the ability to pay for and take time off of work to use health care services.

Finally, women in this rural county also fared worse than the state on several preconception and interconception health measures. Hardin County survey respondents had significantly greater health risks than the statewide population in regard to the percent who were overweight or obese, had hypertension, currently used cigarettes, and lacked daily multivitamin or folic acid supplementation. In addition, these preconception and interconception health measures are indicators of overall good health for all women, including those have not had children or have finished childbearing. For certain health indicators, rural women in Midwestern areas may be falling behind. However, women in Hardin County reported use of the most effective forms of contraception (tubal ligation and vasectomy) significantly more often. While the sample of women in Hardin County were significantly older than the comparison sample in the statewide estimate, these data still indicate an important finding; namely, women in this rural area do have access to services that enable them to avoid future unintended pregnancies.

A major limitation to this study was the use of a convenience sample, although the survey methodology attempted to mitigate this issue through purposeful administration of the survey in different areas of the county (Table D-11) and in different settings (Table D-12). An analysis was performed comparing selected characteristics observed in the study sample to the values reported by the U.S. Census Bureau[43] for female permanent residents of Hardin County ages 18-44 years (Table E-13). No statistically significant differences in distribution of age groups, race/ethnicity, marital

status, college education attainment, and any health insurance coverage were found through this analysis; however, because a nonrandom sampling technique was used, the possibility of sampling error cannot be entirely ruled out, which could affect the validity and reliability of the data.

Notwithstanding this and other potential limitations, this study is significant as it is the first to quantify preconception and interconception health measures for women living in the rural Midwestern U.S. Previously, such data were not available. The data collected through this study can now be used for monitoring, comparisons, and benchmarking. These findings provide important insights about preconception and interconception health and risk factors for women in the rural Midwest, which had not been assessed previously. Consistent with previous studies examining predominantly rural women in central Pennsylvania, Appalachia, and the Mississippi River Delta, women in the rural Midwest had high rates of smoking, being overweight or obese, and physical inactivity.[31-33] However, those previous studies did not examine other measures, such as barriers to receipt of preventive health care and reporting a usual source of care, which may be important determinants of health care access for women living in rural areas.[22] This study quantified these measures for the first time for rural women living in a maternity care desert.

This research was an important step in the process of laying the groundwork to examine potential geographic disparities in birth outcomes in rural northwest Ohio, and three novel recommendations emerged to further facilitate this work. First, the need to establish a regional fetal and infant mortality review (FIMR) program and conduct regional a perinatal periods of risk analysis (PPOR) was identified. FIMR is a

community-based program that provides a comprehensive, multidisciplinary review of fetal and infant death cases and then makes recommendations for systemic change to prevent other infant deaths.[89] Currently, the ten FIMR programs in Ohio are located in or adjacent to the Ohio Equity Institute counties, the state's most urban areas.[90] There is currently not a FIMR in Hardin County or any of the contiguous counties in northwest Ohio. Given its small population size, Hardin County may not be large enough to sustain a FIMR program, but a regional approach including several similar counties could be implemented to examine and identify the significant medical and nonmedical factors that are associated with fetal and infant mortality and propose changes to improve service systems. PPOR is a data-driven process using an analytic framework to determine the time points and specific local causes of fetal and infant mortality. Through the use of vital records and other data sources, the most important underlying causes for excess mortality and the known risk and protective factors most important for a particular community are identified.[91] Data collected through the PPOR process can be used in conjunction with the data from this study to begin to understand the timing and causes of infant mortality in northwest Ohio and to prioritize infant mortality reduction efforts.

Secondly, changes are needed to the methods used by population-based surveys (e.g. BRFSS, PRAMS, OPAS) when collecting and analyzing data from rural areas. Currently, these data sources often have limitations in data derived from areas with low population densities or insufficient sample sizes to generate reliable estimates specific to rural areas. In states like Ohio that encompass several distinct geographical areas, a more regional approach to data collection and analysis should be performed grouping rural areas, Appalachian areas, and urban areas. This may identify important subgroups at risk

who are being overlooked with current data reporting methods. In addition, the development of electronic registries to record information about maternal health and behaviors ascertained during hospitalization for labor and delivery would allow for capture of data from all women who have given birth and mitigate the challenges seen in PRAMS/OPAS response rates and sampling strategies. To be successful, fields in the registry would need to align with electronic health records utilized in the usual health care delivery process and not require additional time or effort from hospital staff.

Thirdly, the PRAM and OPAS surveys should be revised to collect data that are especially relevant to women living in rural areas. Specifically, the question assessing barriers to receipt of health care should list additional choices that may be especially relevant to rural women. These choices should include system-level barriers (e.g., geographic proximity to providers and travel time to usual source of care), individual-level barriers (e.g., stigma and privacy concerns) and provider-level barriers (e,g., culture and trust).

Based on the results of this study, additional studies to more fully explore the preconception and interconception health needs in this population is warranted. The survey tool used in this study was created largely using evidence-based preconception health measures from the CDC and the National Preconception Health and Health Care Initiative's Surveillance and Research work group.[1,38] While this represents expert opinion on which elements of preconception and interconception health should be prioritized, what is missing is the perspective of the women who live in these rural communities. Qualitative studies should be performed to better understand what rural women perceive to be their most pressing health needs. These studies should also assess

the ways in which women obtain information and care if they are unable to get to a health care provider. Future studies should also examine the underlying factors that influence women's interest to receive more information about preconception and interconception health and reasons for lack of interest. It is important to determine what types of messaging may better resonate and the most appropriate times and ways to engage women through comprehensive medical care and via channels outside of the health care system.[44,53]

In addition, as the independent variables included in the logistic regression models were only weakly or modestly associated with the outcomes of interest, additional studies that examine other preconception and interconception health indicators not included in this study may help to identify other areas to prioritize. There are several measures that were not included in this survey but should be further studied due to their significance in the life course framework. There were two tier 1 preconception health indicators that were not assessed through this study: depression (percentage of women ever told by health care professional that they have a depressive disorder) and unwanted pregnancy (percentage of women having a live birth who reported that just before their most recent pregnancy, they didn't want to be pregnant then or at any time in the future).[38] Each is a risk factor for poor short-term and long-term maternal and child health outcomes.[92,93] Other maternal mental health conditions such as anxiety and stress are also important factors for maternal and child health outcomes.[94] Use of potentially teratogenic prescription medications or herbal products should be considered due to the associated risks of miscarriage, fetal death, and/or birth defects.[95] Substance use (e.g., cannabis, opioids) in the preconception and interconception period can lead to several

harmful maternal and neonatal outcomes and therefore should also be evaluated.[96] Lastly, additional questions should focus on social determinants of health; four in particular not assessed in this study but especially relevant in rural populations are poverty, maternal working conditions, food security, and access to safe and healthy homes.[50,97] Because the causes of infant mortality are complex and multifactorial, the impact of environmental contexts and economic factors must also be considered.[14,98]

Once the preconception and interconception health needs are fully characterized, targeted interventions to improve health behaviors for women in this rural area can be developed addressing social, economic, and environmental drivers of these behaviors. Delivery of interventions via innovative models such as mobile clinics or use of non-physician health workers should be explored and new strategies tested both within and outside the health care system. In addition to the immediate biomedical and lifestyle risk factors, preconception and interconception health must also be addressed through the intermediate and underlying determinants of maternal and child health outcomes.[99] The results of this and future studies should be used to address needed social systems change, including overall socioeconomic context and community structures and institutions, as well. Along with direct provision of services, novel policy, systems, and environmental change strategies need to be identified and implemented to accelerate improvements in maternal and child health outcomes in rural Midwestern areas.[100]

Appendix A

SURVEY INSTRUMENT

Today's date: ____/_____/_____ (MM/DD/YY)

Thank you for taking this survey! Please answer each question honestly and to the best of your ability. The answers you provide will give us important information about the health and wellness of women who live in Hardin County.

This project has been reviewed and approved by the Ohio Northern University Institutional Review Board. Your answers will remain anonymous, and only aggregate (summary) data of survey responses will be shared.

	Yes	No
1. How old are you? ____years 2. Do you live in Hardin County 12 months of the year?		

3. In what city or town do you live?_____ 4. What is the zip code where you live? _____

5. How tall are you without shoes? ___feet ___inches 6. How much do you weigh without shoes? _____pounds

7. What is your race and ethnicity? *Circle all that apply*:

Caucasian/ White	African American/ Black	Hispanic/ Latina	Asian	American Indian/ Alaska Native	Native Hawaiian/ Other Pacific Islander	Other: _____

8. Would you say that, in general, your health is:

Excellent	Very Good	Good	Fair	Poor

9. Has a doctor, nurse, or other health professional ever told you that you have any of the following:

	Yes	No	I don't know
a. Type 1 diabetes			
b. Type 2 diabetes			
c. Gestational diabetes (diabetes while pregnant)			
d. High blood pressure (hypertension)			
e. Thyroid problems			
f. Epilepsy (seizures)			

10. Have you had the following vaccines:

	Yes	No	I don't know
a. German measles also known as rubella or MMR vaccine			
b. Hepatitis B			
c. Human Papilloma Virus (HPV)			
d. Flu shot in the *last year*			

11. How many times a **week** do you take a multivitamin, folic acid supplement, or prenatal vitamin?

0 days a week	1-3 days a week	4-6 days a week	Every day (7 days a week)

Survey continues on next page →

12. About how many servings of fruit do you have in a **day**?

Zero servings (None)	1-2 servings per day	3-4 servings per day	5 or more servings per day

13. About how many servings of vegetables do you have in a **day**?

Zero servings (None)	1-2 servings per day	3-4 servings per day	5 or more servings per day

14. How many alcoholic drinks (example: beer, wine, wine cooler, or hard liquor) do you have in an average **week**?

0 drinks a week	1-3 drinks a week	4-7 drinks a week	8-13 drinks a week	14 drinks or more a week

15. In the **last 3 months**, how many times did you drink 4 alcoholic drinks or more in a 2 hour time span?

Zero (None)	1 time	2 or 3 times	4 to 5 times	6 or more times

16. Have you smoked any cigarettes in the **past two years**?

Yes	No

17. How many cigarettes do you currently smoke on an average day **now**? A pack has 20 cigarettes

Zero (None)	Less than 1	1 to 5	6 to 10	11 to 20	21 to 40 (1 to 2 packs)	41 or more (2 or more packs)

18. E-cigarettes (electronic cigarettes) and other electronic nicotine vaping products (such as vape pens, hookah pens, e-cigars, e-pipes) are battery-powered devices that use nicotine liquid rather than tobacco leaves, and produce vapor instead of smoke.

Have you used any of the following products in the **past 2 years?**

	Yes	No
a. E-cigarettes, vaping, or other electronic nicotine products		
b. Chewing tobacco, snuff, or snus		
c. Cigars, cigarillos, or little cigars		

19. How often on average do you use e-cigarettes, vaping, or other electronic nicotine products **now**?

Zero (None)	1 day a week or less	2 to 6 days a week	Once a day	More than once a day

20. How often do you participate in any physical activities or exercise for 30 minutes or more? For example, walking for exercise, swimming, cycling, dancing or gardening.

Less than 1 day per week	1-2 days per week	3-4 days per week	5 or more days per week	I was told by a doctor, nurse, or other healthcare worker not to exercise

Survey continues on next page →

21. To your knowledge, are you now pregnant?

Yes	No	I don't know

22. How many children do you have? _____

23. Are you:

Married	Divorced	Widowed	Separated	Never married	Member of an unmarried couple

24. How many people, including yourself, live in your household? _____

25. What is the **highest** grade or year of school that you completed?

Never attended/ Kindergarten only	Grade 1-8 (elementary)	Grade 9-11 (some high school)	Grade 12 or GED (high school graduate)	College 1-3 years (some college/technical school)	College 4 years or more (college graduate)

26. Are you currently:

Employed for Wages	Self-Employed	Out of work 1 year or more	Out of work for less than 1 year	A Homemaker	A Student	Unable to Work	Other → please tell us:

27. What is your annual household income from all sources? Please estimate to nearest thousand $_____

28. What kind of health insurance do you have now? *Check all that apply.*

a. I do not have health insurance right now	
b. Private health insurance from my job or the job of my husband or partner	
c. Private health insurance from my parents	
d. Health insurance from the Ohio Health Insurance Marketplace or HealthCare.gov	
e. Medicaid	
f. TRICARE or other military health care	
g. Other → please tell us:	

29. Do you have one person you think of as your doctor or health care provider?

Yes, only one	More than one	No	I don't know

30. About how long has it been since you last visited a doctor for a **routine check-up**?

Within the past year	Within the past 2 years	Within the past 5 years	5 or more years ago	Never been	I don't know

Survey continues on next page →

31. In the **past year**, have any of the following kept you from having an appointment with a doctor? *Check all that apply*

	Yes	No
a. I didn't have health insurance to cover the cost of the visit		
b. I couldn't get an appointment when I wanted one		
c. I didn't have any transportation to get to the clinic or doctor's office		
d. I had too many things going on		
e. I couldn't take time off of work		
f. Other → please tell us:		

32. Think about the **last time** you saw a healthcare provider. What type of provider did you see?

Doctor, nurse practitioner, or physician assistant during an office visit	Emergency room/ Hospital visit	Pharmacist	Dentist	Other→ Please tell us	I have never seen a healthcare provider

Where did this occur? City: _____ State: _____

33. Would you like information on:

	Yes	No
a. how to be a healthy woman		
b. family planning		
c. how to have a healthy baby		

34. Are you or your husband/partner doing anything now to keep from getting pregnant? *Check all that apply.*

YES What kind of birth control are you using?	a. Tubes tied or blocked (female sterilization or Essure®)	
	b. Vasectomy (male sterilization)	
	c. Birth control pills	
	d. Condoms	
	e. Shots or injections (Depo-Provera®)	
	f. Contraceptive patch (Ortho-Evra® or Xulane®)	
	g. Vaginal ring (NuvaRing®)	
	h. IUD (including Mirena®, ParaGard®, or Skyla®)	
	i. Contraceptive implant in the arm (Nexplanon® or Implanon®)	
	j. Natural family planning (including rhythm method)	
	k. Withdrawal (pulling out)	
	l. I am not having sex (abstinence)	
	m. Other → please tell us	
NO What are your reasons for not doing anything to keep from getting pregnant now?	a. I want to get pregnant	
	b. I am pregnant now	
	c. I had my tubes tied or blocked (female sterilization or Essure®)	
	d. My husband/partner had a vasectomy (male sterilization)	
	e. I don't want to use birth control	
	f. My husband or partner doesn't want to use anything	
	g. I am worried about side effects from birth control	
	h. I have problems paying for birth control	
	i. I am not having sex (abstinence)	
	j. Other → please tell us	

END OF SURVEY – THANK YOU FOR YOUR TIME!

Appendix B

PERSONALIZED RESULTS FORM

YOUR PERSONALIZED RESULTS!

Meeting Goal	Not Meeting Goal	Not Known	Recommendation
			Vaccines Every woman should be up-to-date on vaccines to protect her health. In addition, there are some vaccines that can help protect a future baby. THIS SERVICE IS AVAILABLE AT THE ONU HEALTHWISE MOBILE HEALTH CLINIC! You can also receive vaccines in various locations in Hardin County from the Kenton-Hardin Health Department (419-673-6230).
			Folic Acid Every Day Folic acid is a B vitamin. All women need folic acid for a healthy body. In addition, if a woman has enough folic acid in her body at least 1 month *before* and *during* pregnancy, it can help prevent major birth defects of the brain and spine. Take folic acid **every day** just in case, as either a supplement (400 micrograms) or a multivitamin! VITAMINS ARE AVAILABLE AT THE ONU HEALTHWISE PHARMACY IN ADA!
			Alcohol Use Women who are not pregnant should drink no more than 1 alcoholic beverage per day. Drinking more can be harmful to your health. Women who are pregnant should not drink any alcohol. If you need help, contact We Care People, 1-800-567-HOPE or www.wecarepeople.org/
			Tobacco Use Quitting tobacco can be hard, but it is one of the best things you can do for your health. There are products available that may help you to quit. THIS SERVICE IS AVAILABLE FOR FREE AT THE ONU HEALTHWISE MOBILE CLINIC!
			Exercise Most women should exercise at least 30 minutes a day at least 5 days of the week. Check with a healthcare provider before you start an exercise program. Please see the back of this sheet for ideas of free places to exercise in Hardin County.
Manage and Monitor Your Health If you currently have any medical conditions, be sure they are under control and being treated. Some of these conditions include diabetes, thyroid disease, seizure disorders, and high blood pressure. THIS SERVICE IS AVAILABLE FOR FREE AT THE ONU HEALTHWISE MOBILE HEALTH CLINIC! WE CAN ALSO SCREEN FOR HIGH BLOOD PRESSURE AND DIABETES.			
Family Planning and Healthy Pregnancy There are steps all women can take to improve their health and help have a healthy baby in the future. INFORMATION IS AVAILABLE FOR FREE AT THE ONU HEALTHWISE MOBILE CLINIC! For family planning services, you can contact the Kenton-Hardin Health Department (419-673-6230).			

Want to make an appointment with the ONU HealthWise Mobile Health Clinic to discuss your health?

CALL 419-772-1050 OR EMAIL HEALTHWISE@ONU.EDU

HealthWise

FREE EXERCISE OPPORTUNITIES IN HARDIN COUNTY

- Parks in Hardin County
  - Ada
    - War Memorial Park
    - Green Monster on Ohio Northern University campus
  - Alger
    - Alger Village Park
  - Dunkirk
    - Dunkirk Community Park
  - Forest
    - Gormley Park
  - Kenton
    - Pioneer Park
    - Glendale Skate Park
    - Saulisberry Park
    - C E Wharton Memorial Park
    - Murray Park
  - Mt Victory
    - Mt Victory Village Park
  - Ridgeway
    - Lawrence Woods State Nature Preserve

- Free Fitness Classes:
  - Ada
    - First United Methodist Church: Tuesday 6:30pm – Yoga
      Thursday 5:45pm – Zumba
  - Kenton
    - Iron Fit Gym LLC: Saturday 8a-8:45am free open gym

Appendix C

TIPS FOR A HEALTHY BABY HANDOUT

TIPS FOR A HEALTHY BABY

Vaccines
Every woman should be up-to-date on vaccines to protect her health. In addition, there are some vaccines that can help protect a future baby. Vaccines to consider are MMR, Hepatitis B, Tdap and, influenza. THIS SERVICE IS AVAILABLE AT THE ONU HEALTHWISE MOBILE HEALTH CLINIC! You can also receive vaccines in various locations in Hardin County from the Kenton-Hardin Health Department (419-673-6230).

Folic Acid Every Day
Folic acid is a B vitamin. All women need folic acid for a healthy body. In addition, if a woman has enough folic acid in her body at least 1 month *before* and *during* pregnancy, it can help prevent major birth defects of the brain and spine. Take folic acid **every day** just in case, as either a supplement (400 micrograms) or a multivitamin! VITAMINS ARE AVAILABLE AT THE ONU HEALTHWISE PHARMACY IN ADA!

Alcohol Use
Women who are not pregnant should drink 1 alcoholic beverage per day or less. Drinking more can be harmful to your health. If you are pregnant, there is no safe amount of alcohol to drink so you should drink no alcohol. If you need help, contact We Care People, 1-800-567-HOPE or www.wecarepeople.org/

Tobacco use
Quitting tobacco can be hard, but it is one of the best things you can do for your health and the health of a future baby. If you are not yet pregnant, there are products available that may help you to quit. THIS SERVICE IS AVAILABLE FOR FREE AT THE ONU HEALTHWISE MOBILE CLINIC!

Exercise
Most women should exercise at least 30 minutes a day at least 5 days of the week. Check with a healthcare provider before you start an exercise program. Listed on the back are places you can exercise for free in Hardin County.

Manage and monitor your health
If you currently have any medical conditions, be sure they are under control and being treated before and during pregnancy. Some of these conditions include diabetes, thyroid disease, seizure disorders, obesity, high blood pressure and phenylketonuria. THIS SERVICE IS AVAILABLE FOR FREE AT THE ONU HEALTHWISE MOBILE HEALTH CLINIC! WE CAN ALSO SCREEN FOR HIGH BLOOD PRESSURE AND DIABETES.

Medication use
There some prescription medications that may cause birth defects. Certain herbal products and very high doses of Vitamin A can also cause birth defects. Talk to your doctor or pharmacist about all types of medicines you take and if they are potentially harmful during pregnancy. THIS SERVICE IS AVAILABLE FOR FREE AT THE ONU HEALTHWISE MOBILE HEALTH CLINIC AND ONU HEALTHWISE PHARMACY!

Screening tests
Before becoming pregnant, get screened for sexually transmitted infections and HIV. You can contact the Kenton-Hardin Health Department (419-673-6230) for these services.

Family planning
Planning when you become pregnant can help you and the baby be more healthy. For family planning services, you can contact the Kenton-Hardin Health Department (419-673-6230).

Want to make an appointment with the ONU HealthWise Mobile Health Clinic to discuss your health?

CALL 419-772-1050 OR EMAIL HEALTHWISE@ONU.EDU

HealthWise

Appendix D

DISTRIBUTION OF SURVEY RESPONSES

Table D-11. Distribution of survey participants by geographic location

Town	RUCA code	n (%)
Ada	7.3	95 (30.2%)
Alger	9.0	11 (3.5%)
Belle Center	6.0	1 (0.3%)
Dola	9.0	4 (1.3%)
Dunkirk	9.0	10 (3.2%)
Forest	9.0	29 (9.2%)
Harrod	2.0	1 (0.3%)
Kenton	7.0	138 (43.8%)
McGuffey	9.0	6 (1.9%)
Mt Victory	8.0	14 (4.4%)
Patterson	9.0	1 (0.3%)
Ridgeway	8.0	4 (1.3%)
Rushsylvania	6.0	1 (0.3%)

RUCA = Rural-Urban Commuting Areas

Table D-12. Distribution of survey participants by collection site

Collection site	n	%
Bingo/purse bingo	28	8.9%
Bowling alley	7	2.2%
Community event	40	12.7%
Elementary school	31	9.8%
Food pantry	2	0.6%
Gas station	5	1.6%
GED class	2	0.6%
Grocery stores	55	17.5%
Gym	14	4.4%
Health department programs	5	1.6%
Jobs fair	24	7.6%
Laundromat	7	2.2%
Pregnancy resource center	5	1.6%
Public library	15	4.8%
Retail stores	58	18.4%
Salon	6	1.9%
University	11	3.5%

Appendix E

SAMPLE REPRESENTATIVENESS

Table E-13. Comparison of study participants and all female Hardin County permanent residents ages 18-44 years[43] on selected demographic characteristics

Characteristic		Study Participants[a]	Hardin County[b]	p-value
Age range (years):	18-24	21.9%	22.1%	p=0.908[c]
	25-29	19.0%	17.8%	
	30-34	18.5%	18.8%	
	35-39	21.5%	19.6%	
	40-44	18.2%	21.8%	
Race/ethnicity:	White, non-Hispanic	96.4%	94.9%	p=0.960[c]
	Black, non-Hispanic	0.7%	1.0%	
	Asian	0.7%	0.7%	
	Two or more races	0.7%	1.6%	
	Hispanic or Latina	1.7%	1.8%	
College education or greater		23.2%	20.6%	p=0.150[d]
Married		52.3%	52.4%	p=0.374[d]
Any health insurance coverage		89.2%	88.1%	p=0.311[d]

Percentages may not total 100 due to rounding

[a]The last Census assigned women on college campuses to the location where the college is located. However, as this study focused on women who were permanent residents of Hardin County, female college students were removed from the estimated population.

[b]While survey responses were collected from women ages 18-45 years, data from women ages 18-44 years only are shown here to allow for a direct comparison with Census data.

[c]p-values (one-sided) calculated based on X^2 goodness of fit test

[d]p-values (one-sided) calculated based on binomial test

REFERENCES

1. Johnson K, Posner SF, Biermann J, et al. Recommendations to improve preconception health and health care — United States: a report of the CDC/ATSDR Preconception Care Work Group and the Select Panel on Preconception Care. MMWR Recomm Rep. 2006; 55.
2. World Health Organization. Preconception care: maximizing the gains for maternal and child health. Available at: http://www.who.int/maternal_child_adolescent/documents/preconception_care_policy_brief.pdf. Accessed July 8, 2019.
3. American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 313: The importance of preconception care in the continuum of women's health care. Obstet Gynecol 2005;106:665–6.
4 American Academy of Family Physicians. Preconception care position paper. 2015. https://www.aafp.org/about/policies/all/preconception-care.html. Accessed July 8, 2019.
5. Office of Disease Prevention and Health Promotion. Healthy People 2020. www.healthypeople.gov. Accessed July 8, 2019.
6. Guttmacher Institute. Unintended pregnancy in the United States, 2019. https://www.guttmacher.org/fact-sheet/unintended-pregnancy-united-states. Accessed July 8, 2019.
7. Ely DM, Driscoll AK. Infant mortality in the United States, 2017: Data from the Period linked birth/infant death file. National Vital Statistics Reports, vol 68 no 10. Hyattsville, MD: National Center for Health Statistics. 2019.
8. Organisation for Economic Co-operation and Development. Infant mortality rates. https://data.oecd.org/healthstat/infant-mortality-rates.htm. Accessed November 20, 2019.
9. Kamal R, Hudman J, McDermott D. What do we know about infant mortality in the U.S. and comparable countries? https://www.healthsystemtracker.org/chart-collection/infant-mortality-u-s-compare-countries/#item-. Accessed November 20, 2019.
10. Hutchison ED. Life course theory. In: Levesque RJR (ed). Encyclopedia of Adolescence. Springer: New York, NY; 2017.
11. Jones NL, Gilman SE, Cheng TL, Drury SS, Hill CV, Geronimus AT. Life course approaches to the causes of health disparities. Am J Public Health. 2019;109(S1): S48-S55.
12. Fine A, Kotelchuck M, Adess N, Pies C. A new agenda for MCH policy and programs: Integrating a life course perspective. Available at: https://cchealth.org/lifecourse/pdf/2009_10_policy_brief.pdf Accessed July 30, 2019.
13. Halfon N, Hochstein M. Life-course health development: An integrated framework for developing health, policy, and research. Milbank Q 2002;80:433-479.
14. Lu MC. We can do better: improving perinatal health in America. J Womens Health. 2010;19(3):569-74.
15. Kwon EJ, Kim YJ. What is fetal programming?: A lifetime health is under the control of in utero health. Obstet Gynecol Sci. 2017;60(6):506–519.

16. Calkins K, Devaskar SU. Fetal origins of adult disease. Curr Probl Pediatr Adolesc Health Care. 2011;41(6):158–176.
17. Barker DJP. Fetal and infant origins of adult disease. BMJ 1990;301:1111.
18. McEwen BS. Protective and damaging effects of stress mediators. N Engl J Med 1998;338:171–179.
19. Lu MC, Halfon N. Racial and ethnic disparities in birth outcomes: A life-course perspective. Maternal and Child Health J. 2003; 7(1):13-30.
20. Atrash HK, Johnson K, Adams MM, Cordero JF, Howse J. Preconception care for improving perinatal outcomes: the time to act. Matern Child Health J. 2006;10(Suppl 1):3–11.
21. Wise PH. Transforming preconceptional, prenatal, and interconceptional care into a comprehensive commitment to women's health. Women's Health Issues. 2008;18:S13–18.
22. Centers for Medicare and Medicaid Services. Maternal health care in rural communities. Available at: https://www.cms.gov/About-CMS/Agency-Information/OMH/equity-initiatives/rural-health/09032019-Maternal-Health-Care-in-Rural-Communities.pdf?utm_campaign=fyi_newsletter&utm_medium=email&utm_source=govdelivery&deliveryName=USCDC_277%20-%20DM9603. Accessed November 20, 2019.
23. Braveman P, Arkin E, Orleans T, Proctor D, Plough A. What is health equity? And what difference does a definition make? 2017; Princeton, NJ: Robert Wood Johnson Foundation.
24. American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 586: Health disparities in rural women. Obstet Gynecol. 2014;123(2 Pt 1):384.
25. National Rural Health Association Policy Brief. Rural women's health. Available at: https://www.ruralhealthweb.org/getattachment/Advocate/Policy-Documents/RuralWomensHealth-(1).pdf.aspx Accessed July 8, 2019.
26. Bailey BA. Factors predicting pregnancy smoking in Southern Appalachia. Am J Health Behav. 2006;30:413–421.
27. Wewers ME, Salsberry PJ, Ferketich AK, Ahijevych KL, Hood NE, Paskett ED. Risk factors for smoking in rural women. J Women's Health, 2012;21:548–556.
28. Jacobson LT, Dong F, Scheuermann TS, Redmond ML, Collins TC. Smoking behaviors among urban and rural pregnant women enrolled in the Kansas WIC program. J Community Health. 2015;40(5):1037-46.
29. Wright Morton L, Blanchard TC. Starved for access: Life in rural America's food deserts. Available at: https://www.iatp.org/sites/default/files/258_2_98043.pdf. Accessed July 30, 2019.
30. Rural Health Information Hub. Rural health disparities. Available at https://www.ruralhealthinfo.org/topics/rural-health-disparities. Accessed July 30, 2019.
31. Short VL, Oza-Frank R, Conrey EJ. Preconception health indicators: a comparison between non-Appalachian and Appalachian women. Matern Child Health J. 2012;16 Suppl 2:238-49.
32. Bish CL, Farr S, Johnson D, McAnally R. Preconception health of reproductive aged women of the Mississippi River delta. Matern Child Health J. 2012;16 Suppl 2:250-7.

33. Weisman CS, Hillemeier MM, Chase GA, et al. Preconceptional health: Risks of adverse pregnancy outcomes by reproductive life stage in the Central Pennsylvania Women's Health Study (CePAWHS). Womens Health Issues. 2006;16(4):216-24.
34. Health Policy Institute of Ohio. A new approach to reduce infant mortality and achieve equity. Available at: https://www.lsc.ohio.gov/documents/reference/current/SDOIM_FinalCombined.pdf. Accessed November 20, 2019.
35. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System 2018 English questionnaire. Available at: https://www.cdc.gov/brfss/questionnaires/pdf-ques/2018_BRFSS_English_Questionnaire.pdf. Accessed July 8, 2019.
36. Centers for Disease Control and Prevention. Pregnancy Risk Assessment Monitoring System. Available at: https://www.cdc.gov/prams/index.htm Accessed July 8, 2019.
37. Ohio Department of Health. Ohio Pregnancy Assessment Survey 2017 English questionnaire. Available at: https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/ohio-pregnancy-assessment-survey-opas/questionnaires/17-english-questionnaire Accessed July 8, 2019.
38. Robbins CL, D'Angelo D, Zapata L, et al. Preconception health indicators for public health surveillance. J Womens Health. 2018;27(4):430-443.
39. MacKinney AC, Coburn A, Lundblad J, McBride T, Mueller K, Watson S. Access to rural health care: A literature review and new synthesis. Available at: http://www.rupri.org/Forms/HealthPanel_Access_August2014.pdf#page=9 Accessed July 30, 2019.
40. Fine A, Kotelchuck M. Rethinking MCH: The life course model as an organizing framework. Available at: https://www.hrsa.gov/sites/default/files/ourstories/mchb75th/images/rethinkingmch.pdf. Accessed July 30, 2019.
41. Chuang CH, Hwang SW, McCall-Hosenfeld JS, Rosenwasser L, Hillemeier MM, Weisman CS. Primary care physicians' perceptions of barriers to preventive reproductive health care in rural communities. Perspect Sex Reprod Health. 2012;44(2):78-83.
42. Shannon GD, Alberg C, Nacul L, Pashayan N. Preconception health care delivery at a population level: construction of public health models of preconception care. Matern Child Health J. 2014; 18(6):1512-31.
43. United States Census Bureau. Available at: https://www.census.gov/quickfacts/hardincountyohio. Accessed July 8, 2019.
44. World Health Organization. Women and health: today's evidence, tomorrow's agenda. Available at: https://apps.who.int/iris/bitstream/handle/10665/44168/9789241563857_eng.pdf?sequence=1. Accessed July 30, 2019.
45. Gee RE, Brindis CD, Diaz A, et al. Recommendations of the IOM clinical preventive services for women committee: implications for obstetricians and gynecologists. Curr Opin Obstet Gynecol. 2011;23(6):471–480.
46. Daniel H, Erickson SM, Bornstein SS. Health and Public Policy Committee of the American College of Physicians. Women's health policy in the United States: An American College of Physicians position paper. Ann Intern Med 2018; 168:874-875.

47. Mokdad AH, Ballestros K, Echko M, et al. The state of U.S. health, 1990-2016: Burden of diseases, injuries, and risk factors among U.S. states. JAMA. 2018;319(14):1444-1472.
48. Gardiner PM, Nelson L, Shellhaas CS, Dunlop AL, Long R, Andrist S, Jack BW. The clinical content of preconception care: Nutrition and dietary supplements. Am J Obstet Gynecol. 2008;199(6 Suppl 2):S345-56.
49. Petroni S, Fritz K. Improving the health of women and adolescents: an unfinished agenda. Available at: https://www.un.org/en/development/desa/population/publications/pdf/expert/2013-12_Petroni-and-Fritz.pdf. Accessed July 30, 2019.
50. Rural Health Information Hub. Social determinants of health for rural people. Available at: https://www.ruralhealthinfo.org/topics/social-determinants-of-health. Accessed July 30, 2019.
51. Katz MG, Jacobson TA, Veledar E, Kripalani S. Patient literacy and question-asking behavior during the medical encounter: a mixed-methods analysis. J Gen Intern Med. 2007;22(6):782-6.
52. Squiers L, Mitchell EW, Levis DM, et al. Consumers' perceptions of preconception health. Am J Health Promot. 2013; 27 (30): S10-S19.
53. Corrarino JE. Health literacy and women's health: challenges and opportunities. J Midwifery Womens Health. 2013;58(3):257-64.
54. The American College of Physicians. Comprehensive women's health care: the role and commitment of internal medicine. Am J Med. 1997;103(6):451-7.
55. Hart LG, Larson EH, Lishner DM. Rural definitions for health policy and research. Am J Public Health 2005;95:1149–55.
56. Jones CA, Parker TS, Ahearn M, Mishra AK, Variyam JN. Health status and health care access of farm and rural populations. Available at: https://pdfs.semanticscholar.org/fe01/6c3006f06385bda09ad205c09850db0c9d52.pdf Accessed July 8, 2019.
57. Rural Health Information Hub. Health care access in rural communities. Available at: https://www.ruralhealthinfo.org/topics/healthcare-access, Accessed July 30, 2019.
58. National Center for Health Statistics. Health, United States, 2011: With special feature on socioeconomic status and health. Hyattsville (MD): NCHS; 2012. Available at: http://www.cdc.gov/nchs/data/hus/hus11.pdf. Accessed July 30, 2019.
59. Kozhimannil KB, Hardeman RR, Henning-Smith C. Maternity care access, quality, and outcomes: A systems-level perspective on research, clinical, and policy needs. Semin Perinatol. 2017;41(6):367-374.
60. Ingram DD, Franco SJ. 2013 NCHS urban–rural classification scheme for counties. National Center for Health Statistics. Vital Health Stat 2(166). 2014.
61. March of Dimes. Nowhere to go: Maternity care deserts across the United States, 2018. Available at: marchofdimes.org/materials/Nowhere_to_Go_Final. Accessed July 30, 2019.
62. Hung P, Kozhimannil K, Henning-Smith C, Casey M. Closure of hospital obstetric services disproportionately affects less-populated rural counties. 2017. Available at: http://rhrc.umn.edu/wp-content/files_mf/1491501904UMRHRCOBclosuresPolicyBrief.pdf. Accessed July 30, 2019.

63. Kozhimannil KB, Henning-Smith C, Hung P, Casey MM, Prasad S. Ensuring access to high-quality maternity care in rural America. Womens Health Issues. 2016; 26(3):247-50.
64. Tong ST, Makaroff LA, Xierali IM, Puffer JC, Newton WP, Bazemore AW. Family physicians in the maternity care workforce: Factors influencing declining trends. Maternal Child Health J. 2013; 17(9), 1576–1581.
65. Chartis Center for Rural Health. Tracking the decline of OB access. Available at: https://www.ivantageindex.com/declining-access-to-ob-in-rural-communities/ Accessed July 30, 2019.
66. National Rural Health Association policy brief: Access to rural maternity care. 2019. Available at: https://www.ruralhealthweb.org/NRHA/media/Emerge_NRHA/Advocacy/Policy%20documents/01-16-19-NRHA-Policy-Access-to-Rural-Maternity-Care.pdf. Accessed July 30, 2019.
67. Hung P, Kozhimannil KB, Casey MM, Moscovice IS. Why are obstetric units in rural hospitals closing their doors? Health Serv Res. 2016;51(4):1546–1560.
68. Kozhimannil KB, Hung P, Henning-Smith C, Casey MM, Prasad S. Association between loss of hospital-based obstetric services and birth outcomes in rural counties in the United States. JAMA. 201;8319(12):1239-1247.
69. Lorch S, Srinivas SK, Ahlberg C, Small DS. The impact of obstetric unit closures on maternal and infant pregnancy outcomes. Health Serv Res. 2013;48(2Pt1):455–475.
70. Grobman W, Bailit JL, Rice MM, et al. Racial and ethnic disparities in maternal morbidity and obstetric care. Obstet Gynecol. 2015;125(6):1460-7.
71. Health Resources and Services Administration. Shortage designation scoring criteria. Available at: https://bhw.hrsa.gov/shortage-designation/hpsas Accessed July 30, 2019.
72. Hartley D, Quam L, Lurie N. Urban and rural differences in health insurance and access to care. J Rural Health. 1994; 10(2):98–108.
73. Schoen C, Osborn R. The Commonwealth Fund 2011 international health policy survey of sicker adults in eleven countries. The Commonwealth Fund. Chartpack.
74. Loftus J, Allen EM, Call KT, Everson-Rose SA. Rural urban differences in access to preventive health care among publicly insured Minnesotans. J Rural Health. 2018; 34 Suppl 1:s48-s55.
75. Rural Health Research Center. Rural-urban commuting area codes. Available at: https://depts.washington.edu/uwruca/ruca-uses.php. Accessed July 30, 2019.
76. Johnson K, Balluf M, Abresh C, Verbiest S, Atrash H. Summary of findings from the reconvened Select Panel on Preconception Health and Health Care, 2015. Available at: http://beforeandbeyond.org/wp-content/uploads/2014/03/002192_Preconception-Health-Report-Booklet_5th.pdf Accessed July 30, 2019.
77. Rural Health Information Hub. Ohio Northern University's HealthWise mobile outreach program. Available at: https://www.ruralhealthinfo.org/project-examples/999. Accessed July 30, 2019.
78. Moos MK, Dunlop AL, Jack BW, et al. Healthier women, healthier reproductive outcomes: Recommendations for the routine care of all women of reproductive age. Am J Obstet Gynecol 2008;199:S280–289.
79. Robbins C, Boulet SL, Morgan I, et al. Disparities in preconception health indicators:

Behavioral Risk Factor Surveillance System, 2013–2015, and Pregnancy Risk Assessment Monitoring System, 2013–2014. MMWR Surveill Summ 2018;67(No. SS- 01):1–16.
80. Floyd RL, Johnson KA, Owens JR, Verbiest S, Moore CA, Boyle C. A national action plan for promoting preconception health and health care in the United States (2012–2014). J Women's Health. 2013;22(10):797-802.
81. Mason E, Chandra-Mouli V, Baltag V, Christiansen C, Lassi ZS, Bhutta ZA. Preconception care: Advancing from 'important to do and can be done' to 'is being done and is making a difference'. Reprod Health. 2014;11 Suppl 3:S8.
82. Ely DM, Driscoll AK, Mathews TJ. Infant mortality rates in rural and urban areas in the United States, 2014. NCHS data brief, No 285. Hyattsville, MD: National Center for Health Statistics. 2017.
83. Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. Available at: http://www.cdc.gov/brfss. Accessed November 20, 2019.
84. Ohio Department of Health. Ohio Pregnancy Assessment Survey. Available at: https://odh.ohio.gov/wps/portal/gov/odh/know-our-programs/ohio-pregnancy-assessment-survey-opas. Accessed November 20, 2019.
85. United Health Foundation. American's Health Rankings. Infant mortality: Ohio summary. Available at: https://www.americashealthrankings.org/explore/annual/measure/IMR/state/OH. Accessed November 20, 2019.
86. Robbins CL, Zapata LB, Farr SL, et al. Core state preconception health indicators: Pregnancy Risk Assessment Monitoring System and Behavioral Risk Factor Surveillance System, 2009. MMWR Surveill Summ. 2014;63(3):1-62.
87. Livingood WC, Brady C, Pierce K, Atrash H, Hou T, Bryant T. Impact of preconception health care: Evaluation of social determinants focused intervention. Matern Child Health J 2010;14:382–391.
88. Hillemeier MM, Weisman CS, Chase GA, Dyer AM, Shaffer ML. Women's preconceptional health and use of health services: implications for preconception care. Health Serv Res. 2008;43(1 Pt 1):54-75.
89. The National Center for Fatality Review and Prevention. FIMR process. Available at: https://www.ncfrp.org/fimr-process/. Accessed December 10, 2019.
90. The National Center for Fatality Review and Prevention. FIMR spotlight – Ohio. Available at: https://www.ncfrp.org/cdr-programs/u-s-fimr-programs/fimr-spotlight-ohio/. Accessed December 10, 2019.
91. Center for Leadership Education in Maternal and Child Public Health. Overview of Perinatal periods of risk analytic methods. Available at: http://www.epi.umn.edu/mch/overview-of-perinatal-periods-of-risk-analytic-methods/. Accessed December 10, 2019.
92. Jacques N, de Mola CL, Joseph G, Mesenburg MA, da Silveira MF. Prenatal and postnatal maternal depression and infant hospitalization and mortality in the first year of life: A systematic review and meta-analysis. J Affect Disord. 2019;243:201-208.
93. Gipson JD, Koenig MA, Hindin MJ. The effects of unintended pregnancy on infant, child, and parental health: A review of the literature. Stud Fam Plann. 2008;39(1):18–38.
94. Dunkel Schetter C, Tanner L. Anxiety, depression and stress in pregnancy:

Implications for mothers, children, research, and practice. Curr Opin Psychiatry. 2012;25(2):141-8.
95. Dunlop AL, Jack BW, Bottalico JN, et al. The clinical content of preconception care: women with chronic medical conditions. Am J Obstet Gynecol. 2008;199(6 Suppl 2):S310.
96. Forray A. Substance use during pregnancy. F1000Res. 2016;5: Rev-887.
97. Kim D, Saada A. The social determinants of infant mortality and birth outcomes in Western developed nations: A cross-country systematic review. Int J Environ Res Public Health. 2013;10(6):2296-335.
98. The National Center for Fatality Review and Prevention. FIMR process. Available at: https://www.ncfrp.org/fimr-process/fimr-principles/. Accessed December 10, 2019.
99. Dean SV, Lassi ZS, Imam AM, Bhutta ZA. Preconception care: closing the gap in the continuum of care to accelerate improvements in maternal, newborn and child health. Reprod Health. 2014;11 Suppl 3:S1.
100. Rural Health Information Hub. policy, systems, and environmental change. Available at: https://www.ruralhealthinfo.org/toolkits/health-promotion/2/strategies/policy-systems-environmental. Accessed November 20, 2019.

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Global Product Safety, Global Regulatory Affairs	2004-2007
Clinical Development, Lilly Research Laboratories	2002-2004
Visiting Scientist Fellowship, Lilly Centre for Women's Health	2001-2002

PEER-REVIEWED PUBLICATIONS

Bright DR, DiPietro Mager NA. Preconception care and contraception services: Opportunities for community pharmacists. *Journal of the American College of Clinical Pharmacy.* 2019;2:414–422.

Alexander S, **DiPietro Mager N.** Ohio community pharmacist interest and participation in community-clinical linkages. *Innovations in Pharmacy.* 2019;10(2): Article 18.

Reidenbach M, Bade L, Bright D, DiPietro Mager N, Ellis A. Preconception care needs among female patients of childbearing age in an urban community pharmacy setting. *Journal of the American Pharmacists Association.* 2019;59(4S):S52-S56.

Alexander SJ, **DiPietro Mager NA**. Ohio community pharmacist provision of clinical preventive services. *Innovations in Pharmacy*. 2019;10(1):Article 12.

DiPietro Mager N. The critical need for clinical decision support systems for identification and management of teratogenic medications. *Journal of the American Pharmacists Association.* 2019;59(2S):S18-S20.

DiPietro Mager N, Lucas B, Clark M, Kelly M, Gabbe P. Ohio providers' practices and barriers to use of reproductive life plans and long-acting reversible contraception with patients and clients. *Ohio Journal of Public Health.* 2018;1(1).

Parker KW, **DiPietro Mager NA**, Aronson B, Hart C. Using a mock board of pharmacy disciplinary hearing to teach concepts related to administrative law, addiction, empathy, and professionalism. *Currents in Pharmacy Teaching and Learning*, 2018;10(11):1512-1517.

Ng C, Najjar R**, DiPietro Mager N,** Rafie S. Pharmacist and student pharmacist perspectives on providing preconception care in the United States. *Journal of the American Pharmacists Association*. 2018;58(4):426-431.

DiPietro Mager NA, Mills C, Snelling A. Utility of reproductive life plans in identification of teratogenic medication use: A pilot study. *Birth*. 2018;45:50–54.

Hilverding AT, **DiPietro Mager NA**. Pharmacists' attitudes regarding provision of sexual and reproductive health services. *Journal of the American Pharmacists Association*. 2017;57(4):493-497.

DiPietro Mager NA, Ochs L, Ranelli PL, Kahaleh AA, Lahoz MR, Patel RV, Garza OW, Isaacs D, Clark S. Partners in public health: Public health collaborations with schools of pharmacy, 2015. *Public Health Reports*. 2017;132(3):298-303.

DiPietro Mager NA, Bright DR, Murphy BL, Rondon-Begazo A, Kelling SE. Opportunities for pharmacists and student pharmacists to provide clinical preventive services. *Innovations in Pharmacy.* 2017;8(1): Article 11.

DiPietro Mager NA, Bright DR, Markus D, Weis L, Hartzell DM, Gartner J. Use of targeted medication reviews to deliver preconception care: A demonstration project. *Journal of the American Pharmacists Association.* 2017;57(1):90-94

Kelling SE, Rondon-Begazo A, **DiPietro Mager NA**, Murphy BL, Bright DR. The provision of clinical preventive services by community pharmacists. *Preventing Chronic Disease.* 2016;13:E149.

Peters LM, **DiPietro Mager NA**. Pharmacists' provision of contraception: Established and emerging roles. *Innovations in Pharmacy*. 2016; 7(3):Article 15.

Casserlie LM, **DiPietro Mager NA**. Pharmacists' perceptions of advancing public health priorities through medication therapy management. *Pharmacy Practice.* 2016;14(3):792.

Covvey JR, Conry JM, Bullock KC, **DiPietro Mager NA**, Goad J, Golchin N, Patel RV, Strand MA, Truong H, Abrons JP, Vinh Venci DP, Patterson-Browning B. Public health and the CAPE 2013 educational outcomes: inclusion, pedagogical considerations and assessment. 2016. 55 p. Located at: AACP Center for the Advancement of Pharmacy Education, Alexandria, VA.
http://www.aacp.org/resources/education/CAPE/pages/default.aspx

Musser MR, **DiPietro Mager N**, Walden L, Montenery S, Terrell S. Development of a novel interprofessional education activity with undergraduate students: Design, assessment, and lessons learned. *Health and Interprofessional Practice.* 2016; 3(1):eP1096.

Bailey LC, **DiPietro Mager NA**. Global health education in Doctor of Pharmacy programs. *American Journal of Pharmaceutical Education.* 2016;80(4):Article 71.

Liu KA, **DiPietro Mager NA**. Women's involvement in clinical trials: Historical perspective and future implications. *Pharmacy Practice*. 2016;14(1):708.

DiPietro Mager NA. Fulfilling an unmet need: Roles for clinical pharmacists in preconception care. *Pharmacotherapy*. 2016. 36(2):141-151.

DiPietro Mager NA. Preventing infant mortality: Pharmacists' call to action. *Journal of the American Pharmacists Association.* 2016; 56(1):82–87.

Boykin CM, **DiPietro Mager NA**. Ohio pharmacy students' knowledge of folic acid and neural tube defects. *Currents in Pharmacy Teaching and Learning*. 2015; 7(2):273-276.

Bykovsky M, Meier MF K, **DiPietro Mager NA**. Impact of an online educational program on pharmacy students' knowledge of folic acid and neural tube defects. *Journal of Pharmacy Practice.* 2014; 27(5):513-517.

DiPietro NA, Bright DR. Medication therapy management and preconception care: Opportunities for pharmacist intervention. *Innovations in Pharmacy*. 2014; 5(1):Article 141.

DiPietro NA. An elective course in women's health issues. *Innovations in Pharmacy.* 2013; 4(3):Article 120.

DiPietro NA, Rush MJ, Bright DR, Kroustos KR, Milks MM. Strategies to engage pharmacy students and residents in worksite-based health and wellness programs. *Currents in Pharmacy Teaching and Learning*. 2013; 5(1):68-74.

Bright DR, Terrell SL, Rush MJ, Kroustos KR, Stockert AL, Swanson SC, **DiPietro NA**. Employee attitudes toward participation in a worksite-based health and wellness clinic. *Journal of Pharmacy Practice*. 2012; 25(5):530-536.

Rodrigues CR, **DiPietro NA**. Knowledge of folic acid and counseling practices among Ohio community pharmacists. *Pharmacy Practice.* 2012; 10(3):168-172.

DiPietro NA, Sobota KF, Giannamore M. Impact of pharmacists and student pharmacists in educating and screening low-income women for cardiovascular disease. *Innovations in Pharmacy*. 2012; 3(2): Article 77.

Murphy BL, **DiPietro NA**. A 12-month follow-up study of the impact of a pharmacist-directed educational program on the long-term knowledge and use of folic acid among college women. *Pharmacy Practice*. 2012; 10(2):105-109.

Truong HA, Taylor CR, **DiPietro NA**. The Assessment, Development, Assurance Pharmacist's Tool (ADAPT) for ensuring quality implementation of health promotion programs. *American Journal of Pharmaceutical Education.* 2012;76(1):Article 12.

Bright DB, Kroustos KR, Thompson RE, Swanson SC, Terrell SL, **DiPietro NA**. Preliminary results from a university-based disease state management program focused on hypertension, hyperlipidemia, and diabetes. *Journal of Pharmacy Practice*. 2012;25(2):130-135.

DiPietro NA, Davlin MV, Kier KL. Public health content in didactic and experiential curriculums of U.S. Doctor of Pharmacy programs. *International Journal of Pharmacy Education and Practice*. 2011;8(2):1-14.

Shields KM, **DiPietro NA**, Kier KL. Drug literature evaluation for observational studies. *Pharmacotherapy*. 2011;31(2):115-127.

DiPietro NA. Methods in epidemiology: Observational study designs. *Pharmacotherapy.* 2010;30(10):973-984.

Murphy BL, **DiPietro NA**, Kier KL. Knowledge and use of folic acid among college women: A pilot health promotion program led by pharmacy students and faculty. *Pharmacy Practice*. 2010;8(4):220-225.

Farris KB, Ashwood D, McIntosh J, **DiPietro NA**, Monastersky Maderas N, Cohen Landau S, Swegle J, Solemani O. Preventing unintended pregnancy: Pharmacists' roles in practice and policy via partnerships. *Journal of the American Pharmacists Association*. 2010;50(5):604-612.

Wernicke JF, Acharya N, Strombom I, Gahimer JL, D'Souza DN, **DiPietro N**, Uetrecht J. Hepatic effects of duloxetine II: Spontaneous reports and epidemiology of hepatic events. *Current Drug Safety.* 2008, 3:143-153.

DiPietro NA, Kier KL. An education intervention study about folic acid and healthy pregnancies targeted at college-age women. *Journal of the American Pharmacists Association.* 2001;41(2):283-285.

EDITORIALS

DiPietro Mager NA, Farris KB. The importance of public health in pharmacy education and practice. *American Journal of Pharmaceutical Education.* 2016;80(2):Article 18.

INVITED LECTURES

Peters L, **DiPietro Mager N.** Contraception: Oh, baby! *Delivered at the Ohio Pharmacists Association Pharmacy Technician Education Conference, Columbus, OH, May 2018.*

Mager DiPietro NA. Expanding pharmacy services to improve public health. *Presented at the Ohio Pharmacists Association Annual Meeting, Columbus, Ohio, April 2018.*

Lucas B, **Mager DiPietro NA** Use of reproductive life plans and systematic inquiry about pregnancy intent to promote optimal women's health before and between pregnancy. *Delivered at the Ohio Infant Mortality Summit, Cleveland, OH, December 2016.*

Mager DiPietro NA. "Step up to catch up": Efforts to reduce infant mortality in Ohio. *Delivered at the Ohio Pharmacists Association Pharmacy Technician Education Conference, Columbus, OH, August 2015.*

Mager DiPietro NA. Reducing Ohio's infant mortality rate: Pharmacists' call to action. *Delivered at the Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2015.*

Mager DiPietro NA. Partnering with pharmacists to provide preconception care. *Delivered at the Ohio Infant Mortality Summit, Columbus, OH, December 2014 and at the Ohio Collaborative to Prevent Infant Mortality Quarterly Meeting, Columbus, OH, April 2015.*

DiPietro NA. Improving maternal and infant outcomes in Ohio through preconception care. *Delivered at the Ohio Public Health Combined Conference, Columbus, OH, May 2014.*

DiPietro NA. Women's health disparities. *Delivered at the American Association of Colleges of Pharmacy Health Disparities and Cultural Competence Special Interest Group webinar series, April 2013.*

DiPietro NA. Improving maternal health in developed countries. *Delivered at the American College of Clinical Pharmacists Annual Meeting, Pittsburgh, PA, October 2011.*

BOOK CHAPTERS

DiPietro Mager NA. Chapter 15: Pregnancy planning and care. In: O'Connell MB, Smith JA, eds. Women's Health Across the Lifespan: A Pharmacotherapeutic Approach, 2nd edition. New York: McGraw-Hill, 2019.

Truong HA, **DiPietro NA**, Hayes M. Chapter 22: Strategies and opportunities for students' involvement in public health. In: Truong HA, Bresette JL, Sellers JA, eds. The pharmacist in public health: Education, applications, and opportunities. Washington, DC: American Pharmacists Association, 2010.

PODIUM PRESENTATIONS

Alexander S, **DiPietro Mager N**. Community pharmacist interest and participation in clinical-community linkages. *American Public Health Association Annual Meeting, San Diego, CA, November 2018.*

DiPietro Mager N, Rafie S. Pharmacists: An overlooked resource in contraception provision for Zika preparedness. *American Public Health Association Annual Meeting, San Diego, CA, November 2018.*

Chaudry R, **DiPietro Mager N**, Maywhoor D. Health and equity in all policies. *Ohio Public Health Association Vital Statistics Conference, Columbus, OH, September 2018.*

Alexander S, **DiPietro Mager N**. USPSTF recommendations and the community pharmacist: Current opportunities to improve population health. *Ohio Pharmacists Association Annual Meeting, Columbus, Ohio, April 2018, and Ohio Northern University Student Research Colloquium, Ada, OH, May 2018.*

DiPietro Mager NA. Opportunities to partner with pharmacists to improve maternal and infant health. *Association of Maternal & Child Health Programs Annual Conference, Arlington, VA, February 2018.*

DiPietro Mager NA, Bright DR, Markus D, Batz L, Hartzell DM, Gartner J. Development, implementation, and assessment of a pharmacist-provided preconception care initiative. *American Public Health Association Annual Meeting, Atlanta, GA, November 2017.*

DiPietro Mager NA, Mills C, Snelling A. Utility of reproductive life plans in identification of teratogenic medication use. *American Public Health Association Annual Meeting, Atlanta, GA, November 2017.*

Hartzell DM, Bright DR, Weaver K, **DiPietro Mager NA**, Markus D, Weis L, Gartner J. Using pharmacists to improve health outcomes: A case study in maternal and infant health. *Medicaid Health Plans of America Conference, Washington, DC, October 2017.*

Hilverding A, **DiPietro Mager NA**. Pharmacist attitudes regarding provision of sexual and reproductive health services. *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2017.*

Parker KP, **DiPietro Mager NA**, Hart DC, Aronson BA. Using a mock Board of Pharmacy disciplinary hearing to teach administrative law, empathy, and professionalism. *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2017.*

DiPietro Mager NA, Bright DR, Markus D, Batz L, Hartzell DM, Gartner J. Development, implementation, and improvement of a pharmacist-provided preconception care initiative. *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2017.*

DiPietro Mager NA, Ochs L, Ranelli P, Kahaleh AA, Lahoz MR, Patel R, Garza OW, Isaacs D, Clark S. Interprofessional collaborations between academic pharmacy programs and public health organizations. *American Public Health Association Annual Meeting, Denver, CO, October 2016.*

DiPietro Mager NA, Bright DR, Markus D, Batz L, Hartzell DM, Gartner J. Community pharmacist provision of preconception care via medication therapy management. *Community Pharmacy Foundation Research Forum at the American Pharmacists Association Annual Meeting, Baltimore, MD, March 2016.*

DiPietro Mager NA. Partnering with pharmacists to provide preconception care. *American Public Health Association Annual Meeting, Chicago, IL, November 2015.*

Arya V, **DiPietro NA**, Hogue GL. Public health, meet pharmacy: Educational activities highlighting opportunities for interprofessional collaboration for students. *American Association of Colleges of Pharmacy Annual Meeting, Grapevine, TX, July 2014.*

Hethcox ME, Kier KL, **DiPietro NA**. Establishing a student-directed peer-reviewed publication: What we have learned and future directions. *American Society of Health-System Pharmacists Midyear Clinical Meeting, Orlando, FL, December 2013.*

DiPietro NA. What do Ohio pharmacists and interns know about folic acid? *Ohio Public Health Combined Conference, Columbus, OH, May 2013.*

Rush MJ, Bright DR, Colwell KR, **DiPietro NA**, Kier KL. Multidisciplinary "Healthy Campus" initiative promotes prevention and wellness at the worksite. *American Public Health Association Annual Meeting, San Francisco, CA, October 2012.*

Hiddleson OC, Vander Molen KA, **DiPietro NA**. Mission possible: Implementing National Public Health Week activities on a college campus. *Ohio Public Health Combined Conference, Columbus, OH, May 2012.*

Rodrigues CR, **DiPietro NA**. Ohio community pharmacists' knowledge and counseling practices regarding folic acid for prevention of neural tube defects. *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2012.*

DiPietro NA. Impact of National Women's Health Week projects led by pharmacy faculty and students. *Ohio Public Health Combined Conference, Columbus, OH, April 2011.*

Terrell S, Bright DR, Thompson R, Swanson S, Kroustos KR, **DiPietro NA**. An interdisciplinary approach to university-wide wellness programming: A preliminary study. *Midwest Chapter of the American College of Sports Medicine Annual Meeting, Indianapolis, IN, October 2010.*

DiPietro NA, Humbert L, Strombom I. Assessing the impact of stressful life events on small-for-gestational-age births: Data from the Indiana Access project. *American Public Health Association Annual Meeting, Washington, DC, November 2007.*

DiPietro NA, Humbert L, Strombom I. Racial/ethnic differences in the experience of stressful life events during pregnancy: Data from the Indiana Access project. *American Public Health Association Annual Meeting, Washington, DC, November 2007.*

Humbert L, **DiPietro NA**. Politics and policies of unintended pregnancies: Indiana's success at finding common ground. *American Public Health Association Annual Meeting, Washington, DC, November 2007.*

DiPietro N, Greene M, Akinola E, Bentley K, Roberson C. Indiana Minority Health Coalition continuous quality improvement project: Results and recommendations. *Indiana Public Health Association Annual Meeting, West Lafayette, IN, May 2006.*

Carrico M, Case K, **DiPietro N**, Potts J, Kremidas J, Kuhstoss D, Sasher T. Designing effective study participant retention programs. *Drug Information Association Annual Meeting, Washington, DC, June 2004.*

DiPietro NA, Kier KL. An educational intervention study about folic acid and healthy pregnancies targeted at college-age women. *American Pharmacists Association Annual Meeting, Washington, D.C. (March 2000); Ohio Pharmacists Association Annual Meeting, Columbus, OH (April 2000); and the Pharmacy Student Research Conference – Eastern States, Morgantown, WV (October 2000).*

POSTER PRESENTATIONS

Aronson B, Ernst K, DeVolld T, Komandt M, Meadows A, Parker K, **DiPietro Mager N**. Management and leadership education in pharmacy curricula. *Ohio Pharmacists Association Annual Meeting, Columbus, OH April 2019.*

Chaudry R, **DiPietro Mager N**, Hicks C, Jennings R, Maywhoor D. Ohio Public Health Association's Health and Equity in All Policies (HEiAP) initiative. *Ohio Infant Mortality Summit, Cincinnati, OH, December 2018 and Association for Prevention Teaching and Research Conference, Cleveland, OH, April 2019.*

DiPietro Mager N. S.B. 332 implementation: Update on pharmacist preparedness. *Ohio Infant Mortality Summit, Cincinnati, OH, December 2018.*

DiPietro Mager N. An interdisciplinary course in women's health issues. *Sex and Gender Health Education Summit, Salt Lake City, UT, April 2018.*

Alexander S, **DiPietro Mager N** USPSTF recommendations and the community pharmacist: What are the current opportunities to improve population health? *American Pharmacists Association Annual Meeting, Nashville, TN, March 2018.*

DiPietro Mager N, Kowalsky J, Erme M, Hall L. Promoting engagement of diverse clinical health professionals: Developing the Clinical Health Section of the Ohio Public Health Association. *American Public Health Annual Meeting, Atlanta, GA, November 2017.*

Parker KP, **DiPietro Mager NA**, Hart DC, Aronson BA. Using a mock Board of Pharmacy disciplinary hearing to teach administrative law, empathy, and professionalism. *American Association of Colleges of Pharmacy Annual Meeting, Nashville, TN, July 2017.*

Hilverding A, **DiPietro Mager NA.** Contraceptive authority: Ohio pharmacist interest and preparedness. *American Pharmacists Association Annual Meeting, San Francisco, CA, March 2017.*

Ng C, Najjar R, **DiPietro Mager NA, Rafie S.** Pharmacist and student pharmacist perspectives on providing preconception care. *American Pharmacists Association Annual Meeting, San Francisco, CA, March 2017, Ohio Pharmacists Association Annual Meeting, Columbus, OH April 2017, and Ohio Northern University Student Research Colloquium, Ada, OH, April 2017.*

Markus D, Batz L, Bright DR, **DiPietro Mager NA**, Gartner J, Hartzell DM. Quality improvement of targeted medication reviews for preconception pharmacy services. *American Pharmacists Association Annual Meeting, San Francisco, CA, March 2017 and the Pharmacy Quality Alliance Annual Meeting, Baltimore, MD, May 2017.*

DiPietro Mager NA, Mills C, Snelling A. Utility of reproductive life plans in identification of potentially teratogenic medication use. *Ohio Infant Mortality Summit, Cleveland, OH, December 2016.*

DiPietro Mager NA, Lucas B, Clark M, Kelly M, Gabbe P. Use of reproductive life plans and inquiry about pregnancy intention among providers in Ohio. *Ohio Infant Mortality Summit, Cleveland, OH, December 2016.*

Clark S, **DiPietro Mager NA**, Truong HA, Aruru M. A response to the APHA policy statement on the role of the pharmacist in public health. *American Public Health Association Annual Meeting, Denver, CO, November 2016.*

Strand MA, Abrons JP, Bullock KC, Conry JM, Covvey JR, **DiPietro Mager NA**, Goad JA, Golchin N, Patel RV, and Truong HA. Challenges and opportunities for integrating public health into pharmacy curricula. *American Association of Colleges of Pharmacy Annual Meeting Anaheim, CA, July 2016.*

Markus D, Batz L, Bright DR, **DiPietro Mager NA**, Gartner J, Hartzell DM. Improving preconception care through medication therapy management. *Pharmacy Quality Alliance Annual Meeting, Arlington, VA, May 2016.*

DiPietro Mager NA, Bright DR, Markus D, Batz L, Hartzell DM, Gartner J. Expanding access to preconception care in Ohio through medication therapy management. *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2016.*

Montenery S, **DiPietro Mager N**, Terrell S, Musser M, Walden L. Creating a collaboration-ready workforce: Using cultural case scenarios with interdisciplinary health care students. *National Nurses Summit, Nashville, TN, April 2016.*

DiPietro Mager NA, Bright DR, Markus D, Batz L, Hartzell DM, Gartner J. Community pharmacist provision of preconception care via medication therapy management. *American Pharmacists Association Annual Meeting, Baltimore, MD, March 2016.*

Casserlie LM, **DiPietro Mager NA**. Ohio pharmacists' perceptions on non-dispensing services and medication therapy management. *American Society of Health-System Pharmacists Midyear Clinical Meeting, New Orleans, LA, December 2015.*

DiPietro Mager NA, Worley MM, Ilenin JS, Sobotka JL. Integrating business planning concepts in a Doctor of Pharmacy curriculum. *American Association of Colleges of Pharmacy Annual Meeting, National Harbor, MD, July 2015.*

DiPietro Mager NA, Ochs L, Ranelli P, Kahaleh AA, Lahoz MR, Patel R, Garza OW, Isaacs D, Clark S. Characterization of collaborations between Doctor of Pharmacy programs and public health departments or organizations. *American Association of Colleges of Pharmacy Annual Meeting, National Harbor, MD, July 2015.*

Bailey LC, **DiPietro Mager NA**. Assessment of global health education in United States Doctor of Pharmacy programs. *American Society of Health-System Pharmacists Midyear Clinical Meeting, Anaheim, CA, December 2014.*

DiPietro NA, Musser MR, Montenery SM, Terrell SL, Walden LL. Implementing interprofessional education at a small, rural university: Best practices and lessons learned. *American Association of Colleges of Pharmacy Annual Meeting, Grapevine, TX, July 2014.*

DiPietro N, Terrell S, Montenery S, Musser M, Walden L. Preparing a collaboration-ready health care workforce: Assessing interprofessional readiness of undergraduate students. *All Together Better Health VII Conference, Pittsburgh, PA, June 2014.*

Meier MF K, Bykovsky M, **DiPietro NA**. Impact of an educational program on pharmacy students' long-term knowledge of folic acid. *American Association of Colleges of Pharmacy Annual Meeting, Chicago, IL, July 2013.*

Hethcox ME, Kier KL, **DiPietro NA**. The Pharmacy and Wellness (PAW) Review: An innovative approach to enhancing professional skills. *American Association of Colleges of Pharmacy Annual Meeting, Chicago, IL, July 2013.*

Bykovsky M, Meier MF K, **DiPietro NA**. Effectiveness of an educational program in improving student pharmacists' knowledge of folic acid for the prevention of neural tube defects. *American Pharmacists Association Annual Meeting, Los Angeles, CA, March 2013.*

Boykin CM, **DiPietro NA**. Ohio pharmacy students' knowledge of folic acid for the prevention of neural tube defects. *American Society of Health-System Pharmacists Midyear Clinical Meeting, Las Vegas, NV, December 2012*.

DiPietro NA, Sobota KF. Impact of an outreach project to raise awareness about heart disease among women in northwest Ohio. *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2012.*

Khan SS, Zoloty AT, Rodrigues CR, Paris Oliver A, Sobota KF, **DiPietro NA**. Role of the pharmacist and student pharmacist in reducing health disparities: Results of a pilot program to educate Latina women about folic acid and neural tube defects. *American Pharmacists Association Annual Meeting, New Orleans, LA, March 2012.*

Sobotka J, Bright D, Rush M, Kroustos K, Stockert A, Kier K, Murphy B, **DiPietro N**. Design and implementation of a multidisciplinary, university-based disease state management and wellness program. *International Congress of the International Pharmaceutical Federation (FIP), Hyderabad, India, September 2011.*

Hazelet E, Hiddleson O, Oliver A, Rizzo B, Salay K, **DiPietro N**. Pharmacists' and student pharmacists' impact on Healthy People 2020. *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2011.*

Bright DR, Rush MJ, Kroustos KR, Terrell SL, Swanson SC, Stockert AL, Kier KL, Thompson RE, Milks MM, Murphy BL, **DiPietro NA**. Design and implementation of a multidisciplinary, university-based disease state management and wellness program**.** *Ohio Pharmacists Association Annual Meeting, Columbus, OH, April 2011.*

Bright DR, Rush MJ, Kroustos KR, Terrell SL, Swanson SC, Stockert AL, Kier KL, Thompson RE, Milks MM, Murphy BL, **DiPietro NA**. Preliminary results from a university-based disease state management program focused on hypertension, hyperlipidemia, and diabetes. *American Pharmacists Association Annual Meeting, Seattle, WA, March 2011.*

DiPietro NA, Clark J, Giannamore MR, Sobota KF. Impact of pharmacists and student pharmacists in educating and screening female patients for cardiovascular disease. *American Pharmacists Association Annual Meeting, Seattle, WA, March 2011.*

DiPietro NA, Kier KL, Murphy BL. Impact of a pilot health promotion program on long-term knowledge and use of folic acid among college women. *American Pharmacists Association Annual Meeting, Seattle, WA, March 2011.*

Truong HA, Taylor CR, **DiPietro NA**. Assessment tool for planning and implementing pharmacist-directed health promotion activities. *American Association of Colleges of Pharmacy Annual Meeting, Seattle, WA, July 2010.*

DiPietro NA. Involving first-year undergraduate students in public health research: Best practices and lessons learned. *Ohio Public Health Combined Conference, Columbus, OH, May 2010.*

Murphy BL, **DiPietro NA**, Kier KL. Opportunities for pharmacists and student pharmacists in health promotion: Educating college women about folic acid and neural tube defects. *American Society of Health-System Pharmacists Midyear Clinical Meeting, Las Vegas, NV, December 2009.*

Anderson LN, Davlin MV, **DiPietro NA**, Kier KL. Student pharmacist perceptions of public health content in U.S. college of pharmacy didactic & experiential curricula and extra-curricular activities. *American Public Health Association Annual Meeting, Philadelphia, PA, November 2009.*

DiPietro NA, Davlin MV, Kier KL. Do U.S. professional pharmacy organizations encourage pharmacists to participate in public health activities? *Annual American Public Health Association Annual Meeting, San Diego, CA, October 2008.*

Davlin MV, **DiPietro NA**, Kier KL. Assessing the extent of public health content in U.S. college of pharmacy curricula and extracurricular activities. *American Association of Colleges of Pharmacy Annual Meeting, Chicago, IL, July 2008*.

DiPietro NA, Finley KN, Kier KL, Sullivan DL. Promoting the role of the pharmacist in public health through curricular and co-curricular activities. *American Association of Colleges of Pharmacy Annual Meeting, Chicago, IL, July 2008.*

DiPietro NA. Knowledge and use of folic acid among Indiana residents aged 18 years and older, 2002. *Indiana Public Health Association Annual Meeting, Bloomington, IN, May 2005.*

DiPietro NA. Data analysis by sex in clinical drug development. *Eli Lilly and Company, Indianapolis, IN, May 2002.*

DiPietro NA, Gujral R, Ansani N. Improving the effectiveness of a food-drug interaction program for hospital patients. *American Society of Health-System Pharmacists Midyear Clinical Meeting, Las Vegas, NV, December 2000.*

SELECTED TASK FORCE APPOINTMENTS

- Association for Prevention Teaching and Research Healthy People Curriculum Task Force, 2016-present
- Birth Control Pharmacist, 2018-present
- Ohio Collaborative to Prevent Infant Mortality, 2014-present
- Reproductive Health Pharmacy School Curriculum Workgroup, 2008-2009
- Indiana Perinatal Network Advisory Committee, 2005-2006

SELECTED HONORS AND AWARDS

- Ohio Pharmacists Association Pharmacist Public Relations Award, 2019
- Walmart Scholar Faculty Mentor, American Association of Colleges of Pharmacy, 2017
- William L. Robinson Young Alumni of the Year Award, Ohio Northern University, 2015
- Mortar Board Aurora Chapter Favorite Professor Recognition, 2013, 2012, 2011, 2008
- Innovations in Teaching Award, American Association of Colleges of Pharmacy, 2013
- National Continued Excellence Award, Kappa Epsilon, 2013
- Young Public Health Professional of the Year Award, Ohio Public Health Association, 2011
- Presentation Merit Award, American Pharmacists Association-Academy of Pharmacy Practice and Management, 2011
- Phi Lambda Sigma *(pharmacy leadership society)*, 2008
- Outstanding Faculty Member of the Year, Ohio Northern University, 2007-2008 *(awarded);* 2013-2014 *(nominated)*
- Student Abstract Award, Epidemiology Section, American Public Health Association, 2007
- Delta Omega *(public health honor society)*, 2006
- Student Poster Award, Indiana Public Health Association, 2005
- Rho Chi *(pharmacy honor society)*, 1999
- Phi Kappa Phi *(university honor society)*, 1999
- Mortar Board *(scholarship, leadership, and service honor society)*, 1998
- Omicron Delta Kappa *(national leadership honor society),* 1998
- Order of Omega *(leadership honor society, members of Greek letter organizations*), 1998
- Gamma Sigma Alpha *(scholarship honor society, members of Greek letter organizations),* 1997
- Alpha Lambda Delta *(freshmen honor society),* 1996