A thematic analysis of WIC office locations in Missouri

Sandhya Tripathi

Introduction and summary of my approach

The Women, Infants, and Children (WIC) program offers supplemental food, health care referrals, nutrition education, and breastfeeding support to eligible pregnant, breastfeeding, and postpartum women, infants, and children up to age five. Additional caregivers, such as fathers, grandparents, guardians, and foster parents, may also apply for benefits for children in their household. Despite a decline in WIC participation among pregnant and postpartum individuals over the past decade, the pandemic presented an unexpected trend. Instead of an increase in enrollment during this period, nationwide WIC participation in this group decreased by nearly 5 percent, with state figures ranging from a 20 percent decline to a 7 percent increase [1]. Several factors could have contributed to this behavior, and one possible element to consider is the accessibility of WIC offices. These offices play a crucial role beyond in-person certification, as they provide essential prenatal and postpartum nutritional services, which necessitate proximity to the intended population. Participants also need to return to the WIC clinic after their benefits expire to receive further assistance and nutrition education.

The goal of the project was to investigate the WIC office locations in Missouri in the context of their targeted population and after conducting this analysis conclude by identifying potential areas where new WIC offices may be needed. My objectives included analyzing the geographical distribution of Missouri WIC offices in relation to two specific criteria: 1) the below-poverty unemployed female population, and 2) the female population who could only graduate high school and gave birth in a given year. Additionally, I also attempted to understand the relation between WIC office locations and the change in low hemoglobin WIC enrolled women across years. I used this as a secondary metric to measure the WIC program's impact. A decrease in these figures over time could indicate that the benefits provided by WIC are effectively supporting women's health. By ensuring that WIC services are accessible to the intended population, we can strive to improve participation rates and better support the health and well-being of pregnant and postpartum women in Missouri.

Datasets

I worked with the county-level data in Missouri from 2019 and 2020. Firstly, I obtained the location of WIC offices across all the counties of Missouri. Further, since I am using unemployment, poverty, education, and birth rate as the criterion, I used the following datasets available from the American Community Survey (Table) 1) unemployed female population who were living below the poverty level and, 2) education information of the female population that gave birth in past 12 months. The WIC office location data is available from Missouri Spatial Data

Information Services and the demographic data is available through the American Community Surveys (ACS). I also used the TIGER/Lines files to merge with the demographic survey files. To identify the counties where the fraction of WIC enrolled women with low hemoglobin (Prenatal or Postpartum) improved or worsened, I used WIC pre-natal and postpartum WIC enrollees for in 2019 and 2020. This was obtained for Missouri Public Health Information Management System's MICA initiative.

1) WIC office locations are obtained from Missouri Spatial Data Information Services website.
2) Census Tract files MO TIGER/Line (2020) from the official census website.
3) Poverty and unemployment datasets: ACS (2020) S1701 table.
4) Education of women who gave birth: ACS (2020) B13014 table.
5) Hemoglobin data is obtained from the MICA dashboard for the years 2019 and 2020. The tables for the years 2019 and 2020 are queried separately and then added for side-by-side comparison and finally downloaded.

Methods

To accomplish the primary objective, I took the site selection approach. Briefly, I first checked if the existing WIC offices can cover the whole state of Missouri. Then, I performed the demographic analysis (poverty and education) which served as criteria if a new office is needed. Next, for the secondary objective, I used the low hemoglobin case data, both prenatal and postpartum, for the years 2019 and 2020. This dataset is only for women who were enrolled in the WIC program. Finally, I compared the numbers for the two years for both prenatal and postpartum groups of women individually and together. In the rest of this section, I will explain each of the above steps in detail.

1) Checking the coverage of the existing WIC office location.

In this step, I created a map, that used the pairwise buffer function in ArcGIS to show the coverage of the existing locations. I needed the census tract lines and the office location shp files in this step. After adding both these geodatabases to the workspace, I used the dissolve function to get rid of the census tract lines beyond the county boundaries. This made the map look less busy. Next, I created a 15 mile buffer around the existing WIC office location. I had also tried 10 miles and 20 miles but decided against it as in terms of average travel time in different counties of Missouri, 15 miles seems sensible (this distance can be covered in close to 40 minutes by public transport or 30 minutes by car). I increased the transparency of buffer layer to be able to see the underlying county boundaries that I was going to use at inference time. I highlighted the counties or areas which were not covered by the buffer circles.

2) Poverty and unemployment criteria

I used the two main estimates from the ACS's poverty table. 1) Unemployed women above the age of 16 and 2) unemployed women above the age of 16 who were below the poverty level. I presented this fraction as the first criterion to determine if a county needed a new WIC office. In terms of the exact steps, I first created an additional column called 'geoid_2' that has the last 11 digits from the GEOID column. This new column would be later used to merge the poverty data to the census tract data. Then I removed all the columns except S1701_C01_012E, S1701_C01_033E, S1701_C02_012E, S1701_C02_033E and the geoid both new and old.

Now, once I have added both the census tract and the poverty shp files to the map, I created a join between the census tract layer and the poverty table on the fields 'GEOID' and the newly created 'geoid_2'. Now, since there are census tracts with very small samples and the other hemoglobin data is at county level, I decided to dissolve the census tract boundaries and work with the county level data. I used 'COUNTYFP' as the field to dissolve and then used 'SUM' as the statistic for other demography (poverty in this case) related columns. After this I used graduated colors as the primary symbology with the main field as 'S1701_C02_033E' (summed one) and the normalization field as 'S1701_C01_033E' (summed one). I used Natural Breaks (Jenks) method for creating the intervals. For the WIC office locations, I copied the layer from the first map that is used for site selection and pasted it here.

3) <u>Women who gave birth were only educated upto high school criteria</u>

I used the two main estimates from the ACS's education table for women who gave birth in last 12 months. 1) Women between the age of 15 and 40 who gave birth in last 12 months, and 2) women who gave birth in last 12 months and have high school or lower as the highest degree. I presented this fraction as the second criterion to determine if a county needed a new WIC office. In terms of the exact steps, I first created an additional column called 'geoid_2' that has the last 11 digits from the GEOID column. Then, I created a new column called 'B13014_04_05_10_11Sum' by adding the four columns that represented the married or unmarried women who either completed high school or not. After this step, I removed all the columns except 'B13014_002E', 'B13014_004E', 'B13014_005E', 'B13014_010E', 'B13014_011E', and 'B13014_04_05_10_11Sum' and both geoid columns.

Now, once I have added both the census tract and the poverty shp files to the map, I created a join between the census tract layer and the poverty table on the fields 'GEOID' and the newly created 'geoid_2'. Now, since there are census tracts with very small samples and the other hemoglobin data is at county level, I decided to dissolve the census tract boundaries and work with the county level data. I used 'COUNTYFP' as the field to dissolve and then used 'SUM' as the statistic for other demography (education among women who gave birth in past year) related columns.

In the symbology I used graduated colors to represent the education level of women who gave birth in 2020. To be exact, I used the field value as the column 'B13014_04_05_10_11Sum' and normalized it with 'B13014_002E' field. These fields have their name also starting with SUM due

to the dissolve function. I used the Natural Breaks (Jenks) methods of creating the classes. For the WIC office locations, I copied the layer from the first map that is used for site selection and pasted it here.

4) Fraction of WIC enrolled prenatal and postpartum women with low hemoglobin

For this secondary objective, I did some processing by adding two columns in the original hemoglobin file. The first column represented the difference between the rate of women that showed up with low hemoglobin at a prenatal stage in 2019 and in 2020. The second column was computed in the similar way but for the postpartum women. I had names them as 'prenatal difference in low hemoglobin percent' and 'postpartum difference in low hemoglobin'

Next, I divided this analysis into three parts. For the first part, I compared changes in the rate of rate of prenatal women with low hemoglobin between two years. For this, I created two separate maps for each year as follows. I first applied the dissolve function on the tl_2022_29_tract layer with the dissolve field set to 'COUNTYFP'. After this, I added a new field called 'unique county code' of numeric datatype in the attribute table of the dissolved tl_2022_29_tract layer. Now, to fill this field I used the same numbers as in 'tl_2022_29_tract_COUNTYFP' field but without the zeros. After this, I join this new layer that has the dissolved tract lines with the table 'WIC_prenatal_postpartum_linked_2020_countywise_withFIPScode1.csv' on the fields 'unique county code' and 'FIPS code' respectively. Next, I needed to display the hemoglobin data for each county. In this map as I am showing the rate of low hemoglobin cases in each county for a fixed year, I select the 'Hematocrit/hemoglobin - low at postpartum visit-2019rate' or 'Hematocrit/hemoglobin - low at postpartum visit-2020rate' as the field to symbolize using the graduated colors. Since I wanted to make a comparison between the years, I decided to use the manual intervals with 5 classes that are same for maps in both years.

In the second part, I follow the same steps but with the data on postpartum women. In particular, I used the 'Hematocrit/hemoglobin - low at postpartum visit-2019rate' or 'Hematocrit/hemoglobin - low at postpartum visit-2019rate' fields to symbolize the low hemoglobin cases while using graduated colors.

In the third part, after obtaining the dissolved and merged database, instead of using the direct estimate, I use the difference columns that I created to present in the map. Next, I wanted to show both the patterns in the same map so decided to use the Bivariate colors as the primary symbology. I used the two fields as the differences mentioned earlier. I used the Natural Breaks (Jenks) method with a 3 by 3 grid. I tried to use the same/similar colors for each field as I had used in the previous maps (prenatal and postpartum).

For each of these maps, I copied the WIC office locations layer from the first map that is used for site selection and pasted it in them.

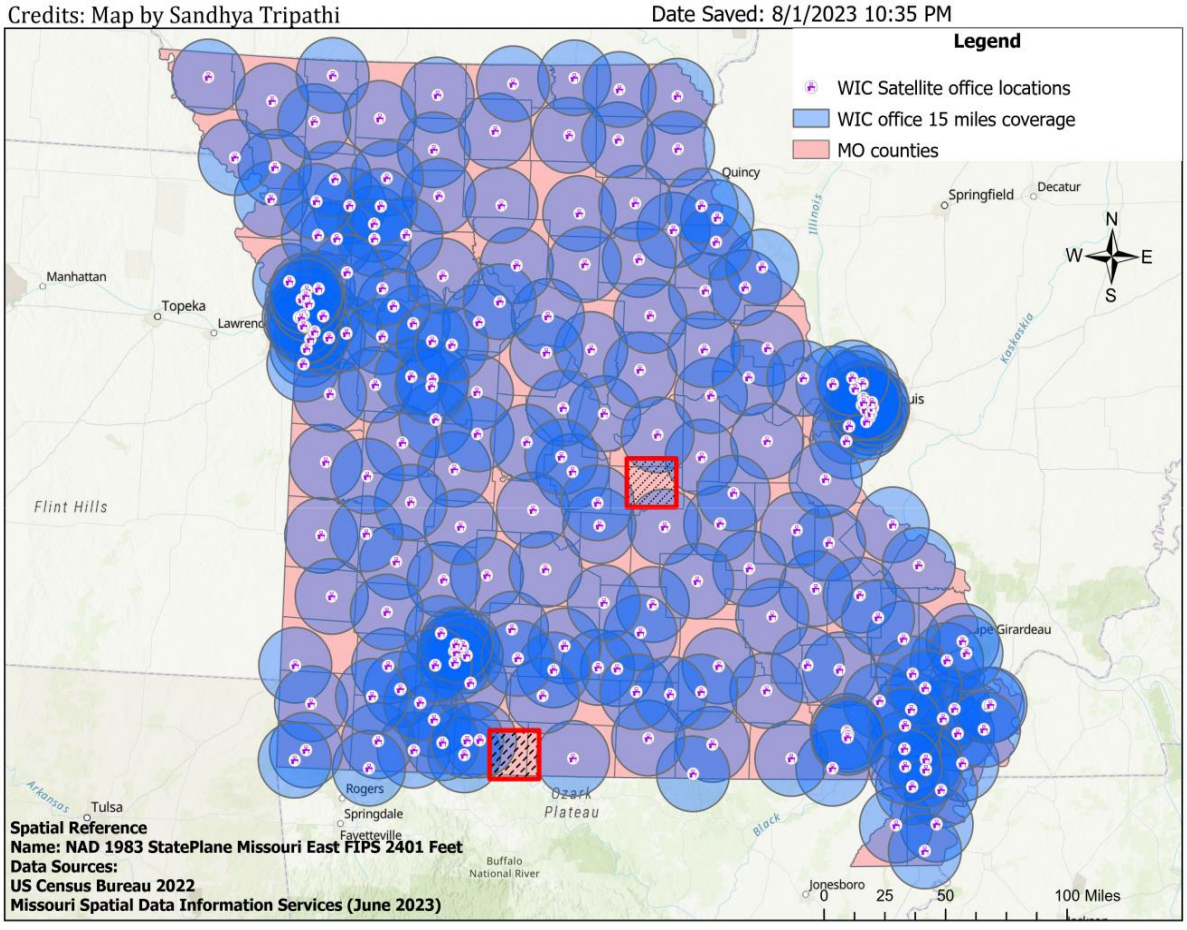
Results

1) What does buffer map suggest?

Based on the first map in Figure 1 showing the WIC office locations and their buffer, I identified two areas that possibly need a new WIC office; represented as red boxes. I used US Census Bureau to get details about these areas. The first observation is that the top red box belongs to Maines County which doesn't have a WIC office even though its female population is more than 4000. Another red box is partly in Taney County and partly in Ozark County. For Taney County, there doesn't seem to be a problem as there are three WIC offices in the whole county but for the women from Ozark County, it could be an issue. I used these counties as the starting point and applied the two criteria defined earlier to see if they actually need new offices.

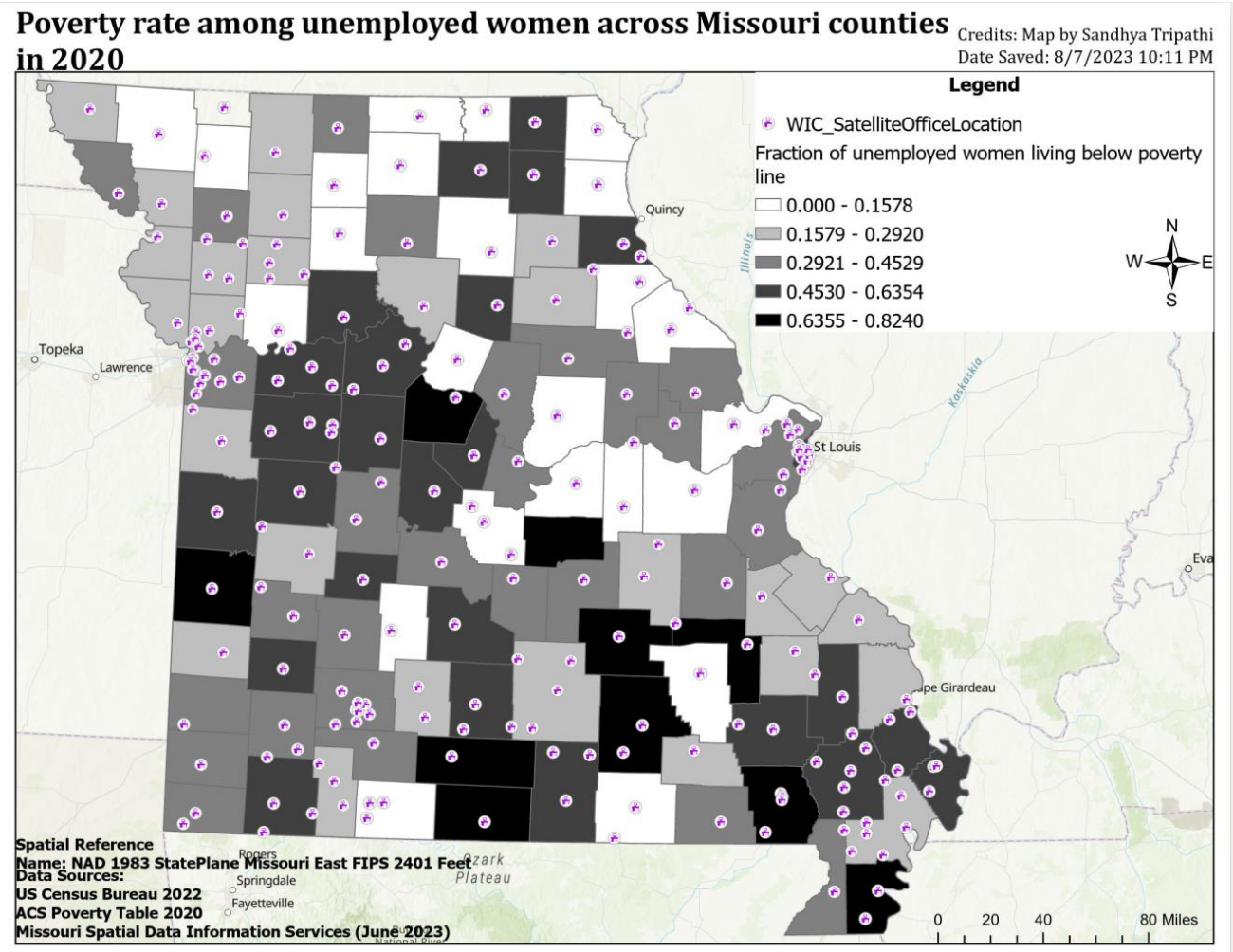
Coverage of different Women Infant and Child care program offices in Missouri

Credits: Map by Sandhya Tripathi Date Saved: 8/1/2023 10:35 PM



2) What do poverty data among women in MO and WIC location map suggest together?

The following map shows the fraction of unemployed women who were living below the poverty level in 2020. As seen in the figure, Ozark County is one of the few counties that have the highest unemployment and poverty. Further, the mean travelling time to work in Ozark is 29 min. Also, note that Maines County which doesn't have any WIC office has the highest poverty and unemployment among women.

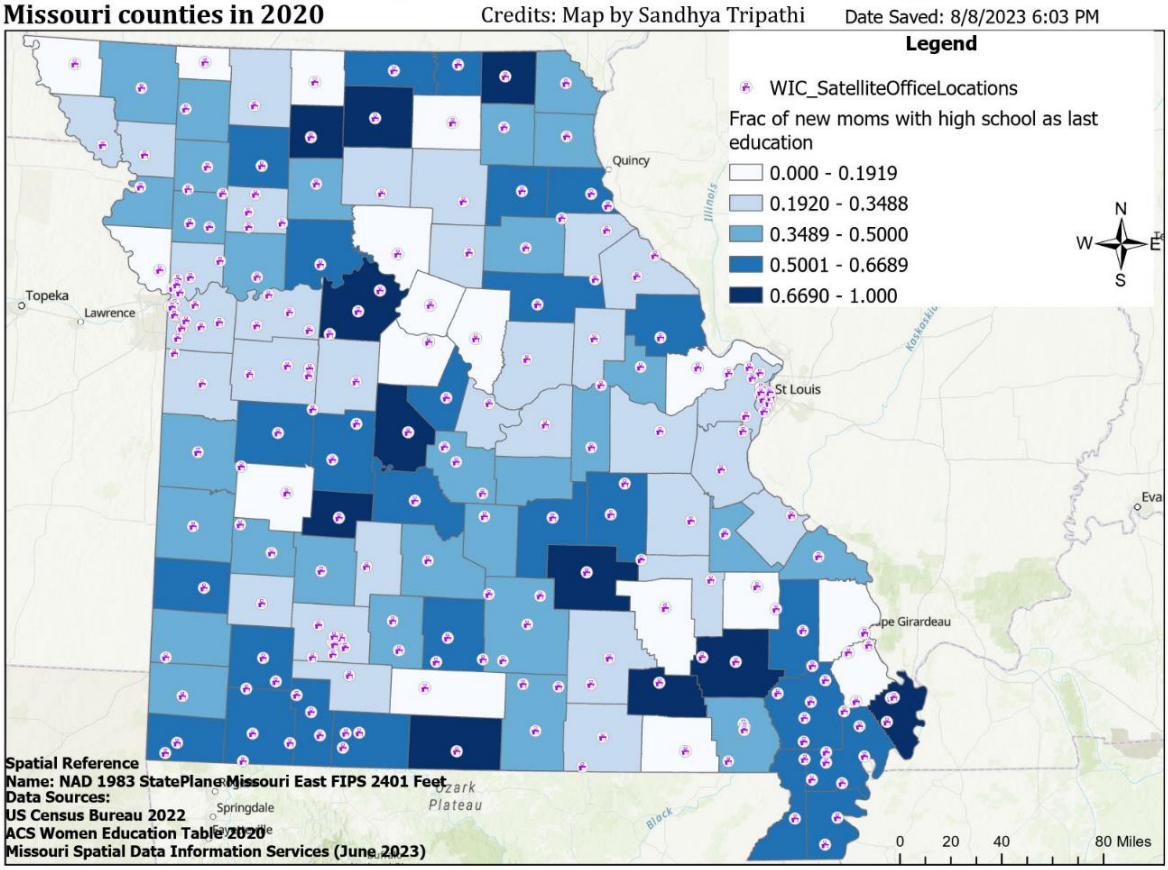


3) What do education among women who gave birth in past 12 years in MO and WIC location map suggest together?

The following map presents the fraction of women who gave birth in 2020 and who only studied up to high school. Ozark County (dark blue color) again ranks high in this metric here implying that this area has the population that WIC intends to serve.

Fraction of women with up to high school education among the ones who gave birth across Missouri counties in 2020

Credits: Map by Sandhya Tripathi Date Saved: 8/8/2023 6:03 PM

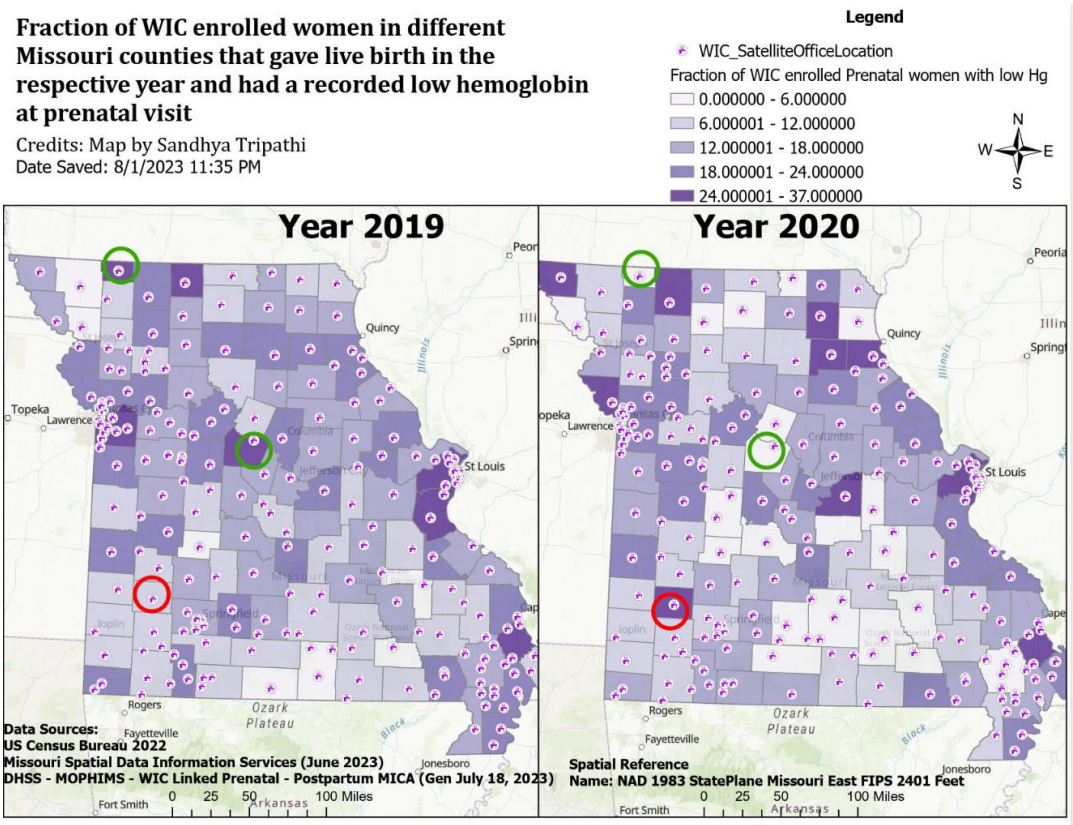


4) What does changes in low hemoglobin data from 2019 to 2020 suggest?

In the following maps, I present the fraction of WIC-enrolled women in each county that presented with low Hemoglobin data during their prenatal or postpartum visit. I made a comparison between 2019 and 2020 and displayed prenatal and postpartum on separate maps. First, let us focus on the prenatal case. The counties where the condition improved are in green and and the ones where it worsened are in red. In the prenatal low hemoglobin plot, the top green circle is Worth County which has only 2000 people and where moving from 2019 to 2020 (the covid year) the fraction of low hemoglobin cases reduced. This could have been due to better distribution of additional resources. Similarly, the green circle at the center is Cooper County where the population is around 17000 so the distribution infrastructure might be already there. Finally, for Dade County in red circle where the low Hemoglobin cases rose is little difficult to explain. Since, its population is around 7500, I can only think of high poverty rate that worsened during Covid that could explain this. For the postnatal case, the two counties circled for change have small population size with Worth County in red at 2000 and Mercer in green at 3400. The fact that there could have been resistance to seeking care or visiting the office with the fear of getting the baby sick could have contributed to many of the patterns that we are seeing and not seeing.

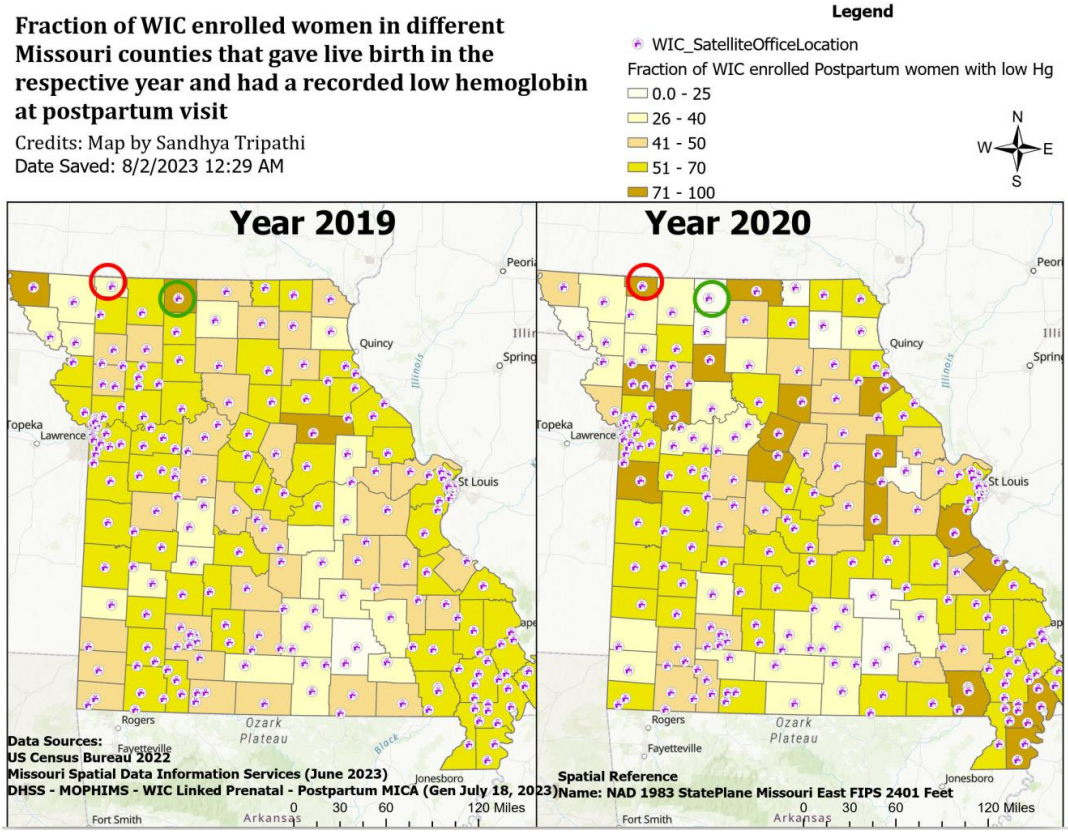
Fraction of WIC enrolled women in different Missouri counties that gave live birth in the respective year and had a recorded low hemoglobin at prenatal visit

Credits: Map by Sandhya Tripathi
Date Saved: 8/1/2023 11:35 PM



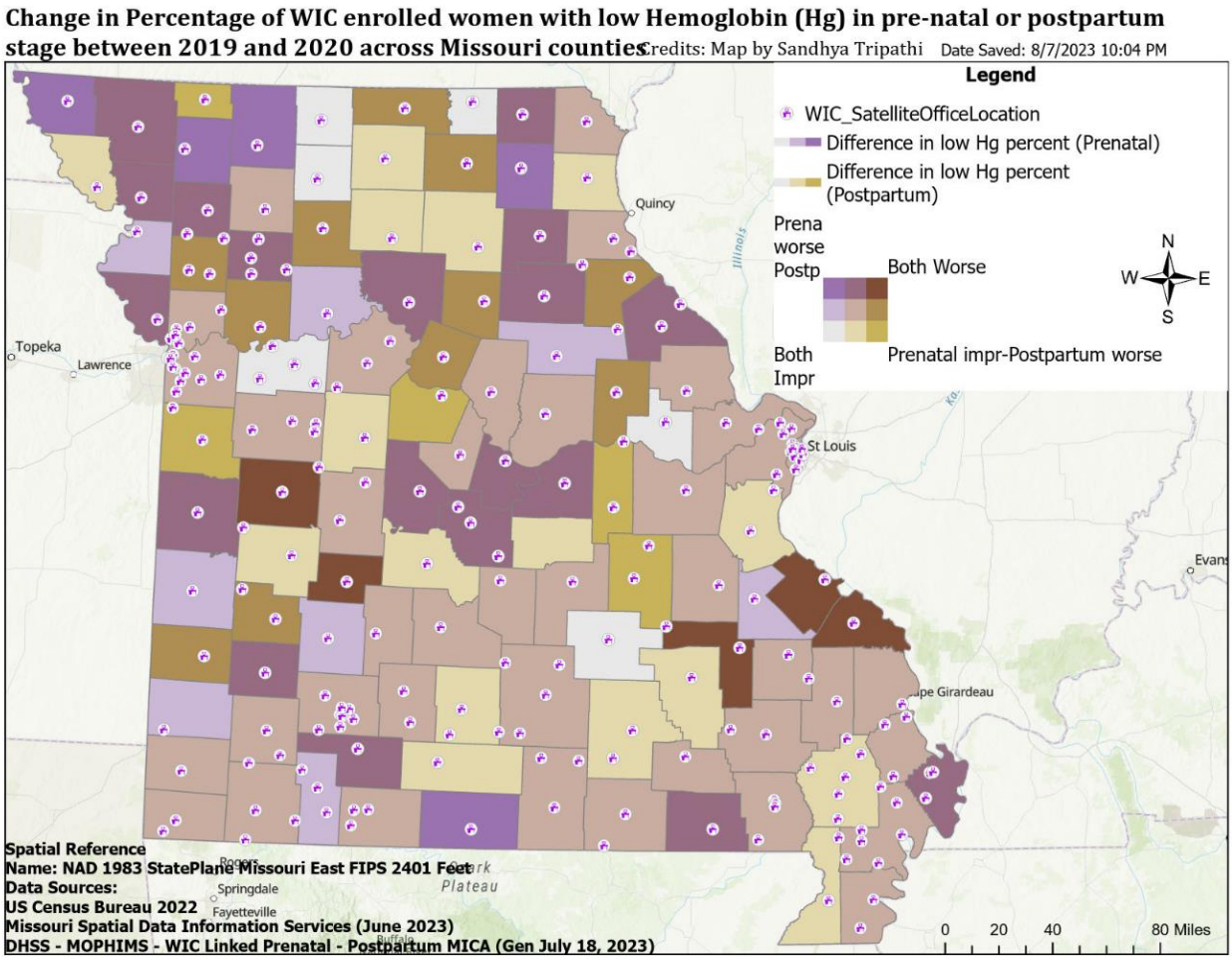
Fraction of WIC enrolled women in different Missouri counties that gave live birth in the respective year and had a recorded low hemoglobin at postpartum visit

Credits: Map by Sandhya Tripathi
Date Saved: 8/2/2023 12:29 AM



Next, I attempted to present the above information together on one map as shown below. To understand the map, Brown color on the map represent the counties where both the metrics saw worsening in the situation with more fraction of women (both prenatal and postpartum) showing up with low hemoglobin in 2020 as compared to 2019. On the other hand, white or very light regions are the ones where the low hemoglobin fraction decreased in 2020 from 2019 both prenatal and postpartum.

After this, I tried to analyze the poverty, education and these combined Hemoglobin map together. One county to pay attention to here is one of the brown colored counties called Hickory County (second brown colored from the left). This county is on the higher side in terms of below poverty level unemployed females and one of the highest with large only high school educated new moms. The demographics of this county show that around half of its population (8630) is female and the average time to travel to work is 33 minutes which is on the higher side.



Inference and Recommendations

Based on the primary objective analysis, I would recommend two things: First, to open a WIC office in Maines County as there is enough population in need and the travelling time there is high so for women to travel to another location for receiving services is very inconvenient. Second, if resources are available then Ozark County is a good candidate both in terms of population need and alignment with program's mission for opening another WIC office.

For the secondary analysis, I asked the following questions to see if I can come to a concrete conclusion.

Was poverty a hindrance in improvement of low hemoglobin cases?

Comparing the poverty figure and the combined hemoglobin (last) figure, the inverted L brown region which is the Iron County could exhibit this behavior as it belongs to the highest poverty bin.

Was not being able to complete education a hindrance in improvement of low hemoglobin cases?

Comparing the education figure and the combined hemoglobin (last) figure, the last second brown colored region from the left (Hickory County) could exhibit this behavior.

Is there any county which needs specific attention in terms of all three measures?

Possibly, Hickory County as it has high poverty and low education. Even though there already exists a WIC center, it might be understaffed due to large travel times.

Since these numbers for a lot of counties are small and the rates are not significant so making any comment in terms of solid recommendation would not be statistically correct.

Challenges

Ideally, I would like to see the impact of the WIC program by directly observing the pregnancy outcomes in women who are enrolled for WIC. However, unlike some other states Missouri doesn't share the detailed data about WIC enrollment in the state to the federal government so the WIC enrollments shown in this project are based on the community surveys and hence cannot be tracked as in a clinical study. This also makes them prone to statistical errors. It would have been interesting to see if the low prenatal hemoglobin changed to high at the time of postpartum due to the services/benefits provided by WIC. However, the available data is just a sample so I'm not sure if for a fixed year this inference can be made. Hemoglobin data for the same group of women both prenatal and postpartum would make the direct comparison possible and see the direct impact of WIC resources.

Currently, the poverty data shown is among all unemployed women. The estimates and the analysis would be more accurate, if we would have had access to this data only for women who gave birth in that particular year.

As a next step, one can explore the relation between the WIC office location and the public-school location in a county as these WIC offices also serve kids under the age of 6. This will be in the context of the information that WIC supported kids are ready for school early.

[1] https://www.cbpp.org/research/food-assistance/eligible-low-income-children-missing-out-on-crucial-wic-benefits-during