Determining At-Risk Groups to Reduce Teen Birth Rate in Baltimore City, MD

Main Pitch/Summary/Abstract

Teen pregnancies carry extra risks to both the mother and the baby. There are also societal, economic, and generational consequences to teen births. Baltimore city has a teen birth rate twice as high as the state of Maryland and the national average. This project uses linear regression and cluster analysis to explore the racial and economic factors contributing to teen birth rate in Baltimore, hopefully giving an insight into how initiatives can be improved to reduce the rate.

Cluster analysis groups show that teen birth rate occurs in areas with higher minorities and lower income. Linear regression also shows that racial factors can contribute greatly to teenage birth rate. After the data analysis, we believe that current initiatives that include education, prevention, and follow-up need to be more targeted to neighborhoods where Hispanic, AIAN and NHOPI residence rate is higher.

Further studies on additional factors that contribute to teen birth rate and how to improve the education, prevention, and follow-up cautions on teenage pregnancy are needed to solve the identified problem at several measures such as campaigns and community resources can be more precisely targeted at high-risk groups.

Problem Statement & Stakeholders

According to the Baltimore City Health Department, Baltimore City has an average teen birth rate of 43.4 out of 1,000 teenage females (ages 15-19). This rate is about twice as high as the national average (26.5 out of 1,000). Although this rate has been steadily declining over the past decade, there is more that can and should be done.

Teen birth is a serious social and economic problem. According to one study, teen pregnancies and births are a significant contributor to dropping out of school. Females who dropout of school face social stigma, fewer job opportunities, lower salaries, and a higher probability of criminal activity. There is also a social ripple effect. Like their mothers, children of teen births are more likely to achieve lower education, be incarcerated, experience teen pregnancy, and have difficulty finding employment. Due to the socioeconomic status of their teen mother, they are also more likely to have health problems.

This is an urgent problem that needs to be addressed as soon as possible because of the significant short- and long-term consequences. If teen pregnancy is not addressed, Baltimore City could be looking at generations of families impacted by the aforementioned social repercussions. These effects impact teen families and the larger community's functionality, efficiency, and productivity.

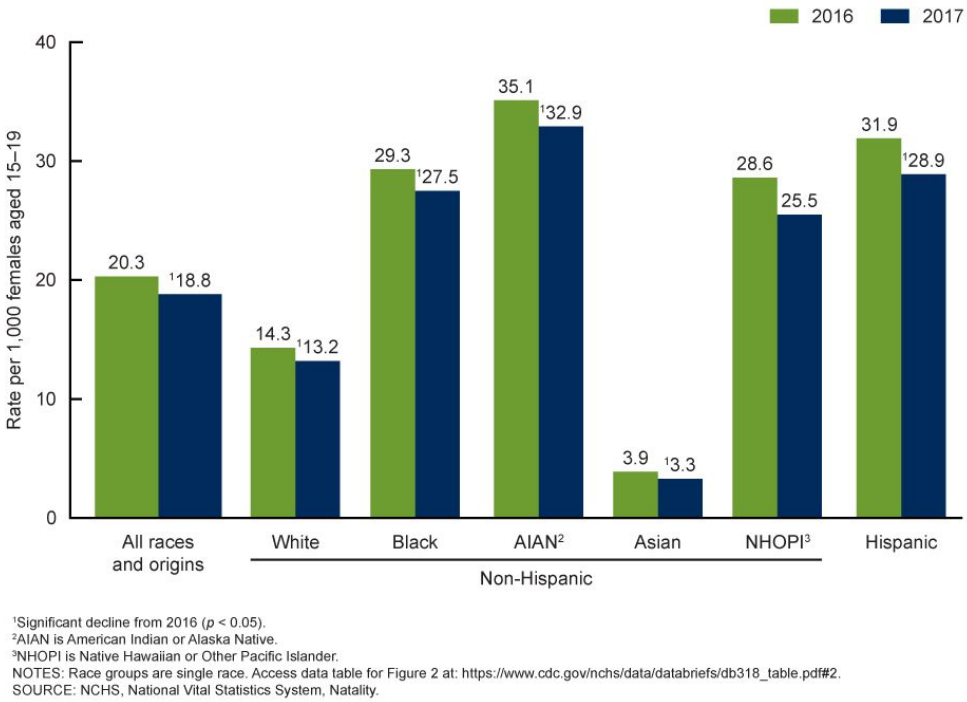

Figure 1. Birth rates for females aged 15-19, by race and Hispanic origin of mother: United States, 2016 and 2017

Several articles and studies found that Latinas have one of the highest teen pregnancy rates in the United States. The bar chart shown above is from data analysis conducted by the Centers for Disease Control (CDC, Figure 1). Due to their high teen pregnancy rates, Hispanic females also have one of the highest teen birth rates in the United States. Black, American Indian/Alaska Native (AIAN), and Native Hawaiian/Other Pacific Islander (NHOPI) also have very high teen birth rates that exceed the rate of all races and origins. Another study found that socioeconomic conditions, such as living under the poverty line, could contribute to high teen birth rates.

Baltimore City has more people living under the poverty line (21.8%) than the national average (13.1%), with the largest demographic group living in poverty being females. Baltimore City is also largely made up of racial minorities. Since prior research on teen birth rates was generally focused on analyzing general or African American populations, we wanted to focus our data analysis on low income, Hispanic, AIAN, and NHOPI populations to see if the aforementioned national trends persist in Baltimore City. We wanted to see if racial

demographics and socioeconomic status could contribute to the teen birth rate in Baltimore City to answer our business question: How can the Baltimore City Health Department reduce teen birth rates in Baltimore City? How can we identify and target at-risk groups for teen birth?

Current Initiatives

Teen Pregnancy Prevention Initiative (TPPI)

This is a program that was originally launched by the Department of Health and Human Services (HHS) in 2010 to reduce teen birth rates across the nation. This is an evidence-based program used in cities across the nation that has been shown to be effective in reducing teen birth rates.

As part of the B'more for Healthy Babies programs, Baltimore City has instituted the Teen Pregnancy Prevention Initiative (TPPI) to reduce teen births. TPPI has four key strategies: a Teen Pregnancy Prevention Task Force, Provider Engagement and Outreach, Youth Advisory Council, and a Social Marketing Campaign.

Healthy Teens and Young Adults Clinic (HTYA)

This clinic in Baltimore, MD provides reproductive health, family planning, health education, and mental health services to individuals 10-24 years of age.

Data Findings and Interpretations

Data Source

Vital Signs Open Data: This is a collection of publically available data on Baltimore City neighborhoods to paint a picture of each neighborhood's quality of life and overall health. It includes information and datasets on census demographics, housing and community development, children and family health, crime and safety, workforce and economic development, arts and culture, education and youth, and sustainability. Data from 2015-2018 were used in this project.

1. Teen Birth Rate per 1,000 Females (aged 15-19) - This dataset shows the rate of female teens aged 15-19 that gave birth per 1,000 females aged 15-19 in each Baltimore City neighborhood.
2. Percent of Family Households Living Below the Poverty Line - This dataset shows the percentage of households living below the poverty line in each Baltimore City neighborhood.
3. Percent of Residents - All Other Races (Hawaiian/ Pacific Islander, Alaskan/ Native American Other Race) (Non-Hispanic) - This dataset shows the percentage of residents who identify their ethnicity as Hawaiian/Pacific Islander or Alaskan/Native American in each Baltimore City neighborhood.

4. Percent of Residents - Hispanic - This dataset shows the percentage of residents who identify their ethnicity as Hispanic in each Baltimore City neighborhood.

Initial Findings

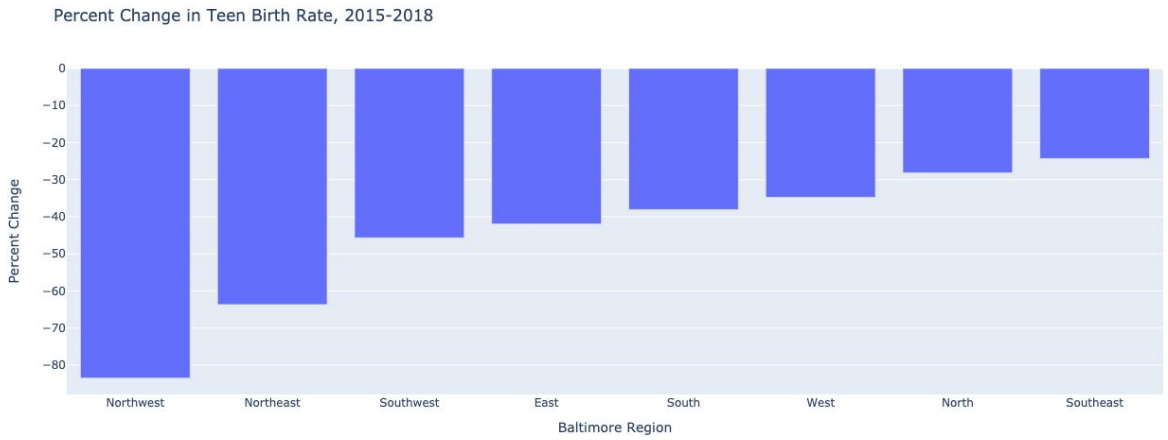

Figure 2. Percent Change in Teen Birth Rate, 2015-2018

The figure above reinforces our background research for our problem statement. In the past four years, teen birth rate has been declining in every region of Baltimore City. Notably, the Northwest region of Baltimore City experienced a 83.5% decline in teen birth rates over 2015-2018. However, this bar chart also shows the dichotomy of percent change between the regions. Not every region was as successful as the Northwest region in reducing teen birth rate. For example, the Southeast region experienced the least percent change decline in those years. Although teen birth rates have been declining due to the initiatives in place, there is room for improvement.

Linear Regression

	Teen Birth Rate	*% Living Under the Poverty Line*
Teen Birth Rate	1	
hhpov17	0.355132004	1
	Teen Birth Rate	*% AIAN or NHOPI*
Teen Birth Rate	1	
% AIAN or NHOPI	0.378397488	1
	Teen Birth Rate	*% Hispanic*
Teen Birth Rate	1	
% Hispanic	0.501578192	1

Figure 4. Correlation coefficient calculations

The equation indicated by the linear regression analysis summary is:

$$Teen\ Birth\ Rate = 2.71753139 + 0.62017753(\%\ Living\ Under\ the\ Poverty\ Line) + 7.63375962(\%\ AIAN\ or\ NHOPI) + 1.1805099(\%\ Hispanic)$$

This suggests that as the percentage of families living under the poverty line, percentage of AIAN or NHOPI populations, and percentage of Hispanic population increase, so does teen birth rate. In the figure above, you can easily see that all three factors are positively correlated with teen birth rate (Figure 4). The percentage of Hispanic population has an especially high correlation coefficient, which indicates that it is doing a better job of explaining the outcome and has a greater effect on teen birth rate compared to the other two factors.

Coefficient	p-value
% Living Under the Poverty Line	0.00023268
% AIAN or NHOPI	0.00221137
% Hispanic	0.00011135

Table 1. p-values associated with each coefficient

The R-squared value is 0.4854415, which means that about 48.5% of the data can be predicted with the model. The regression model also had a low F-significance value of 1.7994E-07, which indicates that these factors matter for the end model. All factors also have p-values of less than 0.05, which means that they are significant in predicting the outcome (Table 1).

Cluster Analysis - Qiutong

anchor	number	county	z_tbr	z_hhpov	z_phisp	z_ppac
1	24	Greenmount East	-0.0080212	0.55156254	-0.527552	-0.5415792
2	40	Northwood	-1.0289203	-0.9825999	-0.2012251	-0.1068572
3	4	Brooklyn/Curtis Bay/Hawkins	2.46085581	0.55269448	1.46928927	0.88212767

Figure 5. Cluster analysis on four variables

This suggests that each of the three different cluster groups anchored as 1, 2, and 3 are represented by Greenmount East, Northwood, Brooklyn/Curtis Bay/Hawkins, respectively. Group 1 has a slightly lower than average teen birth rate, a much higher than average percent of families living below the poverty line, a much lower percent of Hispanic or AIAN/NHOPI minority residence rate. Group 2 has a lower than average teen birth rate, extremely less than average percentage of families below poverty line rate, and a less than average percentage of Hispanic or AIAN/NHOPI populations. Group 3 has an extremely high teen birth rate, a high percentage of families living below the poverty line, and a higher than average percentage of

Hispanic and AIAN & NHOPI minorities. Group 1 is the largest cluster, followed by groups 2 and 3, respectively (Figure 6). The table below shows the breakdown of each group into Baltimore neighborhoods (Table 2).

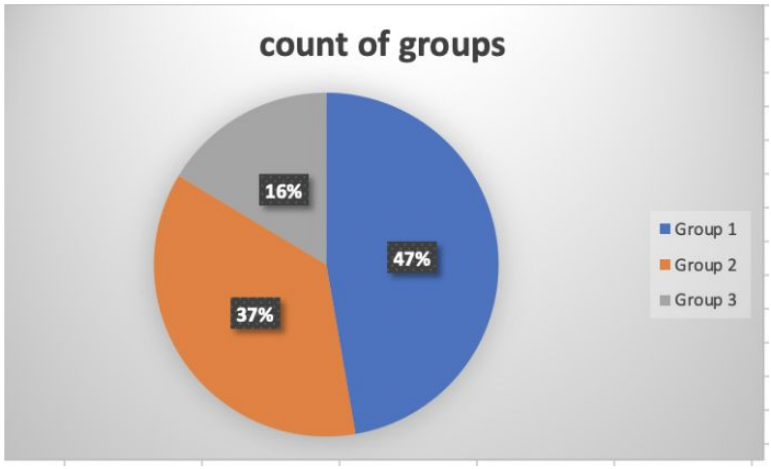

Figure 6. Ratio of clusters

Group & Feature	Counties
Group 1: low teen birth rate, high % of families living below the poverty line, low % of Hisp & AIAN/NHOPI	Allendale/Irvington/S. Hilton Belair-Edison Cedonia/Frankford Cherry Hill Clifton-Berea Dorchester/Ashburton Forest Park/Walbrook Glen-Fallstaff Greater Govans Greater Mondawmin Greater Rosemont Greenmount East Harbor East/Little Italy Howard Park/West Arlington Midway/Coldstream Oldtown/Middle East Patterson Park North & East Penn North/Reservoir Hill Pimlico/Arlington/Hilltop Poppleton/The Terraces/Hollins Market Sandtown-Winchester/Harlem Park Southern Park Heights Southwest Baltimore Upton/Druid Heights Washington Village/Pigtown

	Westport/Mount Winans/Lakeland
Group 2: very low teen birth rate, very low % of families living below the poverty line, low % of Hisp & AIAN/NHOPI	Beechfield/Ten Hills/West Hills Canton Chinquapin Park/Belvedere Cross-Country/Cheswolde Dickeyville/Franklintown Edmondson Village Fells Point Greater Charles Village/Barclay Greater Roland Park/Poplar Hill Hamilton Harford/Echodale Inner Harbor/Federal Hill Lauraville Loch Raven Medfield/Hampden/Woodberry/Remington Midtown Mount Washington/Coldspring North Baltimore/Guilford/Homeland Northwood South Baltimore
Group 3: very high teen birth rate, high % of families living below the poverty line, very high % of Hisp & AIAN/NHOPI	Brooklyn/Curtis Bay/Hawkins Point Claremont/Armistead Downtown/Seton Hill Highlandtown Madison/East End Morrell Park/Violetville Orangeville/East Highlandtown Southeastern The Waverlies

Table 2. Counties in 3 cluster groups

Concrete Recommendations and Impact for Baltimore City/Department

Key Takeaways

The linear regression suggests a significant positive relationship between the factors and teen birth rate. The correlation coefficient calculations indicate that Hispanic, AIAN, and NHOPI ethnicities and low income are positively correlated with the outcome. This means that Baltimore City should focus their initiatives on reducing teen birth rates among minority populations

(specifically Hispanic, AIAN, and NHOPI) and low income families. Baltimore City should also focus their efforts in regions that have seen a smaller reduction in teen birth rates, such as the Southeast, North, and West Baltimore regions.

The results of the cluster analysis shows that 84% of the neighborhoods in Baltimore have below average teen birth rates. Among the 84%, 37% (Group 2) have significantly more than average families above poverty lines and significantly less teenage birth rate. Groups 1 and 2 share relatively similar (lower than average) teen birth rates and prevalence of Hispanic, AIAN, and NHOPI populations, although they differ when looking at the percentage of families living under the poverty line. Group 1 has a higher than average percentage of families living under the poverty line, while group 2 has a lower than average percentage. On the other hand, Group 3 has a similar higher than average percentage of families living under poverty rate to Group 1, but this does not stop them from having extremely higher than average teenage birth rates. They are also the only group having significantly more Hispanic and non-Hispanic/Black residency than the average.

This leads to the conclusion that, in Baltimore, even though the teenage birth may not geographically coincide with low income, teenage birth rates occur more with racially-determined factors.

Improving Baltimore City's Teen Pregnancy Prevention Initiative (TPPI)

We believe that the best way to address the issue of teen births in Baltimore is to build on the already existing initiative. Government employees and the Baltimore community are already familiar with this initiative, so it would not make sense to create a new one. Based on our analysis, we recommend improving TPPI in the following ways:

- Targeted initiatives: focus more on minority races (especially Hispanic, AIAN, and NHOPI females) and low income populations
- Offer education for parents of at-risk teens to talk about safe sex, contraception, and pregnancy planning
- Train Teen Pregnancy Prevention Task Force how to deal with at-risk groups
- Offer sex education and pregnancy information in ethnic minority native languages
- Expand the social marketing campaign

At the moment, TPPI's strategy addresses the general population and does not really focus on specific at-risk populations aside from foster care youths. Since Hispanic, AIAN, NHOPI, and low income were significant factors in the outcome, with Hispanic race being the highest correlated with teen birth rate, we believe that TPPI should target these at-risk groups.

As mentioned in the problem statement, a child of a teen parent often experiences teen pregnancies themselves. Since our analysis points to Hispanic, AIAN, NHOPI, and low income populations as significant at-risk groups, we recommend providing education for parents within these groups. This education will teach parents how to communicate with their child(ren) about

safe sex, contraception, and pregnancy planning. This way, parents will get accurate, important information on this topic.

Research has shown that focusing initiatives on at-risk populations allows for better and more effective results. By targeting the at-risk populations explored in this analysis, Baltimore City would be able to decrease the teen birth rate more quickly and efficiently.

Another way to improve TPPI is to train task force members about how to deal and connect with at-risk groups. This way, the Baltimore community would get better and more accurate support.

Along the same line, we also recommend diversifying TPPI's social marketing campaign. We would recommend expanding the campaign to target the at-risk groups discussed in this analysis. For example, if AIAN individuals are more likely to join certain FaceBook groups, TPPI could partner with those groups to increase awareness on information about sexual health and teen pregnancy and births. TPPI should also consider expanding their campaign onto e-health and m-health platforms to increase exposure. 75% of consumers believe that technology is essential to managing health, and 48% of healthcare consumers are using m-health apps. These numbers continue to rise year-by-year. Additionally, TPPI should campaign in multiple languages to increase comprehension and awareness in ethnic minority communities.

From 2010 to 2015, CDC's federal Office of Adolescent Health evaluated the effectiveness of interventions that focus on at-risk groups like the ones discussed in this analysis. These interventions increased awareness about community factors that are positively linked to teen birth rates and offered culturally and linguistically tailored educational programs. This program is very similar to the changes we recommend for TPPI. Their subsequent study confirmed the effectiveness of their approach.

Our recommendations can be implemented relatively quickly at a low cost. Diversifying the task force, council, and social marketing campaign can be done by implementing more diverse hiring and recruiting practices and providing training to members so they are more equipped to deal with at-risk groups. Training should take up to three months and would cost up to $2,000 per employee. Therefore, we expect to be able to start implementing these initiatives in Q2 of 2021. This is a very cost-effective method of improving the program because of the social and economic implications of reducing teen birth rates.

To evaluate the efficacy of our recommendation, annual data analysis should be conducted to look at the teen birth rate in each of the at-risk groups. Based on our analysis, we predict that the teen birth rate will decrease, which will benefit Baltimore City's social and economic standing in the future. This will also help to reduce the generational pattern of teen birth and its consequences in at-risk groups.

Improving Healthy Teens & Young Adults Clinic Accessibility (HTYA)

After doing further research into this program, we believe that it could be improved with the following strategies:

- Inform more teens seeking for help online/in community about Healthy Teens & Young Adults Clinic
- Targeting at-risk groups: inform about services provided and cost charged
- Provide quotes: be more open and clear about pricing policy and the insurance coverage
- Provide a finder/list of locations of clinics

Our primary two strategies are to increase campaigns and decrease barriers to utilize. This program is open to the general public, but, like TPPI, it could be improved by disseminating information specifically to low income, Hispanic, and AIAN/NHOPI populations. This could be easily done through brochures, Instagram feeds, or physical advertisements (i.e. advertisements on public transportation). Online and offline community campaigns can help more teens know about the help they could get.

The program's pricing and insurance policy can also be clearer and more open with a quote calculator, which could reduce the economic barriers for at-risk groups seeking help. It is also a good idea to add a map or finder for Healthy Teens & Young Adults clinics to allow individuals to easily find the nearest clinic and make appointments. This would improve access to the clinic. HTYA should also include prior patient testimonials on their website. This would not only decrease the stigma about talking about teen pregnancy, but also help at-risk groups find a community of people sharing the same experience that could possibly support them.

This recommendation is also an economically feasible one. Social media advertisements, for example, are $3,350 per 500,000 views. Redesigning the website to be more open, accessible, and receptive would cost $3,000. All of these recommendations could begin to be implemented in Q1 of 2021. Like our TPPI recommendations, this is a very cost-effective method of improving the program because of the social and economic implications of reducing teen birth rates.

Future Research

The discrepancy in findings regarding income between the linear regression analysis and cluster analysis should be explored further. Linear regression found income to be significant factor when predicting teen birth rate, while the cluster analysis found that in some areas with higher than average percentage of individuals living below the poverty line, teen birth rate was lower than the average.

In addition, about 48.5% of the data can be predicted with the linear regression model, which means that about 51.5% of the data can be predicted with other factors not included in this analysis. Further analysis could consider looking at whether the teen is living in a single or dual parent household, level of communication between the teen and parents/guardians, amount of available and accurate sexual and reproductive health information in the community, average age of puberty, and average age of first relationship or sexual encounter.

Appendix

Initial Findings

- Step-by-step creation of the visualization: Google Collaboratory

Step-by-Step Excel Analysis

Linear Regression

1. Dataset was downloaded from Google Collaboratory (linked above)
2. Regression function of the Data Analysis tool was used to summarize the output of the simple linear regression with outcome (y input) being "teenbir17" and factors (x input) being "hhpov17", "ppac17", and "phisp17"
3. Correlation function of the Data Analysis tool was used to calculate correlation coefficients between the outcome and each of the factors

Cluster Analysis

1. Dataset cleaned and downloaded from Google Collaboratory
2. Cluster analysis from Solver tool was used to group data into three clusters based on "teenbir17", "hhpov17", "ppac17", and "phisp17"
3. Sort data by anchor number to find counties that belonged to each group
4. Use "COUNTIF" to count the numbers of each group and graph into a pie graph