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An Assessment of Infant Mortality Rates in Jamaica, 2002-2021

Paul Andrew Bourne[1], Subrina South[2], Sannekia Ellis[2], Donae Hansle[2], Pheonie Lewis[2], Kenneva Smalling[2], James Fallah[3], Calvin Campbell[4], Clifton Foster[5], Caroline McLean[2], Tabitha Muchee[6]

[1]Department of Institutional Research, Northern Caribbean University, Mandeville, Manchester, Jamaica, WI.
[2]Department of Nursing, Northern Caribbean University, Mandeville, Manchester, Jamaica, WI.
[3]Department of Dental Hygiene, Northern Caribbean University, Mandeville, Manchester, Jamaica, WI.
[4]Department of Mathematics and Engineering, Northern Caribbean University, Mandeville, Manchester, Jamaica, WI.
[5]Department of Biology, Chemistry, and Environmental Sciences, Northern Caribbean University, Mandeville, Manchester, Jamaica, WI.
[6]Department of Nutrition and Dietetics, Northern Caribbean University, Mandeville, Manchester, Jamaica, WI.

Abstract

Introduction: We live in a society that is affected by the inevitable, infant mortality. According to the World Health Organization (WHO), the infant mortality rate is defined as the probability of a child born in a specific year or period dying before reaching the age of one, if subject to age-specific mortality rates of that period.

Objective: The objectives of this study are: 1) To evaluate the trend of the infant mortality rates in Jamaica for the last 20 years, and 2) To find out the reason for either decline or increase of mortality rates of infants in Jamaica for the last 20 years.

Methods and Material: Time-series data were used for this study. Said data was collected, retrieved, transferred and analyzed using the IBM Statistical Package for the Social Sciences (SPSS) with the use of tables consisting of frequencies, per cent, descriptive statistics, and confidence interval. Additionally, the use of the Macrotrends website was helpful as it collects data from various countries concerning economy, health, education, growth rate, density, environment and others just to name a few.

Findings: The descriptive statistics of the incidence of infant mortality for Jamaica for the last 20 years is on average 15.007 per 1000 live birth.

Conclusion: This research provided insight into the infant mortality rate in Jamaica.

Keywords: Infant, Infant Mortality, Death Rate, Population, Economy.

Introduction

The Island of Jamaica covers an area of 10,991 km² and lies around 885 km² south of Miami (United States of America) and 145 km² south of Cuba (PAHO & WHO, 2017a). It is the biggest of the English-speaking Commonwealth Caribbean Islands and the third-biggest island in the district. The island is separated into 14 parishes and there are two significant metropolitan communities: Kingston on the southeast coast and Montego Bay on the northwest coast. The infant mortality rate is common worldwide, and Jamaica is no exception to it. The infant mortality rate is defined as the probability of a child born in a specific year or period dying before reaching the age of one if subject to age-specific mortality rates of that period. The newborn child death rate is the quantity of infant death for every 1,000 live births. As well as giving us key data about maternal and newborn child wellbeing, the infant death rate is a significant marker of the overall health of society (National Center for Chronic Disease Prevention and Health Promotion, 2022).

Infant mortality rates have shown marked improvement over the last seven years, declining from 29.8 deaths per 1,000 live births in 1990 to 23.8 in 1996 (The World Bank, 2022a; PAHO &WHO, 2017a). To register a given year's infant death rate in a specific region, we would have to know the number of infants that were conceived alive nearby during the period and the number of infants that were born alive and died before their first birthday. The number of baby births then divides the quantity of newborn child death, and the outcomes are multiplied by 1,000 so the rate mirrors the quantity of baby death per 1,000 births in a normalized way (WHO, 2022)). The main highlight of this research is the infant mortality rate in Jamaica over 20 years from 2002 to 2021. The causes of infant mortality vary from unfortunate sterilization, poor water quality, malnourishment of the mother and newborn child, lacking pre-birth and clinical consideration, and utilization of infant formula as a breast milk substitute. The research will be carried out by using credible websites and articles that show statistical data.

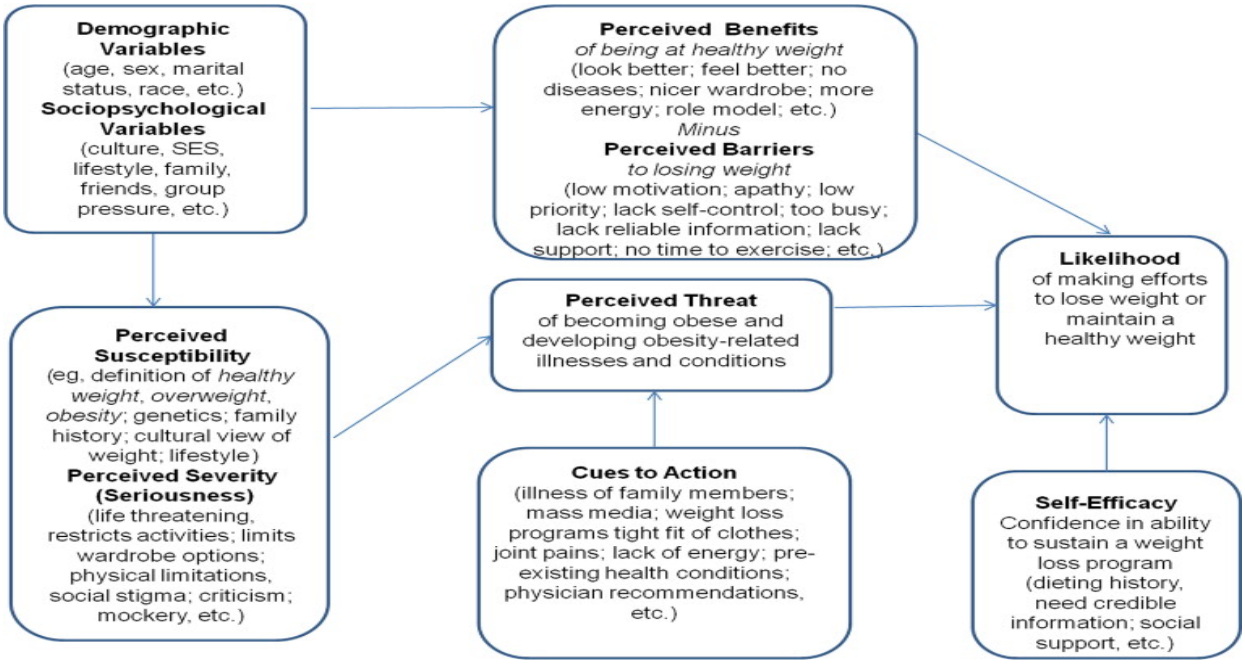
To help resolve the infant mortality rate, below is vaccination coverage for 2018: From birth to 11 months: 93% of children received the BCG Vaccine; 98% received the third dose of the Polio Vaccine; 97% received the third dose of the Diphtheria Pertussis Tetanus (DPT) Vaccine; 97% received the Hepatitis B Vaccine; 98% received the Haemophilusinfluenzae Type B Vaccine. For children 12 to 23 months: 89% received the first Measles, Mumps and Rubella (MMR) vaccine and 82% received the second dose of MMR (Aaby*et al*., 2004; PAHO & Who, 2015; WHO, ud, 2022). The findings of the study also highlight the infant mortality rate in Jamaica, from 2002 – 2021.

Theoretical Framework

The Health Belief Model is a theoretical model that is used to assist persons to increase control over their health. It is also necessary for improving health and preventing diseases. It is used to explain and predict individual changes in health behaviours. It is one of the most widely used models for understanding health behaviours (Glanz*et al*., 2019; Jones, *et al*., 2015; LaMorte, 2019; Rural Health Information Hub, 2018; Sulat, *et al*., 2018). The Health Belief Model came about in the 1950s due to the works of U.S. public health researchers and social psychologists

Godfrey Hochbaum, Stephen Kegels, Howard Leventhal, Irwin Rosenstock et al (LaMorte, 2019; Rosenstock, 1974; Rosenstock, *et al*., 1994).). Their reason for establishing the Health Belief Model was to explain the failure of people participating in programs to prevent and detect disease. Over time, others to study people's behavioural responses to health-related conditions (Glanz et al., 2019) have improved the model.

As seen in Figure 1 below, the Health Belief Model has several constructs that are used to predict why people engage in prevention, screening, and/or controlling health conditions.Demographic and socio-psychological variables (Figure 1) such as age, sex, race, culture, lifestyle, etc., influence how a person responds to their health. Perceived Susceptibility (Figure 1) is an individual's perceived threat to sickness or disease. Perceived Severity (Figure 1) is the belief about the seriousness of the condition or leaving it untreated and its consequences. Perceived Benefits (Figure 1) are the individual's belief about the potential positive aspects of health action. Perceived Barriers (Figure 1) are the belief about the potential negative aspects of particular health action. Cues to Action (Figure 1) are factors, which trigger a person to want to be more proactive about their health and wellness such as seeing a family member, suffer from lung cancer. Self-Efficacy (Figure 1) is the belief that one can achieve the behaviour required to execute the outcome (Glanz et al., 2019; Rural Health Information Hub, 2018). The health belief model, therefore, is used to examine peoples' decisions to have children in Jamaica.



Source: Rosenstock (2000)

Figure 1: shows the Health Belief Model

Literature Review

The main purpose of this study is to carry out analytic procedures on the trend of infant mortality rates in Jamaica. This study examined how the various procedures that have been put in place are working to decrease the infant mortality rates in Jamaica for the years 2002 to 2021. According to the Center for Disease Control and Prevention (CDC), Infant Mortality is described as the death of a person who has yet to reach the age of one (1) year old. It is statistically the number of

infant deaths in every 1000 live births. In general, the CDC highlights the following as some of the major causes: “Sudden infant death syndrome, Birth defects, Injuries, Preterm birth and low birth weight, and maternal pregnancy complications.” (National Center for Chronic Disease Prevention and Health Promotion, 2022))

Most internet sites such as the World Health Organization (WHO) highlight how these rates can bring attention to the issues faced in society. These aspects include the economic conditions of the society, their access to health care and information, as well as the social lives of the people in the society. Collecting the data on these rates has proven quite effective in identifying those who are most vulnerable in society (World Health Organization (WHO), 2022)

Studieshave shown that child death has decreased by more than half from 11.8 million in 1990 to about 5.4 million by the year 2017 (Roser*et al*., 2013; The World Bank, 2018). This is because the causes of death vary in infants than in older children. Measures such as vaccination and secondary treatment have been effective in improving child mortality rates. In the case of infants, however, these measures cannot rectify the problem. The deaths in infants are mostly due to pre- and post-natal complications. There is an increase in advocating for better maternal care, safer delivery practices and treatment and detection measures for infants (Roser, Ritchie, &Dadonaite, 2019).Much more emphasis needs to be placed on carrying out the measures implemented to prevent infant mortality rates; for example, upholding vaccination coverage (BCG, OPV/IPV, Pentavalent and MMR) for infants.

In 2013, the Programme for the Reduction of Maternal and Child Mortality (PROMAC) was launched in Jamaica (PAHO & Who, 2017b). The slogan for PROMAC was ‘Protecting Mother and Child-Securing the Future’. Some of the main components of this programme are caring for the newborns as well as emergency care for the mothers, special training for the health care workers and creating quality primary health care services to name a few (*Ministry of Health and Wellness, 2022*). Based on the downward trend of infant mortality rates in Jamaica, it is evident that this programme had some effect. However, if there is to be a much greater decline in the numbers, more emphasis needs to be placed on ensuring that these measures are upheld, and improvements are made where necessary. .

In Gleaner (2018), the article "Infant Mortality Benchmark of Progress and Prosperity” highlighted the reduction in the rate of decline in infant mortality.This was attributed to the fact that Jamaica struggles in many other areas, most economically and as such, the possibility of investing in the areas that can assist with the decrease in the infant mortality rates has become low. The writer of the article made quite an interesting point that much more attention needs to be placed on how those who are dependent on others in society are treated, as the country would not be able to handle the repercussions. (Gleaner, 2018).

In September 1997, the Expanded Programme on Immunization (EPI) was launched to allow Jamaican children to have a "disease-free childhood". According to Public Health Act, children up to one (1) year old must be sufficiently vaccinated against the various diseases that can cause life-threatening complications. At birth, children are required to get vaccinated against Tuberculosis (BCG). At six (6) weeks the first Injectable Polio Vaccine (IPV) is given, also the

first Diphtheria, Pertussis and Tetanus (DPT), and Hepatitis B/Haemophilus influenza type B (HIB). At three (3) and six (6) months, they are required to get boosters of the vaccines received at six (6) weeks and twelve (12) months they are administered their first Measles, Mumps and Rubella (MMR) vaccine. Continuing into childhood they are required to get booster shots for these vaccines. Due to the implementation of this programme these life-threatening diseases have almost been completely eradicated. (Russell, 2012).

There are quite a few ways to lessen Infant mortality rates. Birth defects, which are currently one of the leading causes of infant deaths, can be prevented by ensuring that the mother receives adequate nutrition such as taking folic acid. The health of the mother during pregnancy is a key component of how the infant will be affected. If a mother is in a safe environment, is healthy, not participating in substance abuse and receiving adequate prenatal care, many of the risk factors for infant death can be greatly lessened.

Methods & Materials

This study employed time series secondary data taken from The World Bank (2022b) and Macrotrends LLC (2022). The data were on infant mortality ratesfor Jamaica for a-20 period, 2002 to 2021. In addition, data were from the Trading Economics'(2022) website on BCG immunization for infants in Jamaica for the previously mentioned time. Data collected from these websites, online books and articles were transferred to the IBM Statistical Package for the Social Sciences (SPSS), where it was analyzed using tables consisting of frequencies, per cent, descriptive statistics, confidence interval and graphs.

Research Findings

Table 1 presents the infant mortality rate in Jamaica over 20 years (2002-2021). The table shows a steady decline in the infant mortality rate since 2002. The infant mortality rate for Jamaica in 2021 was 11.112 deaths per 1000 live births, a 1.96% decline from 2020 (Table 3). The infant mortality rate for Jamaica in 2020 was 11.334 deaths per 1000 live births, a 1.92% decline from 2019 (Table 3). This means that advancements in science and research have resulted in fewer of our Jamaican children under 1-year-old dying throughout these 20 years (2002-2021).

Table 1: Prevalence of Infant Mortality Rate (IMR) per 1000 live births from 2002-2021

Year	Infant Mortality Rate (IMR)per 1000 live birth
2002	18.516
2003	18.030
2004	17.764
2005	17.499
2006	17.233
2007	16.968
2008	16.702
2009	16.349
2010	15.996
2011	15.644

2012	15.291
2013	14.938
2014	14.306
2015	13.674
2016	13.042
2017	12.410
2018	11.778
2019	11.556
2020	11.334
2021	11.112

Table 2 presents the descriptive statistics of the incidence of infant mortality in Jamaica. The incidence of infant mortality for the last 20 years (2002-2021) is on average 15.007, with skewness of -0.306. Based on the skewness, the distribution is relatively symmetrical and as such the average can be represented by the mean (15.007±2.45). The coefficient of variation (standard deviation/mean * 100) was 16.33%, which speaks to a relatively good distribution. Also, the values for the mean and median are relatively close, therefore, the mean can be used to describe the centre of the dataset.

Table 2: Descriptive statistics of the Incidence of Infant Mortality

			Statistic	Std. Error
Infant Mortality Rate	Mean		15.00710	.547911
	95% Confidence Interval for Mean	Lower Bound	13.86031	
		Upper Bound	16.15389	
	5% Trimmed Mean		15.02856	
	Median		15.46750	
	Variance		6.004	
	Std. Deviation		2.450331	
	Minimum		11.112	
	Maximum		18.516	
	Range		7.404	
	Interquartile Range		4.599	
	Skewness		-.306	.512
	Kurtosis		-1.315	.992

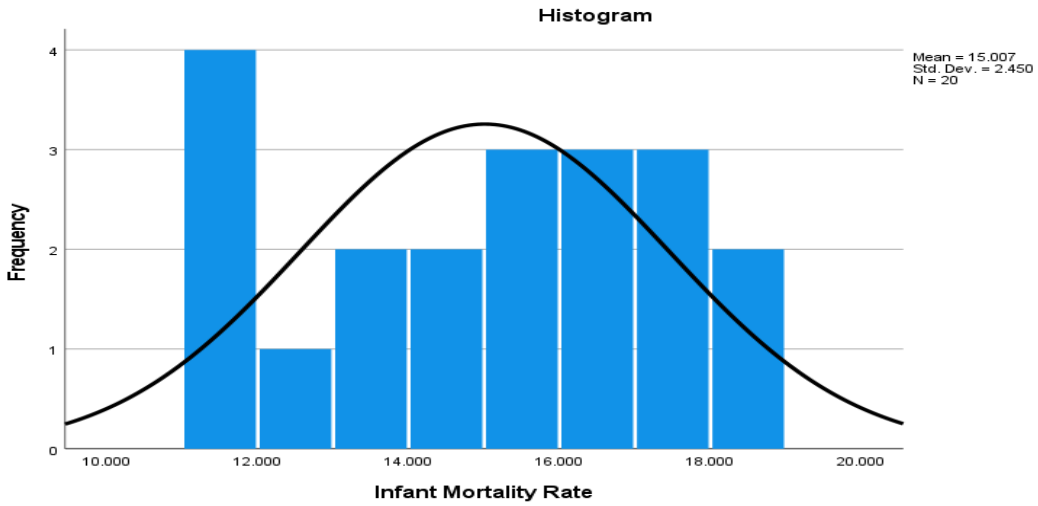


Figure 2: Frequency Distribution Polygon of Incidence of Infant Mortality, 2002-2021

Table 3 presents the incidence of infant mortality in Jamaica in the last 2 decades and the percentage change. The table shows that the number of infant deaths per 1000 live births has been steadily decreasing since 2002. In 2016, the per cent change was -4.62% which is double that of 2013 (-2.31). These decreases are a result of effective measures such as antenatal care, postnatal care, vaccination, etc. The greatest decline was in 2018 (-5.09%). From 2019-2021, however, the declines in the infant mortality rates were not much compared to previous years.

Table 3: Percent change for the Incidence of Infant Mortality, 2002-2021

Year	Infant Mortality Rate	Percentage Change
2002	18.516	
2003	18.030	-2.62
2004	17.764	-1.48
2005	17.499	-1.49
2006	17.233	-1.52
2007	16.968	-1.54
2008	16.702	-1.57
2009	16.349	-2.11
2010	15.996	-2.16
2011	15.644	-2.20
2012	15.291	-2.26
2013	14.938	-2.31
2014	14.306	-4.23
2015	13.674	-4.42
2016	13.042	-4.62
2017	12.410	-4.85
2018	11.778	-5.09
2019	11.556	-1.88
2020	11.334	-1.92
2021	11.112	-1.96

Determining the Incidence of Infant Mortality Function

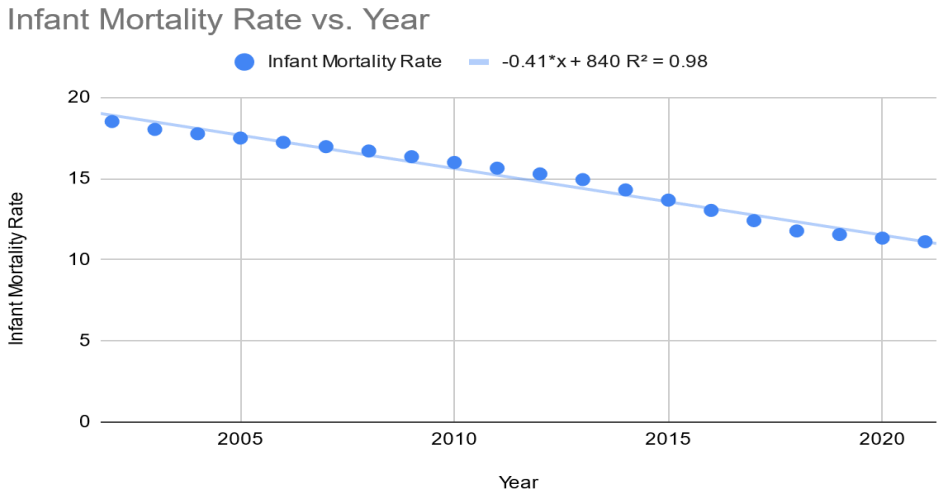


Figure 3: Annual Incidence of Infant Mortality function, linear

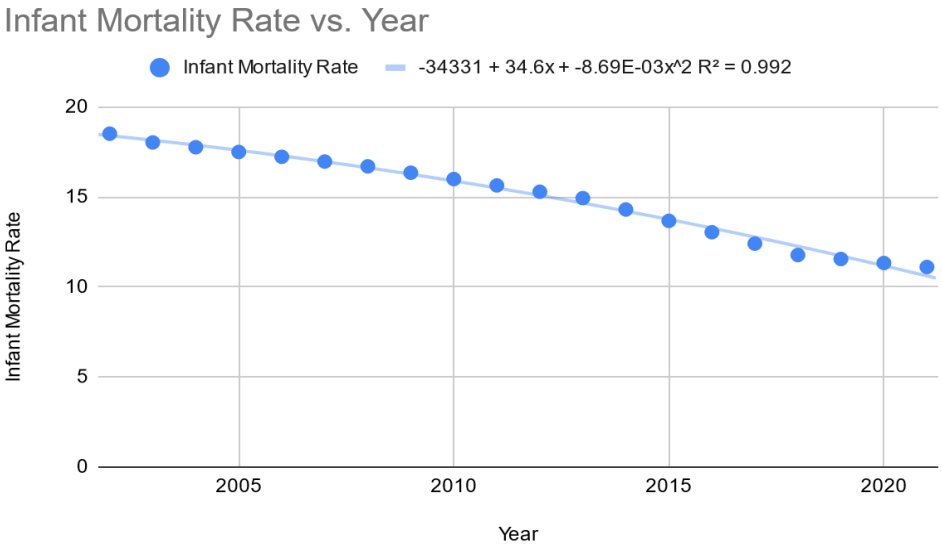


Figure 4: Annual Incidence of Infant Mortality function, 2-degree polynomial

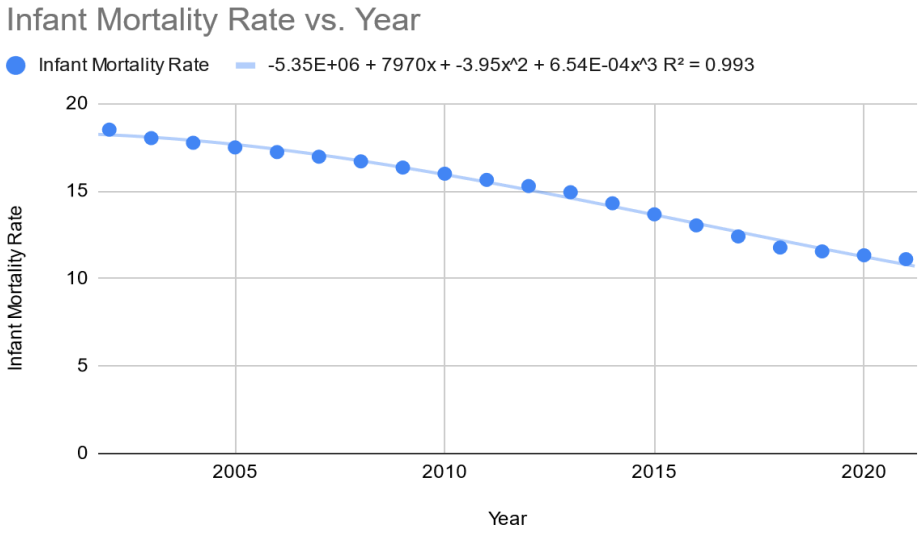


Figure 5: Annual Incidence of Infant Mortality function, 3-degree polynomial

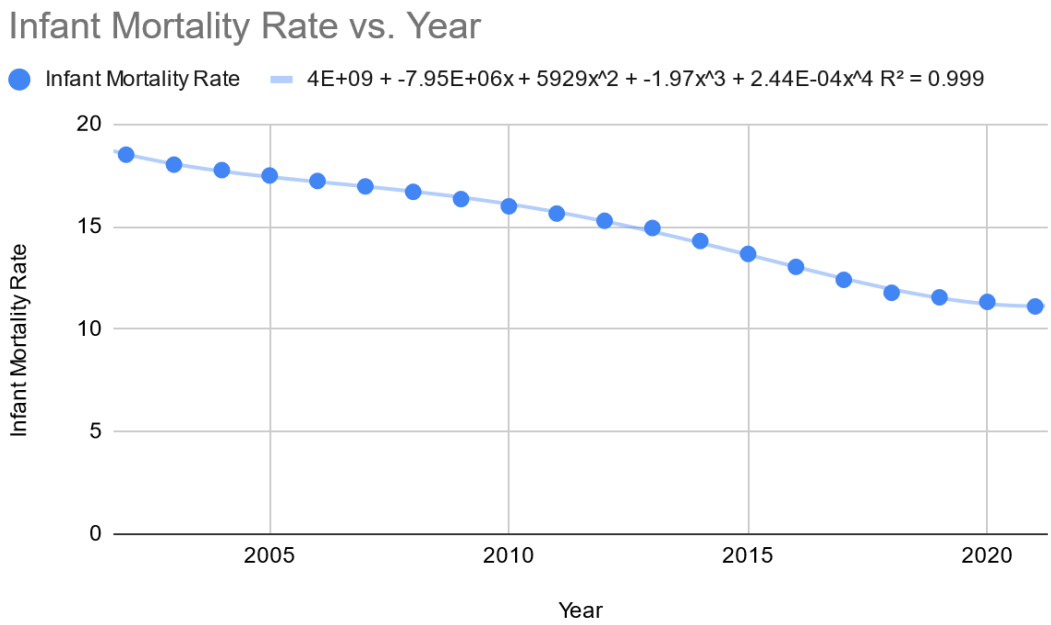


Figure 6: Annual Incidence of Infant Mortality function, 4-degree polynomial

Figures 3-6 depict various scatter points fitted by particular functions. Those functions range from linear to 4-degree polynomials. Using the squared "R values",it can be deduced from the curves that the annual incidence of infant mortality in Jamaica can be best fitted by a 4-degree polynomial (i.e., Figure 6). The 4-degree polynomial accounts for 99.9% of the scatter values compared to the other functions, with a linear function accounting for the least explanation (i.e., 98.0%). The linear, 2-degree and 3-degree polynomials were still very close which means the data points were following a pattern and future patterns can be predicted. The ideal function, 4-degree polynomial, is expressed as an equation, below:

Yi= 0.000244Xi^4 -1.97Xi^3 + 5929X^2 -7,950,000X +4,000,000,000

where Yi represents the incidence of infant mortality for period i, and Xi represents the year.

This information tells us that the annual incidence of infant mortality in Jamaica is, therefore, a quartic function and it is influenced by many factors.

Table 4 presents fluctuations in the percentage of one-year-old children in Jamaica who received the BCG vaccine from 2001- 2020. The table also shows the percentage change over this period. In 2002 over 2001, the percentage of one-year-olds with BCG immunization decreased by 6.25%. This is also the highest decrease over the 2 decades. In 2004 over 2003, it increased to 2.27%. In the following year (2005), the percentages increased by 5.56%. The highest increase in BCG vaccination was seen in 2015 which had a percentage increase of 10%. The years 2011-2012 were at a constant level and so had no percentage change.

Table 4: Per cent change for the Percentage of one-year-old in Jamaica with BCG Immunization, 2001-2020

Year	Percentage of one-year-old with BCG Immunization	Percentage Change
2001	96	-
2002	90	-6.25
2003	88	-2.22
2004	90	2.27
2005	95	5.56
2006	90	-5.26
2007	87	-3.33
2008	92	5.75
2009	94	2.17
2010	95	1.06
2011	95	0.00
2012	95	0.00
2013	93	-2.11
2014	90	-3.23
2015	99	10.00
2016	96	-3.03
2017	93	-3.13
2018	93	0.00
2019	97	4.30
2020	99	2.06

Discussion

The Infant Mortality rate in Jamaica is a major cause for concern. Even though there has been a decrease in the rate, more emphasis needs to be placed on measures to facilitate this decrease in the number of infant deaths per 1000 live births in Jamaica. Though there has been a decrease, based on Table 3, showing the percentage change of infant mortality rates from 2002 to 2021, from the years 2019 to 2021 there has been an almost identical percentage decrease. If you look at Table 1, shows the infant mortality rates in Jamaica from the years 2002 to 2021. The year 2002 had the highest infant mortality rate of 18.516 deaths per 1000 live births in the 20 years. After which the numbers of infant rate steadily decreased until 2018.

In Jamaica, children up to 6 years must get a certain number of vaccinations. The BCG vaccine is given to children under 1-year-old to prevent tuberculosis, which is a lower respiratory tract infection. Lower respiratory tract infectionsare one of the leading causes of infant death worldwide (Roser, Ritchie, &Dadonaite, 2019) as seen in Table 4, up to 99% of one (1) year old have been vaccinated in the year 2020, helping to ensure that the number of infant mortality continues to decrease.

As seen in Annex 11-13, the percentage of years old with BCG Immunization and Infant Mortality rate share a strong relationship. They have a negative correlation which means an

increase in one results in a decrease in the other. For example, an increase in BCG vaccines results in a decrease in the infant mortality rate.

Conclusion

This research provided insight into the infant mortality rate in Jamaica. Various measures have been put in place to curve the increase of the rates and as such, it is evident that there is a reduction. With some research and statistical data, we can witness that there is indeed a vast improvement over the 20 years.

Recommendations

- Reinforce the strategies that have been effective over the 20 years.
- Educate individuals on the causes of infant mortality.
- Educate persons on ways to prevent infant mortality.
- Practice good sanitation
- Practice breastfeeding instead of giving formulas
- Attend prenatal visits and medical check-ups
- Encourage persons to practice good nutrition.
- Encourage vaccination.
- Further studies should be done to find out the reasons for decline of infant mortality rate. Studies to be conducted to determine the causes of infant mortality rate

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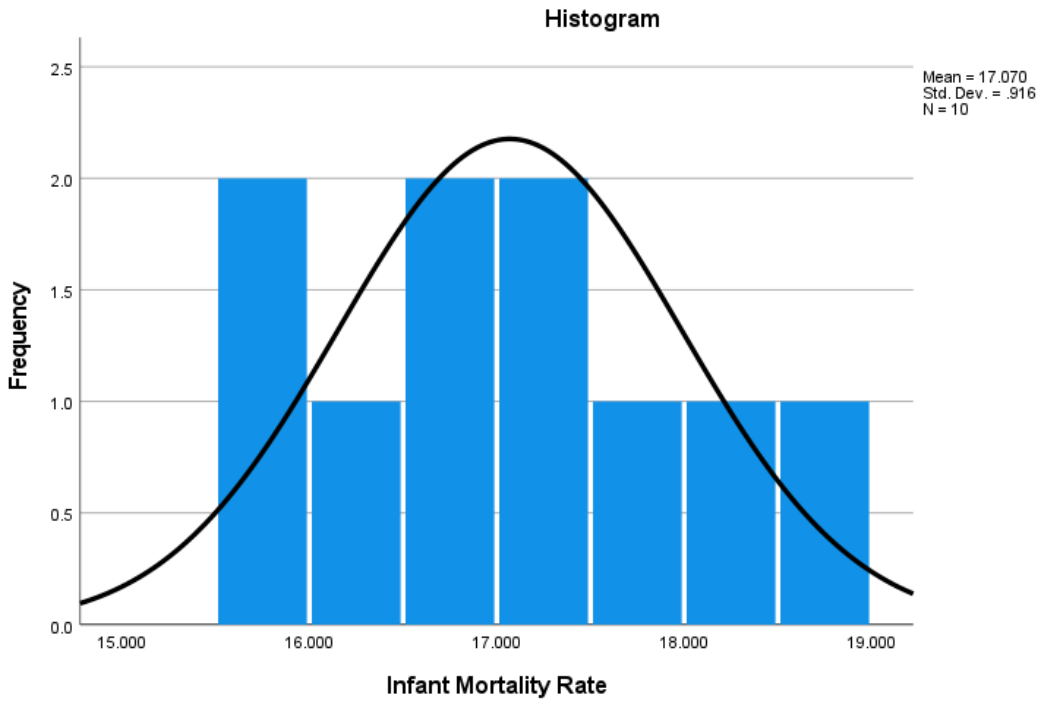
Appendix

Annex 1 presents the descriptive statistics of the incidence of infant mortality in Jamaica in the first decade (2002-2011). The incidence of infant mortality for the first 10 years (2002-2011) is on average 17.070, with skewness of -0.043. Based on the skewness (i.e., -0.043), the distribution is negatively skewed. The distribution is relatively symmetrical. As such, the average can be represented by the mean (17.070±0.92). The coefficient of variation (standard deviation/mean * 100) was 5.39%, which speaks to a relatively good distribution.

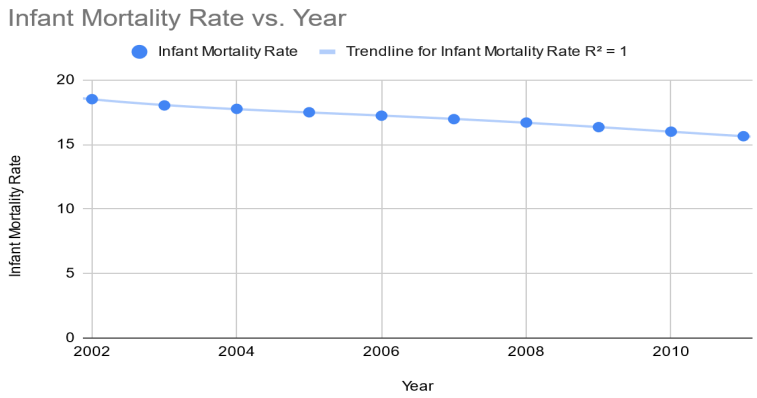
Annex 1: Descriptive statistics of the Incidence of Infant Mortality in the first decade

			Statistic	Std. Error
Infant Mortality Rate	Mean		17.07010	.289777
	95% Confidence Interval for Mean	Lower Bound	16.41458	
		Upper Bound	17.72562	
	5% Trimmed Mean		17.06900	
	Median		17.10050	
	Variance		.840	
	Std. Deviation		.916356	
	Minimum		15.644	
	Maximum		18.516	
	Range		2.872	
	Interquartile Range		1.570	
	Skewness		-.043	.687
	Kurtosis		-.859	1.334

Annex 2: Frequency Distribution Polygon of Incidence of Infant Mortality, 2002-2011



Annex 3: Scatter Plot of Infant Mortality, 4-degree polynomial (2002-2011)

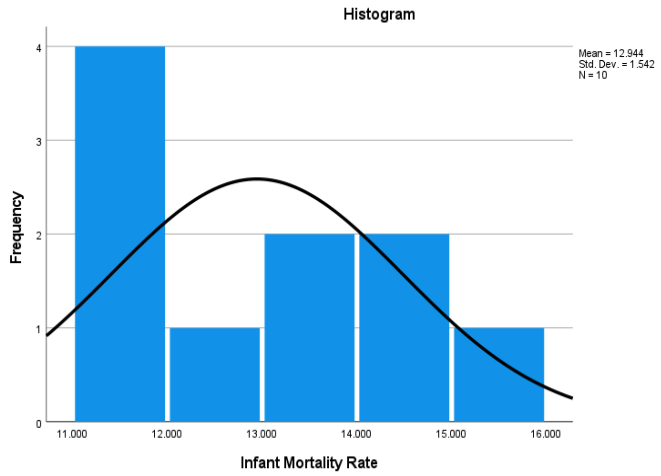


Annex 4 presents the descriptive statistics of the incidence of infant mortality in Jamaica. The incidence of infant mortality for the last 10 years (2012-2021) is on average 12.944, with skewness of 0.342. Based on the skewness, the distribution is positively skewed and relatively symmetrical. As such, the average can be represented by the mean (12.944±1.54). The coefficient of variation (standard deviation/mean * 100) was 11.90%, which speaks to a relatively good distribution.

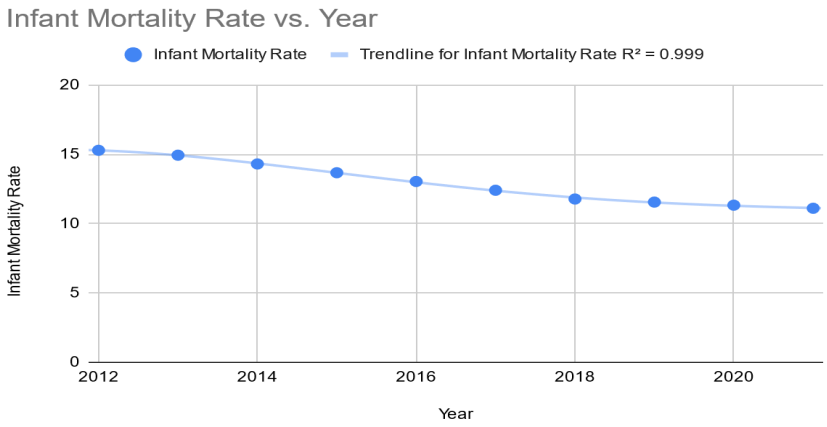
Annex 4: Descriptive statistics of the Incidence of Infant Mortality in the last decade

			Statistic	Std. Error
Infant Mortality Rate	Mean		12.94410	.487643
	95% Confidence Interval for Mean	Lower Bound	11.84098	
		Upper Bound	14.04722	
	5% Trimmed Mean		12.91550	
	Median		12.72600	
	Variance		2.378	
	Std. Deviation		1.542061	
	Minimum		11.112	
	Maximum		15.291	
	Range		4.179	
	Interquartile Range		2.964	
	Skewness		.342	.687
	Kurtosis		-1.502	1.334

Annex 5: Frequency Distribution Polygon of Incidence of Infant Mortality, 2012-2021



Annex 6: Scatter Plot of Infant Mortality, 4-degree polynomial (2012-2021)



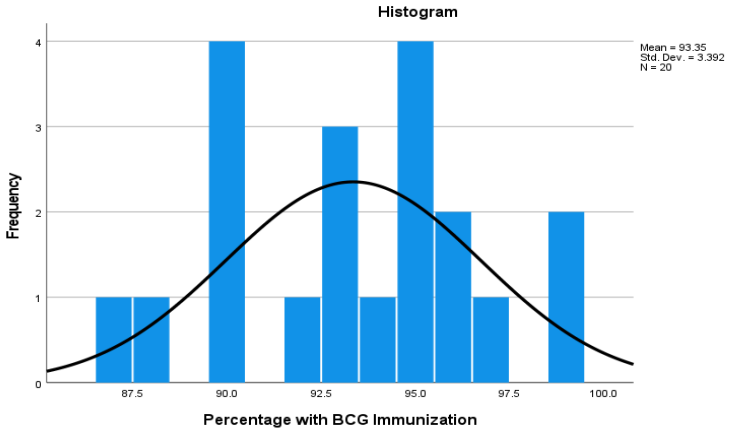
Annex 7 presents the descriptive statistics of the percentage of one-year-olds with BCG immunization in Jamaica. The percentage of one-year-olds with BCG immunization in Jamaica for the last 20 years (2001-2020) is on average 93.2%, with skewness of -0.043. Based on the skewness, the distribution is negatively skewed and it is relatively symmetrical. As such, the average can be represented by the mean (93.2±3.43). The coefficient of variation (standard deviation/mean * 100) was 3.68%, which speaks to a relatively good distribution.

Annex 7: Descriptive statistics for the Percentage of one-year-olds with BCG Immunization

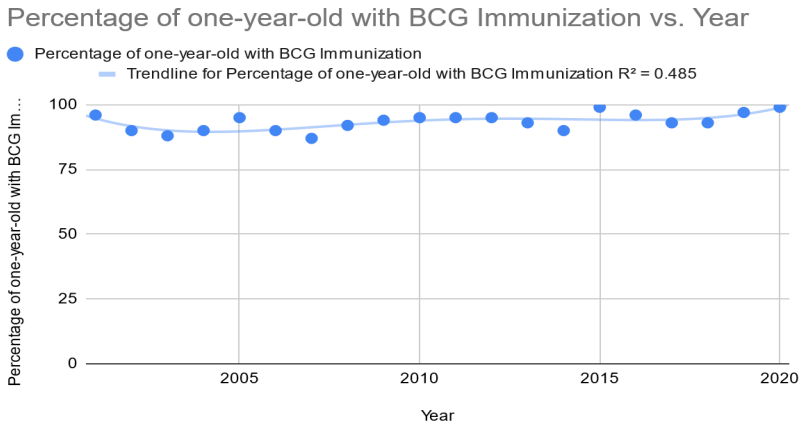
Descriptives

			Statistic	Std. Error
Percentage with BCG Immunization	Mean		93.21	.786
	95% Confidence Interval for Mean	Lower Bound	91.56	
		Upper Bound	94.86	
	5% Trimmed Mean		93.23	
	Median		93.00	
	Variance		11.731	
	Std. Deviation		3.425	
	Minimum		87	
	Maximum		99	
	Range		12	
	Interquartile Range		5	
	Skewness		-.043	.524
	Kurtosis		-.637	1.014

Annex 8: Frequency Distribution Polygon of Percentage of one-year-old with BCG Immunization, 2001-2020



Annex 9: Scatter Plot of Percentage of one-year-old with BCG Immunization, 4-degree polynomial (2001-2020)



Annex 10: Percentage of one-year-old with BCG Immunization and Infant Mortality Rate in Jamaica, 2002-2020

Year	Percentage with BCG Immunization (%)	% Change	Infant Mortality Rate	% Change
2002	90	-	18.516	-
2003	88	-2.22	18.03	-2.62
2004	90	2.27	17.764	-1.48
2005	95	5.56	17.499	-1.49
2006	90	-5.26	17.233	-1.52
2007	87	-3.33	16.968	-1.54
2008	92	5.75	16.702	-1.57
2009	94	2.17	16.349	-2.11
2010	95	1.06	15.996	-2.16
2011	95	0.00	15.644	-2.2
2012	95	0.00	15.291	-2.26
2013	93	-2.11	14.938	-2.31
2014	90	-3.23	14.306	-4.23
2015	99	10.00	13.674	-4.42
2016	96	-3.03	13.042	-4.62
2017	93	-3.13	12.41	-4.85
2018	93	0.00	11.778	-5.09
2019	97	4.30	11.556	-1.88
2020	99	2.06	11.334	-1.92

Annex 11 presents the correlations between the percentage of one-year-olds with BCG immunization and the infant mortality rate in Jamaica for the period 2002-2020. The correlation coefficient is r=-0.642. This means that there is a negative correlation between the measured variables. A negative correlation indicates an inverse relationship where one variable increases, the other variable decreases, or vice versa. The relationship between the two measured variables is also noted to be significant. Therefore, according to Pearson product-moment correlation

coefficient, there is a strong relationship between the percentage of one-year-olds with BCG immunization and the infant mortality rate in Jamaica for the period 2002-2020.

Annex 11: Correlations between Percentage of one-year-old with BCG Immunization and Infant Mortality Rate, 2002-2020

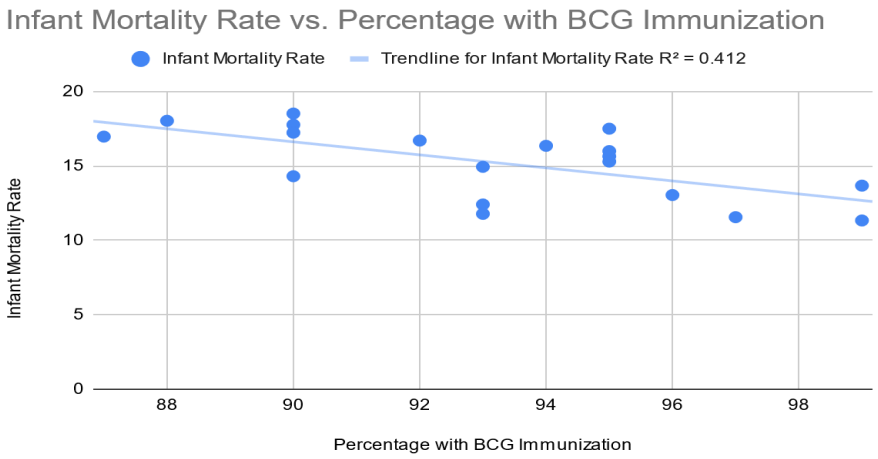
Correlations

		Percentage with BCG Immunization	Infant Mortality Rate
Percentage with BCG Immunization	Pearson Correlation	1	-.642**
	Sig. (2-tailed)		.003
	N	19	19
Infant Mortality Rate	Pearson Correlation	-.642**	1
	Sig. (2-tailed)	.003	
	N	19	19

**. Correlation is significant at the 0.01 level (2-tailed).

Annex 12 shows us that there is a linear relationship between the two variables. The linear polynomial accounts for 41.2% of the scatter values.

Annex 12: Scatter plot of the Percentage of one-year-olds with BCG Immunization and Infant Mortality Rate in Jamaica, linear polynomial (2002-2020)



Annex 13: Scatter plot of the Percentage of one-year-old with BCG Immunization and Infant Mortality Rate in Jamaica, 4-degree polynomial (2002-2020)