A GIS Based Spatio-Temporal Analysis of Unidentified Dead Bodies in Pune, Mumbai, and Nagpur

A Thesis Submitted to

Savitribai Phule Pune University

In Partial Fulfilment of the Requirements for

The Degree Of

Masters of Science in Geoinformatics

Submitted by

Tushar Balasaheb Kothule (22071010)

Under the Guidance of

Mr. Nilesh Shinolikar

Chief Technology Officer

CodeRize Technologies Private Ltd

Department of Geography (Geoinformatics)

Savitribai Phule Pune University

Pune - 411007

Maharashtra, India

(11 May 2024)

CodeRize Technologies Private Limited
Green Park, Above Pizza Hut, Pune - Satara Rd,
opposite Bharati Vidyapeeth, Katraj,
Pune - 411046, Maharashtra.

Date:10th May 2024

Date:10th May 2024 **Ref: CR/Cert/Intern/2023-24/6**

Internship completion Letter

We are delighted to announce the successful completion of **Mr. Tushar Kothule's** four-month summer internship with CodeRize Technologies Private Limited in Pune. During this brief period, Tushar collaborated closely with our team, focusing on the development of the **"A GIS Based Spatio-Temporal Analysis of Unidentified Dead Bodies in Pune, Mumbai, and Nagpur"** project. Leveraging his robust programming, analytical, and logical skills, he deliveredthe project within the stipulated timeline.

It was truly a pleasure to have Tushar as part of our team this summer. His dedication and valuable contributions significantly contributed to the project's success. We found his association with us to be exceptionally fruitful, and we extend our best wishes to him for all his future endeavors.

Project Guide

Mr. Nilesh Shinolikar

Nilesh Shinolikar

Digitally signed by Nilesh Shinolikar
Date: 2024.05.10 21:35:33 +05'30'

CODERIZE TECHNOLOGIES PVT. LTD. PUNE

CTO, CodeRize Technologies Pvt Ltd

SAVITRIBAI PHULE PUNE UNIVERSITY

DEPARTMENT OF GEOGRAPHY

Ganeshkhind
Pune - 411 007 (INDIA)
Telephone:
Office
EPABX: 020-25601364 / 65
Head: 020-25601363
Fax: 020-25693370

Email ID:
bhoogol@unipune.ac.in

Date: 11/05/2024

CERTIFICATE

This is to certify that the project work entitled ***"A GIS Based Spatio-Temporal Analysis of Unidentified Dead Bodies in Pune, Mumbai, and Nagpur"*** has been carried out by ***Mr. Tushar Balasaheb Kothule*** under the guidance of Mr. Nilesh Shinolikar, during the academicyear 2023-2024 for the partial fulfillment of the degree of Master of Science in Geoinformatics.

Place: Pune
Date: 11/05/2024

Dr. Sudhakar Pardeshi
Professor and Head,
Department of Geography,
Savitribai Phule Pune University,
Pune – 411 007.

Savitribai Phule Pune University

Department of Geography

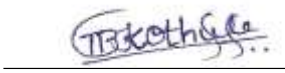
Declaration

I, Tushar Balasaheb Kothule, bearing Examination/Roll No. 22071010, bonafide student of the Department of Geography (Geoinformatics), Savitribai Phule Pune University hereby declare that the project titled '**A GIS BASED SPATIO-TEMPORAL ANALYSIS OF UNIDENTIFIED DEAD BODIES IN PUNE, MUMBAI, AND NAGPUR**, has been carried out and composed by me.

I do hereby declare that the thesis submitted is original and is the outcome of the independent investigations/research carried out by me. This work has not been submitted to any other University or Body in quest of a degree, diploma or any other kind of academic award.

I do hereby further declare that the text, diagrams or any other material taken from other sources (including but not limited to books, journals and the web) have been acknowledged, referred and cited to the best of my knowledge and understanding.

Date: 11/05/2024



Signature of the student

To my entire family, for their constant love, support, and sacrifices that have made this academic achievement possible.

ACKNOWLEDGMENTS

I am deeply grateful for the unwavering support and encouragement I received throughout the entirety of this thesis journey.

First and foremost, I extend my heartfelt appreciation to my supervisor, Mr. Nilesh Shinolikar, whose invaluable guidance and assistance were instrumental at every stage of this project. His expertise and vast experience have greatly enriched my academic endeavors.

I am also indebted to Dr. Sudhakar Pardeshi, Head of the Department, for granting me this opportunity and providing unwavering support, which has played a pivotal role in shaping my academic pursuits.

Furthermore, I extend my sincere gratitude to Dr. Swapnil Vyas and Mr. Ravindra Medhe, whose insightful guidance has been instrumental in making informed decisions and completing my dissertation. I am truly grateful for their patience and support throughout.

I wish to express my profound appreciation to my parents for their unwavering assistance and encouragement throughout my educational journey. Their support has been a constant source of strength and motivation.

Lastly, I extend my heartfelt thanks to my friend Rushikesh for his generous support and his invaluable companionship and camaraderie during both academic and social endeavors.

Abstract

This thesis explores the major issue of Unidentified Dead Bodies (UDBs) in urban areas, focusing on the cities of Mumbai, Pune, and Nagpur in India. Using the GIS spatial analysis and temporal data analysis running from 2016 through 2023, this study targets identifying the distribution patterns of UDBs, aiming to unearth the hotspots for effective actions. This will be utilized to ascertain the presence of patterns, and hotspots as well as the identification of areas requiring higher surveillance. Utilizing data sources that are commonly used such as the Maharashtra Police website coupled with geocoding and normalization techniques that ensure demographic patterns are revealed and trends in UDB are brought to the fore, are employed. The study substantiates the fact that a considerable proportion of the two death categories were not affected by the passage of years, and, particularly since 2020, the number of unnatural cases has increased, presumably as a result of COVID-19. Given that it is doubtful to pin causation on the health crisis and suicides, care is advised when doing so, and researchers should therefore carry out extensive analytical studies. The participation of the Power BI dashboard is in line with one of my main research projects which was to develop a user-friendly platform through which Chhaya Foundation could track the spatial and temporal dynamics of UDBs. This is intended to assist decision-making in coming up with wise policies and appropriate interventions to the emergent problems in safety and welfare. This thesis illuminates the critical need for a multidisciplinary approach as well as the assessment of data-derived measures in tackling the intricate deaths and politics of global health crises and promoting a healthy environment in the long term.

CONTENTS

Chapter 4: Results and Discussion

Chapter 5: Conclusions

List of Tables

2042000

List of Figures

Titles

CHAPTER 1

INTRODUCTION

CHAPTER 1

1.1 INTRODUCTION

According to the World Bank, as of 2022, approximately 56% of the world's population, which is around 4.5 billion people, resided in urban areas. This trend of urbanization is expected to continue, with the urban population projected to more than double its current size by 2050. The issue of Unidentified Dead Bodies (UDBs) in urbanized and densely populated areas is a significant concern. This problem, exacerbated by rapid urbanization and population growth, poses challenges for public health, law enforcement, and human rights.

Unidentified persons are people who have died and whose bodies have not been identified during autopsy. Every year, millions of dead people across the globe remain unidentified and are never returned to their families or communities (Mazzarelli et al., 2021; Reid et al., 2023). The extremely high number of unidentified dead bodies, accompanied by minimal contextual data, has been referred to as a silent mass disaster (Ritter, 2007). When they were alive, many of these people have been marginalized due to social and health inequalities—for example, undocumented migrants, people who are members of disadvantaged minority ethnic groups, people of color, the urban poor and homeless, individuals with severe mental illnesses, and other stigmatized health conditions (Raghavendra Babu et al., 2012). The International Committee of the Red Cross and the Johannesburg Forensic Pathology Service highlight migrants as constituting a substantial proportion of unidentified bodies, as when they were alive, they feared legal repercussions, experienced heightened vulnerability, and often succumbed to illness or violence (Keyes et al., 2022).

The Census of India, 2011 revealed that 31.16% of the country's population resided in urban areas. In absolute terms, it accounted for 37 crore population. The issue of Unidentified Dead Bodies (UDBs) in India is a significant concern. According to the National Crime Records Bureau, a shocking 2,22,446 bodies were passed off as "unidentified" by the police in six years. According to the national crime record bureau, a total of 34,592 unidentified dead bodies were recovered at all Indian levels and necessary inquests as per the law were conducted by the police. Thus, the police had to conduct inquiries for around 95 such cases every day on average at all Indian levels. Some States reported higher recovery of un-identified dead bodies, these States were Maharashtra (6,187 victims), Tamil Nadu (3,739 victims), Karnataka (3,533 victims) Uttar Pradesh (3,409 victims), West Bengal (3,086 victims) and Delhi UT (3,063 victims) (Crime in India 2015, chapter 3-page no.66, 63 editions) July 2016.

Mumbai tops the national charts in disposing of unclaimed bodies. Unidentified bodies are disposed of as per the provision laid under section 5 of the Bombay Anatomy Act of 1949. Mumbai is the financial capital of India, having every facility to live a dignified life. But Mumbai has also a large number of unknown, unclaimed dead bodies. There is an increase in the number of unclaimed /unknown dead bodies day by day in Mumbai. The increasing number of unknown dead bodies is also described as a silent mass disaster. The identification of cadavers is a key issue in autopsies and is equally important for ethical, criminal, and civil reasons.

Geographic Information Systems (GIS) technology is a powerful tool for analyzing the distribution of Unidentified Dead Bodies (UDBs), allowing Chaaya Foundation to identify patterns, and hotspots, and inform policy decisions for arranging campaigns for awareness to reduce the incidence. This research focuses on the cities of Mumbai, Pune, and Nagpur cities overall but mainly focuses on Mumbai City in India, using GIS-based analysis for the distribution of UDBs for Chhaya Foundation and public health.

The primary aim of this research is to conduct a comprehensive GIS exploration of unidentified bodies in Pune and Mumbai from 2017 to 2023. By scrutinizing demographic patterns, spatial distribution, and temporal trends, we endeavor to unearth insights that transcend the numerical realm. This exploration aims not only to contribute to academic understanding but, more crucially, to inform practical strategies for Chhaya Foundation and public welfare. Through the lens of Geographic Information Systems (GIS), this study seeks to bridge the gap between theoretical knowledge and tangible actions, emphasizing the need for holistic approaches to address the profound challenges posed by unidentified bodies in the urban landscapes of the city.

Studying Unidentified Dead Bodies (UDBs) in Mumbai is crucial due to several reasons. Mumbai, being the financial capital of India, has a high incidence of UDBs, largely due to its diverse and transient population. These UDBs pose a significant public health concern and present substantial challenges to forensic medicine and law enforcement. Furthermore, from a human rights perspective, every individual has the right to a dignified death and identification. The data derived from studying UDBs in Mumbai can inform policy decisions, helping to allocate resources effectively and implement strategies to reduce the number of UDBs. Therefore, this study is not only important for Mumbai, Pune, and Nagpur but can also provide valuable insights for other urban areas facing similar challenges.

The study investigated unidentified bodies in Pune, Mumbai, and Nagpur from 2016 to 2023, utilizing data from official sources like the Maharashtra Police website. Through meticulous data processing, including geocoding and normalization, spatial and temporal patterns were

uncovered. Monthly distribution analysis revealed fluctuations in occurrences, aiding resource allocation, while quarterly trends analysis provided insights into urban landscape influences and targeted interventions. Additionally, using ArcGIS Pro, an 80-20 analysis identified high-risk areas contributing significantly to reported incidents. Percentage change analysis assessed temporal trends, while the Summarize Incident Tool provided insights into crime distribution patterns across Mumbai. These findings are crucial for evidence-based decision-making, enhancing community safety and well-being by addressing crime effectively.

These findings provide valuable insights for evidence-based decision-making and targeted interventions to enhance community safety and well-being. Understanding the spatial and temporal patterns of unidentified bodies enables authorities to allocate resources effectively and implement preventive measures. By identifying high-risk areas and assessing temporal trends, Chhaya Foundation can prioritize interventions and address emerging challenges in public safety to reduce the incidence. Additionally, the analysis of crime distribution patterns aids in the strategic deployment of resources, ultimately improving overall security and well-being in the studied cities.

1.2 CONCEPTUAL BACKGROUND:

The issue of unidentified dead bodies is a significant global health crisis that requires urgent attention. Every year, millions of dead people across the globe remain unidentified and are never returned to their families or communities. The circumstances surrounding their death are often unknown, and their bodies go unclaimed (Suwalowska et al., 2023). Identification of the deceased is crucial not only for criminal justice but also for social justice and the well-being of the families left behind. However, the process of identification is often challenging, especially when the body has been significantly damaged or decomposed. (Reid et al., 2023).

Studies have found that developing countries experience more than double the rate of unidentified bodies compared to developed countries, likely due to a lack of standardized identification procedures and investigative databases (Reid et al., 2023). This data gap perpetuates the belief that those who are not counted, do not count, further marginalizing vulnerable populations. Addressing the issue of unidentified dead bodies requires a combined effort involving global and local actors, with the prioritization of identification, especially for marginalized communities (Suwalowska et al., 2023).

Initiatives such as the World Health Organization's efforts to strengthen global health emergency preparedness should incorporate the identification of unidentified dead bodies within their surveillance and social protection frameworks. By standardizing identification procedures, utilizing existing infrastructure, and creating comprehensive databases, the number of unidentified bodies can be significantly reduced globally. (Suwalowska et al., 2023).

The study of unidentified dead bodies and the integration of Geographic Information Systems (GIS) technology plays a crucial role in forensic sciences and humanitarian efforts. Unidentified deceased individuals are often deposited in various locations such as morgues, cemeteries, or clandestine sites, highlighting the need for effective identification methods and dignification processes. GIS technology offers a valuable contribution to the restoration of lost components of victim recognition, such as identity and connectedness, especially in cases of mutilated or dismembered bodies (Parra et al., 2020).

By utilizing GIS, forensic scientists can create movement maps of unidentified bodies, track postmortem movements, and clarify commingled cases, ultimately aiding in the identification and repatriation of deceased individuals (McKinney, 2022).

In summary, GIS technology plays a vital role in the study of unidentified deceased individuals by facilitating the restoration of identity, mapping and tracking movements, enhancing identification and repatriation processes, and addressing key challenges in this field of forensic science.

1.3 THE SIGNIFICANCE OF UNIDENTIFIED DEAD BODIES STUDY USING GIS:

The investigation of unknown bodies of the dead is vital for gaining justice for the dead, contributing to closure for families, and preserving public health. With the integration of Geographic Information Systems (GIS), this area is charged, offering competent devices for spatial analysis, locating data, allocating resources, and raising the culture of society. Here's a detailed breakdown of the importance of using GIS in the study of unidentified remains for your research thesis: Here's a detailed breakdown of the importance of using GIS in the study of unidentified remains for your research thesis:

1. **Enhanced Spatial Analysis:**

- Identifying Clusters: GIS helps you locate unidentified bodies; once that pattern has been recognized within a given area. This can be crucial for: This can be crucial for:
- Locating Missing Persons: Through the indication of sites where unknown deaths took place frequently, the authority can be guided to the positions where individuals are missing.
- Risk Assessment: Through an instrument like GIS, causes of death are searched for factors for example, demographic, socioeconomic, and the proximity to the water or dangerous spots, and can point out places with high risk of unidentified deaths. This approach then enables authorities to proactively utilize their resources in preventive measures, dissemination of information, and undertaking focused patrols.

2. **Investigative Support:**

- Movement Reconstruction: GIS may be efficient in topping the last known locality of the missing persons and spotting the bodies that are not identified. This information can be invaluable for investigators by This information can be invaluable for investigators by:
- Reconstructing Potential Movement Patterns: Through scrutinizing spatial patterns, the investigators can isolate the paths that were potentially followed by the missing persons,

stemming search campaigns into the most direct tack.

- Identifying Connections: Interconnecting markers displayed on the map, involving sites of unidentified bodies and reports on missing people, might be used for studying their correlations. Such relationships can become even more noticeable, while investigation progresses through traditional methods.

3. Temporal Analysis and Trend Identification:

- Temporal Overlays: The value of GIS allows you to study the temporal pattern of unidentified body cases. By visualizing these patterns through temporal overlays or animation, investigators could identify which of them affects the given person more or could be a reason for these correlations.
- Seasonal Trends: Adjustments in unidentified body core cases can have to do with the weather, the coming holidays, or any other factors. In this way, one can foresee these trends and therefore can give during the high demand access to necessary resources at a specified period.
- Emerging Patterns: Incorporating the evaluation of the unrecognized body cases through time can exhibit new traits that could be suggestive of targeted crimes, outbreaks, or any other problems that need the analysis to be pursued further.

4. Resource Allocation and Planning:

- Targeted Search Efforts: The efficiency of search and rescue missions can be considerably enhanced through the use of spatial data such as the location and characteristics of the bodies that have not been identified yet. The data can be used to target high-risk areas or places with potential connecting cases among the bodies found. It helps to optimize resource allocation and better the probability of missing individual salvage greatly.
- Morgue Capacity Planning: Spatial modeling of the unidentified bodies can help in finding a high possibility of future cases and give authorities enough time to arrange for more morgues. This proactive approach allows having sufficient permanent supportive resources to operate with unidentified remains.

5. **Public Awareness and Outreach:**

- Community Engagement: Educational campaigns that use maps of the ill effects of air pollution produced by GIS are powerful tools. Highlighting areas with a high number of unidentified bodies can encourage people to Highlighting areas with a high number of unidentified bodies can encourage people to:
- Report Missing Individuals Promptly: Thereby the general population becomes more inclined to instant reporting of disappearing persons which, in turn, has a chance of locating the missing people alive rather than dead.
- Be More Vigilant in Certain Areas: GIS maps can facilitate the public education campaign hence the citizens can be informed about the high-risk areas which can encourage increased precautions as well as the prevention of future disappearances.

6. **Family Support:**

- Geographic Connections: For unidentified bodies with a potential geographical connection to a missing person report, GIS maps can be used to:
- Inform Families about Search Areas: Providing families with visual representations of search areas based on spatial analysis can offer some solace and a sense of direction during a difficult time.
- Identify Potential Locations: Families can use GIS maps to identify areas where their loved one might be based on their known habits or potential routes taken.

With the help of the incorporation of GIS, the pursuit of unidentified dead bodies is transformed into a very powerful objection for the range of actors. Such an approach enables families to get closure, enhances public safety, as well as provides forensic investigations with a major tool. Develop these themes in your thesis and, by way of some overview of real-life cases, where GIS has been effective.

CHAPTER 2

LITERATURE REVIEW

2.1 Review of Literature

‘Study of demographic profile of unidentified dead bodies in central Mumbai region.’ The study of unidentified dead bodies is a significant area of research, particularly in forensic science and criminal investigation. Geographic Information Systems (GIS) can play a crucial role in this field, as demonstrated in the study by Wankhede et al. In their research, the authors used GIS to analyze the demographic profile of unidentified dead bodies in central Mumbai, India. They found that most of the unidentified bodies were of middle-aged males, and the most common cause of death was related to pulmonary pathology. The study also highlighted the importance of using photographs for identification purposes and the need for better management of unidentified dead bodies. (Wankhede et al. 2017).

The use of GIS in the management of unidentified dead bodies is not limited to forensic science and criminal investigation. It can also be used in public health and policy-making. For example, ‘Five-year study of unidentified/unclaimed and unknown deaths brought for medicolegal autopsy at Premier Hospital in New Delhi, India’ the study analyzed the demographic profile of unidentified/unclaimed and unknown bodies in Delhi, India. The authors found that most of the unidentified bodies were of males in the 31- to 50-year age group and that the predominant pathology was in the lungs. The study also highlighted the need for a national missing-persons database and a DNA databank to aid in the identification of unidentified/unclaimed and unknown bodies. (Yadav et al., 2017)

In summary, the study of unidentified dead bodies is a complex and multidisciplinary field that requires the integration of various tools and techniques, including GIS. GIS can help in the analysis of demographic profiles, the documentation and recording of landscapes of dignification, and the management of unidentified dead bodies. It can also contribute to public health and policy-making by providing insights into the causes of death and the demographic profile of unidentified dead bodies. Therefore, the use of GIS in the study of unidentified dead bodies is a promising area of research that has the potential to improve forensic science, criminal investigation, public health, and policy-making

CHAPTER 3

MATERIALS AND METHOD

3.1. Data Used:

The study is mainly done on secondary data. The data involves Unidentified dead bodies data, demographic data, Police station data, location data, and Police station boundary.

The unidentified dead body data mainly contains the name of the person, the date, the address where the body was found, and the names of the police for the cities of Mumbai, Pune, and Nagpur were collected from Maharashtra State Police official website.

For the geocoding of police station addresses the geolocation data such as latitude and longitude for Mumbai city was collected from the Brihanmumbai Municipal Corporation (BMC) and Mumbai police official website. For Pune city, it was collected from Pune Municipal Corporation (PMC), and for Nagpur city, it was taken from the Nagpur police station website and Google Earth Pro as data was inconsistent for some police stations.

As per the Mumbai police Station data, Mumbai city is composed of 91 Police Stations. These Police station boundaries are considered for the study. The Boundary data was taken from Mumbai Police's official website.

Table No. 3.1: The representation of Data and Sources.

	Data	Sources
1.	Unidentified dead bodies data	Maharashtra State Police website. (https://citizen.mahapolice.gov.in/Citizen/MH/SearchDeadBodyList.aspx)
2.	Police station Geolocation data latitude and longitude (Mumbai)	Brihanmumbai Municipal Corporation (BMC) and Google Earth Pro (https://www.mcgm.gov.in/irj/portal/anonymous)
3.	Police station Geolocation data latitude and longitude (Pune)	Pune Corporation (Open Data Portal) http://opendata.punecorporation.org/Citizen/User
4.	Police station Geolocation data latitude and longitude (Nagpur)	Google Earth Pro and NMC
5.	Mumbai Police Station Boundaries data	Open City, Urban Data Portal (https://data.opencity.in/dataset/police-jurisdiction-maps-for-major-cities-of-india)
6.	Police Station-wise population data of Mumbai.	Mumbai police website https://mumbaipolice.gov.in/policestation?ps=17

Source: Computed by the researcher based on data.

3.2. Study Area:

The study area for this research comprises Three big cities in Maharashtra, India, namely Mumbai, Pune, and Nagpur. These bustling metropolises, with populations exceeding 18.5 million (Mumbai), 3 million (Pune), and 2.4 million (Nagpur) according to the 2011 census, present distinct challenges in managing unidentified body cases due to their varying sizes, demographics, and urban landscapes. Analyzing data from these diverse environments allows for a more comprehensive understanding of the factors influencing unidentified body occurrences.

Pune city is located in the central part of the Maharashtra state at an altitude of 560 m above mean sea level. Pune city lies between latitudes 18° 25'N and 18° 37' N and longitudes between73° 44' E and 73° 57' E and covers an area of 250.56 sq. km. Pune is one of the fastest-growing cities in India. It is considered one of the eight megacities of India. It has emerged as an important city for education, Information Technology hub, and manufacturing hub.

Brihanmumbai, also known as Mumbai, pulsates with life on the western coast of India, located between the latitudes 18° 59' N and 19° 30' N and longitudes 72° 47' E and 73° 01' E. This sprawling metropolis covers an area of 603.4 sq km. Brihanmumbai Municipal Corporation (BMC) efficiently manages the city, divided into 24 administrative wards. A global hub for finance, commerce, and entertainment, Brihanmumbai serves as the economic powerhouse of India.

Nagpur, the "City of Oranges," is also the heart of Maharashtra, situated at an altitude of 310 meters above sea level. Latitude lines 21° 08' N and 21° 27' N embrace Nagpur, while longitude lines 78° 41' E and 79° 12' E define its geographical boundaries. Spanning an area of 393.5 sq km, Nagpur offers a vibrant blend of historical charm and modern development.

As per reports, Mumbai city ranks at the top in contribution of unidentified dead bodies number. Furthermore, all three cities boast significant migration rates, fostering diverse demographics within their urban landscapes. This combination of high population density and diverse demographics presents unique challenges in managing unidentified body cases, making them ideal locations for a comprehensive analysis.

STUDY AREA MAP

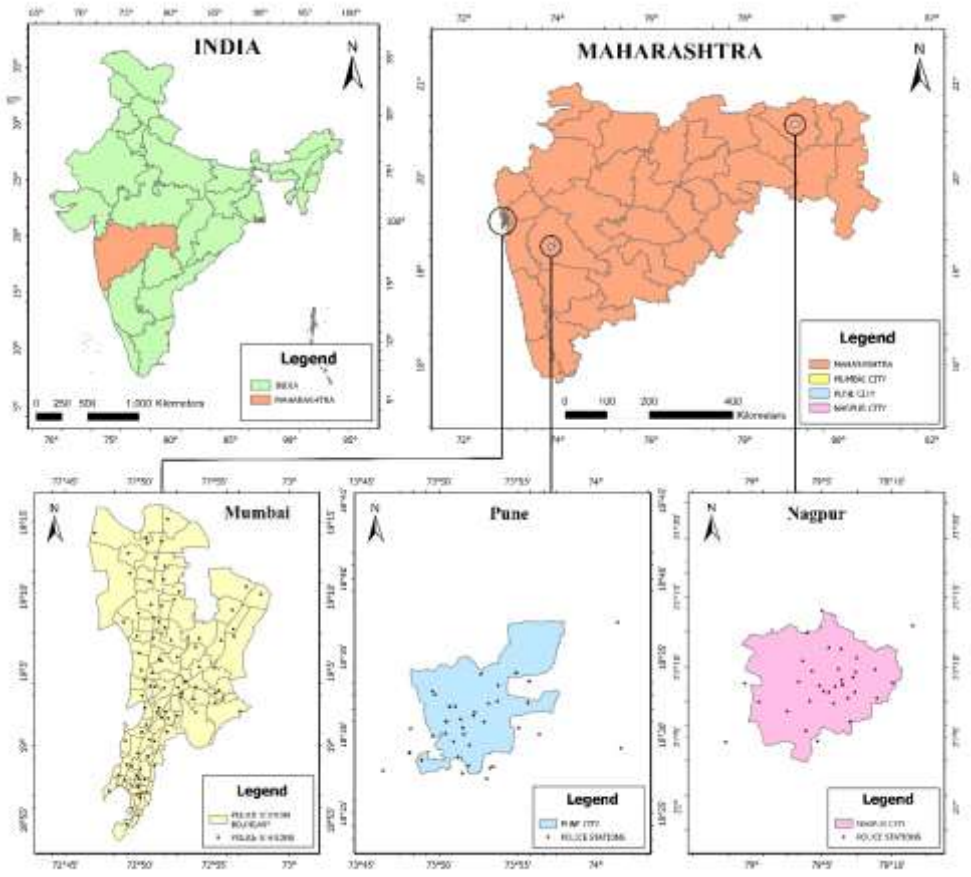


Figure No. 3.1: Study Area Map

3.3. Aim and Objective: -

This project aims to achieve a comprehensive understanding of multifaceted issues with unidentified bodies in the busy cities of Mumbai, Pune, and Nagpur. By utilizing Geographic Information Systems (GIS) tech, the project dives into detailed exploration data over seven years (2016-2023). This exploration not only analyzes the spatial distributions of unidentified bodies across police stations but also reveals temporal trends in occurrences slip three crack kings of theirs.

This project will also finish evolving an interactive Power BI dashboard. The user-friendly dashboard will effectively speak the findings, providing crucial info on spatial trends, monthly and quarterly trends, and breakups by causing death (natural vs. unnatural). This knowledge will empower the Chhaya Foundation to assign resources for Awareness campaigns strategically to hit high-risk regions and to take preventive measures to reduce the incidence.

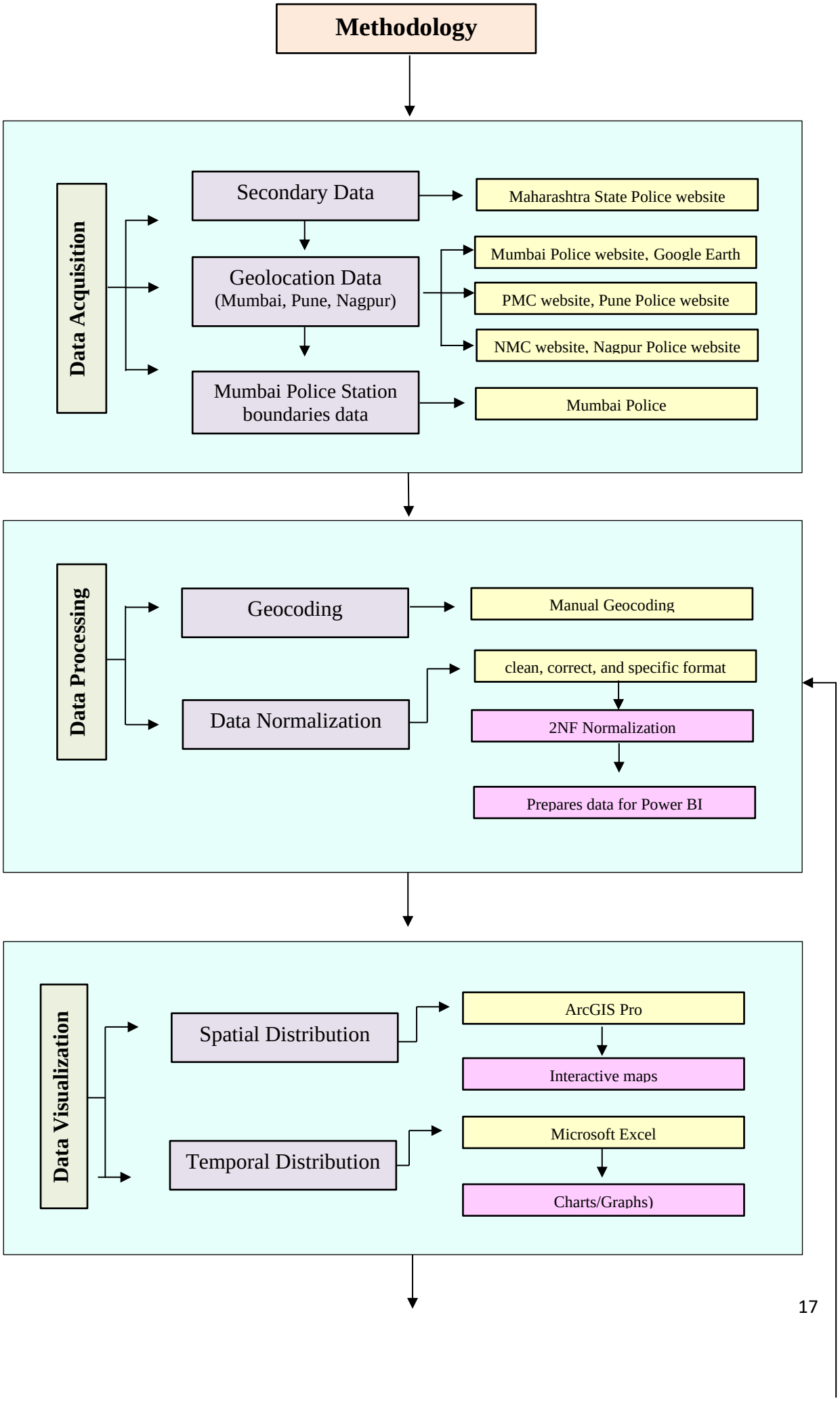
Objectives –

1. Analyze spatial and temporal patterns of unidentified bodies using Geospatial technology.
2. Investigate and compare the pattern of unidentified bodies in Mumbai, Pune, and Nagpur for implementing preventive measures to reduce the incidence.
3. Create an interactive Power BI dashboard and use the analysis findings to develop actionable insights.

3.4. Methodology:

In accordance with the target and the objectives of the research, the methodology of the study had been developed. For the above objective, the primary data was collected from the secondary sources by means of. The analysis takes place when all this data has been summarized, grouped and presented in the logical way. The necessary statistical tools were used to summarize the data which otherwise would have been hard to comprehend with the significance of statistical data.

The method of this work is aimed to follow a systematic examining the unidentified bodies in Pune, Mumbai, and Nagpur from 2016 to 2023 on the basis of the Geographic Information Systems (GIS) technique. Exploring space-time patterns by using the data of demography, distribution and potential localizations gives understanding of the human profile, tendencies and possible hot spots of he unidentified bodies in the cities. Moreover, the production of an interactive Power BI dashboard is aimed at conversion of the data into the effective insights to answer relevant questions for the end users of the law enforcement operations and public welfare agencies which aid in the proper decision-making and budget allocation.


Methodology
Data Acquisition
Secondary Data
Maharashtra State Police website
Geolocation Data
(Mumbai, Pune, Nagpur)
Mumbai Police website, Google Earth
PMC website, Pune Police website
NMC website, Nagpur Police website
Mumbai Police Station boundaries data
Mumbai Police
Data Processing
Geocoding
Manual Geocoding
Data Normalization
clean, correct, and specific format
2NF Normalization
Prepares data for Power BI
Data Visualization
Spatial Distribution
ArcGIS Pro
Interactive maps
Temporal Distribution
Microsoft Excel
Charts/Graphs)

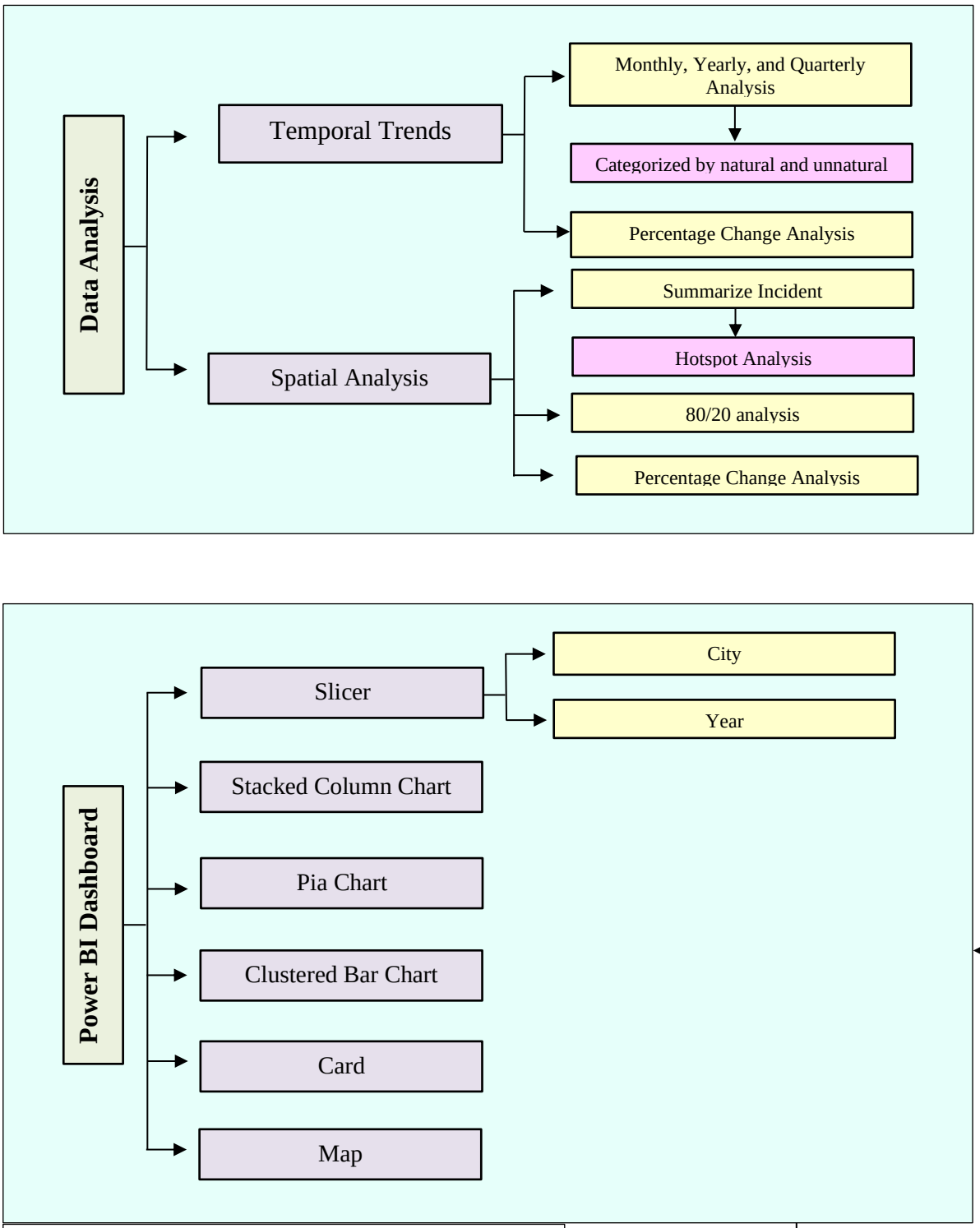


Figure No. 3.2: Methodology Flow Chart Diagram

Result & Report Writing

3.4.1. Data Acquisition:

1. **Primary Data:** The primary source of data on unidentified dead bodies for Pune, Mumbai, and Nagpur (2016-2023) was the Maharashtra State Police website. This official platform provided details on temporal and spatial information such as person names, discovery dates, locations, and Police Station names of the deceased individuals.
    I. **Pune**: Geolocation data for police stations for Pune city was obtained from two sources:

    Pune Municipal Corporation (PMC) website: Provided essential geospatial information for spatial analysis.

    Pune Police website: Contributed geocoded data specific to Pune police stations, enhancing spatial accuracy.

    II. **Mumbai**: Geolocation of police station data and jurisdictional boundaries data were acquired directly from the official website of the Mumbai Police.

    III. **Nagpur**: Geolocation data for police stations in Nagpur faced limitations in availability from official sources. Thus, a dual-source approach was adopted:

    Nagpur Municipal Corporation (NMC): Served as a valuable resource for geospatial information.

    Manual Geocoding using Google Maps: Filled in data gaps for specific police stations in Nagpur, enhancing overall spatial coverage and accuracy.

3.4.2. Data Processing:

1. Geocoding:

Official datasets contained inherent geospatial information such as the name of police stations and latitude and longitude to some extent. So geocoding was needed. Manual geocoding using Google Maps supplemented these datasets, particularly for locations with limited spatial details. This process assigned precise latitude and longitude coordinates to each Police station data, laying the foundation for spatial analysis.

2. Data Normalization:

Data normalization is imperative to ensure uniformity and comparability across different datasets. This step involves standardizing the format, units, and scales of various attributes

within the collected datasets. In the context of unidentified bodies, normalization includes aligning temporal references, demographic variables, and geographical units. This process enhances the coherence of the datasets, allowing for a more accurate and meaningful analysis. Additionally, normalization was crucial for incorporating the data into Power BI as the platform requires clean, correct, and specific format data for effective visualization.

3.4.3. Data Visualization:

1. **Spatial Distribution**: Leveraging the power of GIS (Geographic Information Systems), interactive maps were created in ArcGIS Pro to depict the spatial distribution of unidentified bodies across police stations in Pune and Mumbai.
2. **Temporal Trends:** Monthly and quarterly trends in unidentified body occurrences (natural vs. unnatural causes) were visually represented to reveal seasonal patterns and variation.

3.4.4. Data Analysis:

1. Temporal Trends:

I. **Monthly, yearly, and Quarterly Analysis:** As mentioned earlier, monthly and quarterly analyses were conducted to dissect the occurrences of unidentified bodies across Pune, Mumbai, and Nagpur (2016-2023). This involved categorizing cases by natural and unnatural causes. The results were visually represented using charts or graphs to reveal seasonal patterns and variations in the number of unidentified body occurrences for each city. This helped identify:

a) Months with higher or lower incidents of unidentified bodies.

b) Potential seasonal trends (e.g., more occurrences during specific seasons).

2. Monthly Average Analysis:

Calculation: The monthly average of unidentified bodies for each city (Pune, Mumbai, Nagpur) across the entire eight-year period (2016-2023) was calculated. This involved: Summing the number of unidentified body cases for each month across the eight years.

Dividing the sum for each month by eight (number of years).

Analysis: The calculated monthly averages served as a baseline for evaluating deviations and anomalies in monthly trends. Deviations from the average could indicate Months with a significantly higher or lower number of unidentified body occurrences compared to the typical pattern.

3. Percentage Change Analysis:

Natural and Unnatural Causes: The percentage change in the number of unidentified bodies due to natural and unnatural causes over the eight years (2016-2023) was calculated for each city (Pune, Mumbai, Nagpur). This involved:

Calculating the difference in the number of cases between 2016 and 2023 for both natural and unnatural causes in each city. Dividing the difference by the number of cases in 2016 (baseline year) and multiplying by 100 to express the change as a percentage.

Interpretation: The percentage change analysis aimed to reveal trends in the prevalence of natural versus unnatural causes of unidentified deaths over time. This could indicate: Increasing or decreasing occurrences of unidentified deaths due to natural causes. Fluctuations in the number of unidentified deaths are suspected to be unnatural.

3.4.5. Spatial Analysis using ArcGIS Pro:

i. Analysis of Mumbai data using Summarise Incident Tool:

Utilized the Summarize Incident Count tool in ArcGIS Pro, a spatial analysis was performed on the Mumbai crime dataset. This analysis aimed to aggregate and summarize incident counts within predefined geographic units, revealing patterns of crime distribution across the city. By summarizing incident counts within specified areas, the tool provided valuable insights into areas with higher incident frequencies, helping stakeholders identify potential crime hotspots and areas of concentrated criminal activity.

ii. **Hotspot Analysis (Mumbai):** ArcGIS Pro's Crime Analysis Safety tools were employed to conduct hotspot analysis specifically for Mumbai's data. This analysis identified the 20% of locations (police stations) contributing to 80% of the reported unidentified body incidents. This provided insights into:

High-risk areas with a disproportionate number of unidentified bodies, potentially indicating crime hotspots or areas requiring increased police presence.

i. **Percentage Change Analysis of Mumbai Data:** Using the Crime Analysis Safety tool in ArcGIS Pro, a percentage change analysis was performed on the Mumbai dataset to assess temporal trends and variations in crime rates over time in all police stations. This analysis enables stakeholders to identify trends of increasing or decreasing crime rates in specific areas or categories, facilitating informed decision-making and targeted interventions.

3.4.6. Creating an Interactive Power BI Dashboard:

To effectively communicate the findings of the data analysis and facilitate exploration for Chhaya Foundation, a user-friendly Power BI dashboard was created. This dashboard served as a comprehensive analysis tool, offering:

Interactive Visualizations: The dashboard incorporated various interactive visualizations to represent the key findings from the data analysis. These visualizations could include:

a) **Maps:** Displaying the spatial distribution of unidentified bodies across police stations in Mumbai, Pune, and Nagpur. Users could interact with the map to explore details for specific locations.

b) **Stacked Column Chart:** Representing breakdowns of unidentified body occurrences by month and cause of death (natural vs. unnatural). Users could filter the data by city or year for a more granular view.

c) **Donut Charts:** Highlighting the percentage-wise monthly distribution of unidentified bodies, allowing for easy comparison across months.

d) **Pie Charts:** Displaying the percentage of Natural and Unnatural dead bodies for the selected year.

e) **Stacked Column Chart:** Showing the Number of cases by police stations for the selected year.

f) **Filtering and Slicing:** Users could interact with the dashboard elements by applying filters and slicers. This allowed them to focus on specific aspects of the data, such as:

Selecting a particular city (Pune, Mumbai, Nagpur)

Viewing data for a specific year or period from 2016 to 2023.

Focusing on occurrences due to natural or unnatural causes.

By creating this interactive Power BI dashboard, the complex data analysis results were

transformed into a user-friendly format that empowers stakeholders to explore the trends and patterns surrounding unidentified bodies in the study area. These fosters informed decision-making and facilitates targeted interventions for improving public safety.

And the appropriate color scheme was applied for a better visual representation of the maps and the dashboard. At last, the final map layout was created for further analysis and interpretation.

CHAPTER 4

RESULTS AND DISCUSSION

Results:

4.1. Temporal Percentage Change in Natural & Unnatural Cases:

The percentage change in natural and unnatural unidentified dead body cases over the eight-year period was meticulously assessed for Mumbai, Pune, and Nagpur. This comparative analysis sheds light on the evolving nature of unidentified deaths, revealing shifts in the prevalence of natural versus unnatural causes over time. Understanding these dynamics is crucial for adapting response strategies and allocating resources effectively to address emerging challenges in public safety and welfare.

4.1.1. Mumbai:

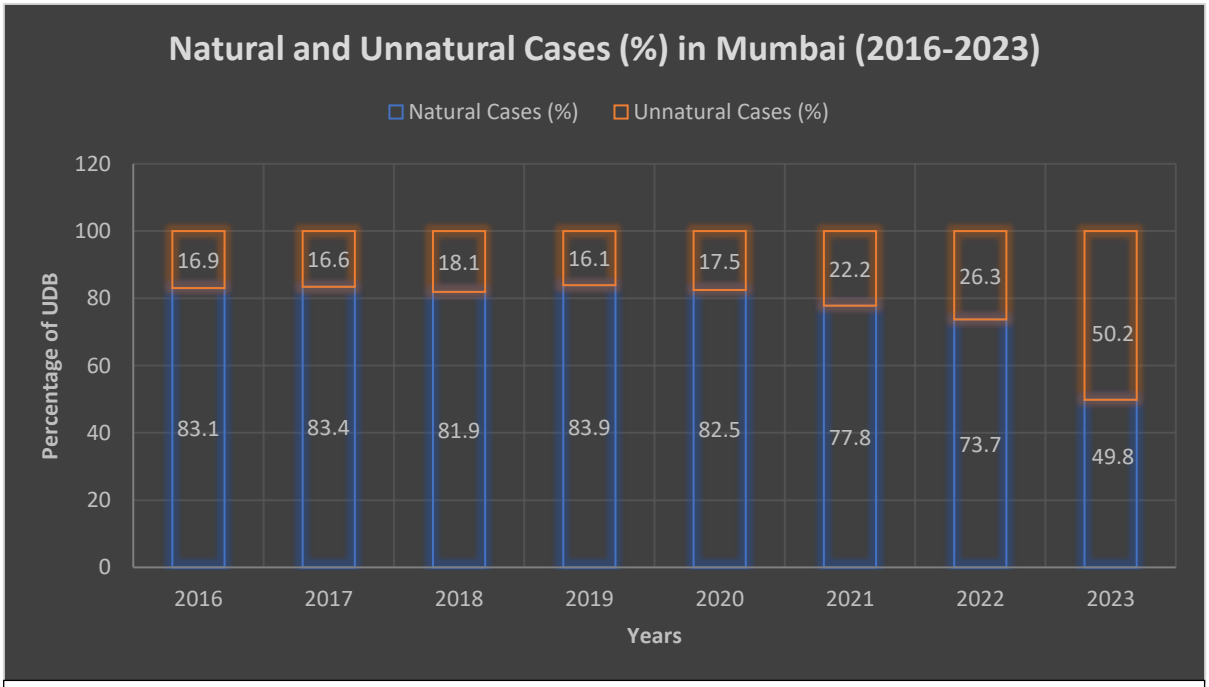


Figure No. 4.1: Natural and Unnatural Cases (%) in Mumbai (2016-2023)

The line graph titled "Natural and Unnatural Cases (%) in Mumbai (2016-2023)" provides a comparative analysis of the percentage of natural and unnatural cases from 2016 to 2023. The data reveals a significant shift in the trend of these cases over the years. The percentage of natural cases, which was initially high at 83.10% in 2016, shows a consistent decrease, reaching a low of 49.80% by 2023.

Conversely, the percentage of unnatural cases, which was relatively low at 16.90% in 2016, exhibits an increasing trend, escalating to 50.20% by 2023. This shift in trends indicates a substantial increase in unnatural cases and a decrease in natural cases in Mumbai over the years.

4.1.2. Pune:

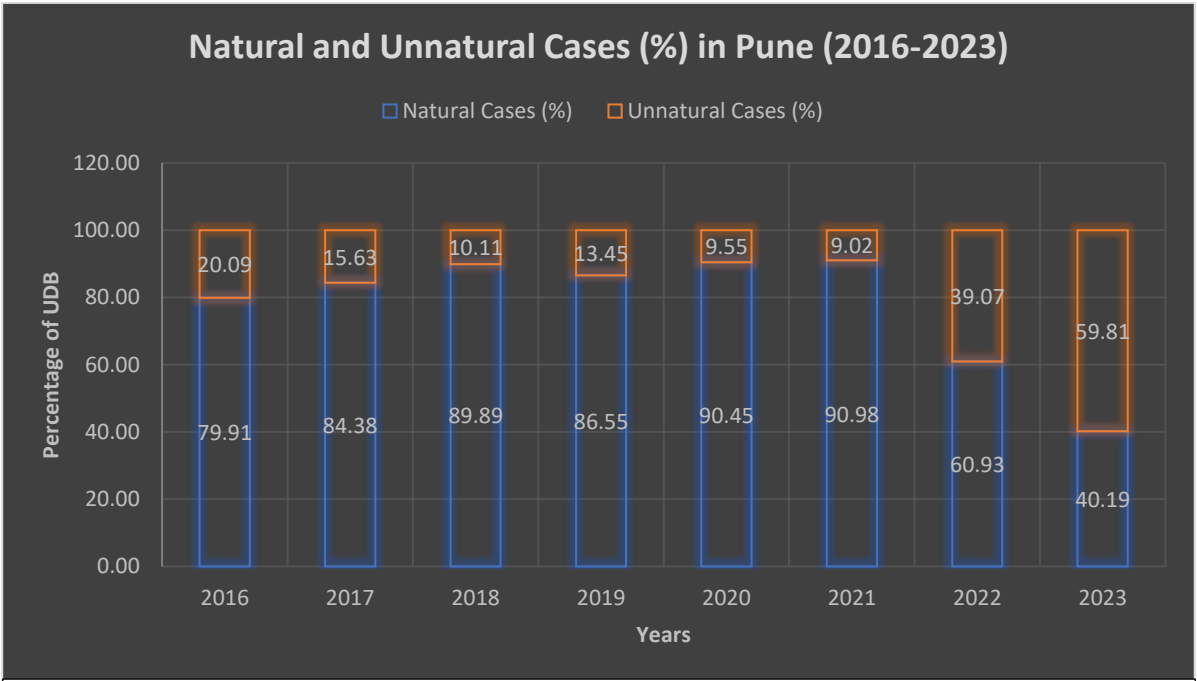


Figure No. 4.2: Natural and Unnatural Cases (%) in Pune (2016-2023)

The bar graph titled "Natural and Unnatural Cases (%) in Pune (2016-2023)" provides a comparative analysis of the percentage of natural and unnatural cases from 2016 to 2023. The data reveals a significant shift in the trend of these cases over the years. The percentage of natural cases, which was initially high at 79.91% in 2016, shows a consistent decrease, reaching a low of 40.19% by 2023.

Conversely, the percentage of unnatural cases, which was relatively low at 20.09 % in 2016, exhibits an increasing trend, escalating to 59.81% by 2023. This shift in trends indicates a substantial increase in unnatural cases and a decrease in natural cases in Pune over the years.

4.1.3. Nagpur:

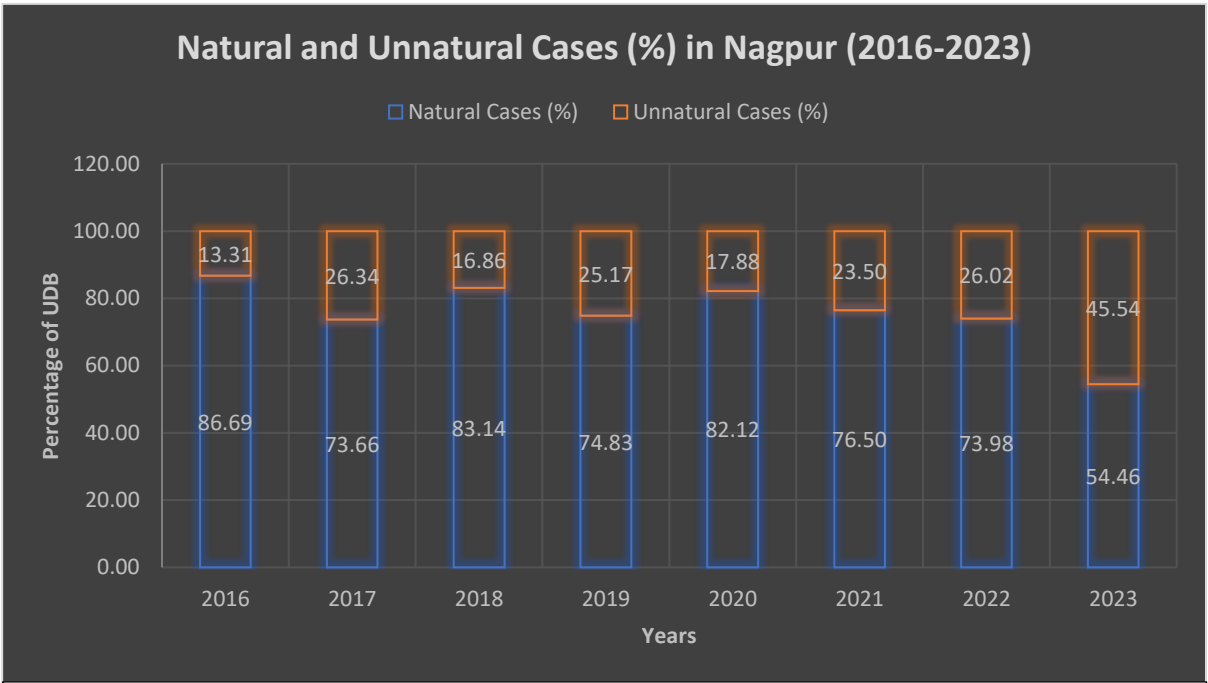


Figure No. 4.3: Natural and Unnatural Cases (%) in Nagpur (2016-2023)

The bar graph titled “Natural and Unnatural Cases (%) in Nagpur (2016-2023)” provides a comparative analysis of the percentage of natural and unnatural cases from 2016 to 2023. The data reveals a significant shift in the trend of these cases over the years. The percentage of natural cases, which was initially high at 86.69 % in 2016, shows a consistent decrease, reaching a low of 54.46% by 2023.

Conversely, the percentage of unnatural cases, which was relatively low at 13.31 % in 2016, exhibits an increasing trend, escalating to 45.54 % by 2023. This shift in trends indicates a substantial increase in unnatural cases and a decrease in natural cases in Nagpur over the years.

4.2. Impact of Pandemic on Unnatural Cases:

This analysis aims to shed light on the profound impact of the COVID-19 pandemic on the count of 'Unnatural Cases' among these individuals, particularly in Mumbai, Pune and Nagpur city. The analysis underscores a significant shift in the number of 'Unnatural Cases' following the onset of the pandemic. However, it is crucial to note that while the data suggests a correlation, it does not necessarily imply causation. Therefore, this report also emphasizes the need for further empirical investigation to establish a direct causal relationship between the pandemic and the observed increase in 'Unnatural Cases'. The findings of this report could potentially contribute to a better understanding of the far-reaching impacts of global health crises such as the COVID-19 pandemic.

The objective is to provide a comprehensive understanding of how global health crises, such as the COVID-19 pandemic, can have far-reaching effects that extend beyond the immediate health implications. By examining these effects in the specific context of 'Unnatural Cases' in Mumbai, the report hopes to contribute valuable insights that could inform future public health responses and social support systems.

In conclusion, this report presents a detailed exploration of the potential correlation between the COVID-19 pandemic and the increase in 'Unnatural Cases' among unidentified deceased individuals in Mumbai, Pune and Nagpur. The findings could provide a broader perspective on the societal impacts of global health crises.

4.2.1. Mumbai

Table No. 4.1: Pre and Post UDB cases in Mumbai.

Year	Natural Cases	Unnatural Cases
2016	**908**	**185**
2017	**730**	**145**
2018	**919**	**203**
2019	**883**	**169**
2020	**798**	**169**
2021	**796**	**227**
2022	**855**	**308**
2023	**549**	**553**

Source: Computed by the researcher based on official data.

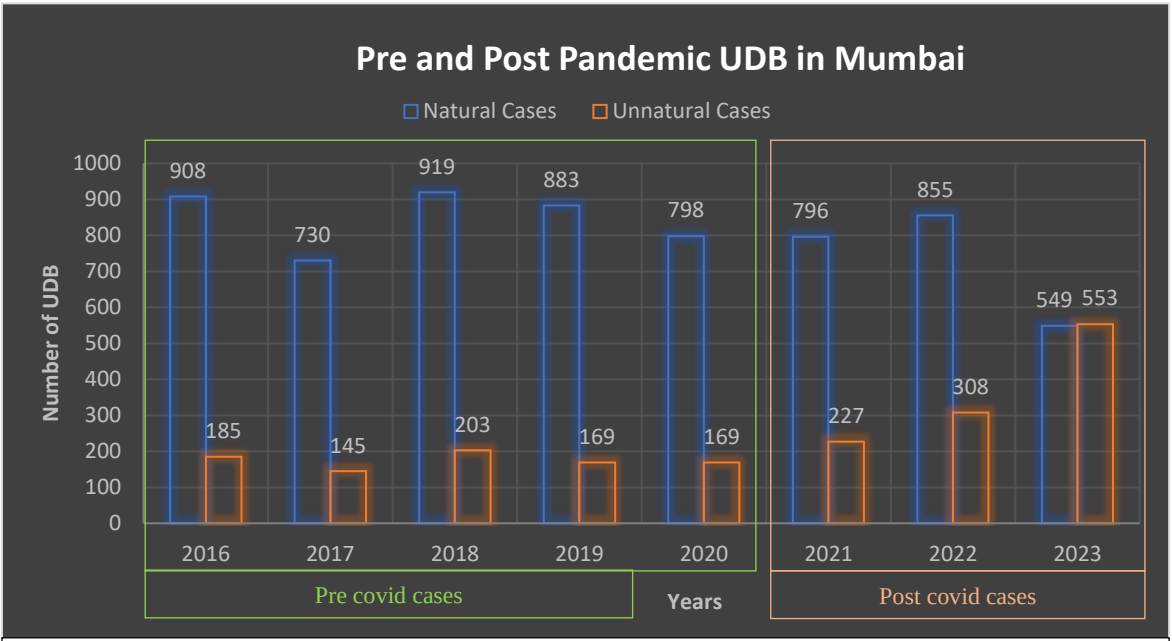


Figure No. 4.4: Pre and Post Pandemic UDB in Mumbai (2016-2023)

In the pre-COVID-19 pandemic era, specifically from 2016 to 2020, the count of unidentified deceased individuals in Mumbai, classified as 'Unnatural Cases', demonstrated minimal variation. The data during this period exhibited a relative stability with minor fluctuations.

However, the emergence of the COVID-19 pandemic in 2020 marked a significant inflection point. Commencing from 2021, there was a substantial change in the number of 'Unnatural Cases'. The data indicates an increase from 169 cases in 2020, escalating to 227 cases in 2021, followed by a sharp rise to 308 cases in 2022, and culminating at 553 cases in 2023. This denotes an increase exceeding threefold within a concise span of three years.

4.2.2. Pune:

Table No. 4.2: Pre and Post UDB cases in Pune.

Year	Natural Cases	Unnatural Cases
2016	**171**	**43**
2017	**162**	**30**
2018	**240**	**27**
2019	**148**	**23**
2020	**199**	**21**
2021	**222**	**22**
2022	**209**	**134**
2023	**166**	**247**

Source: Computed by the researcher based on official data

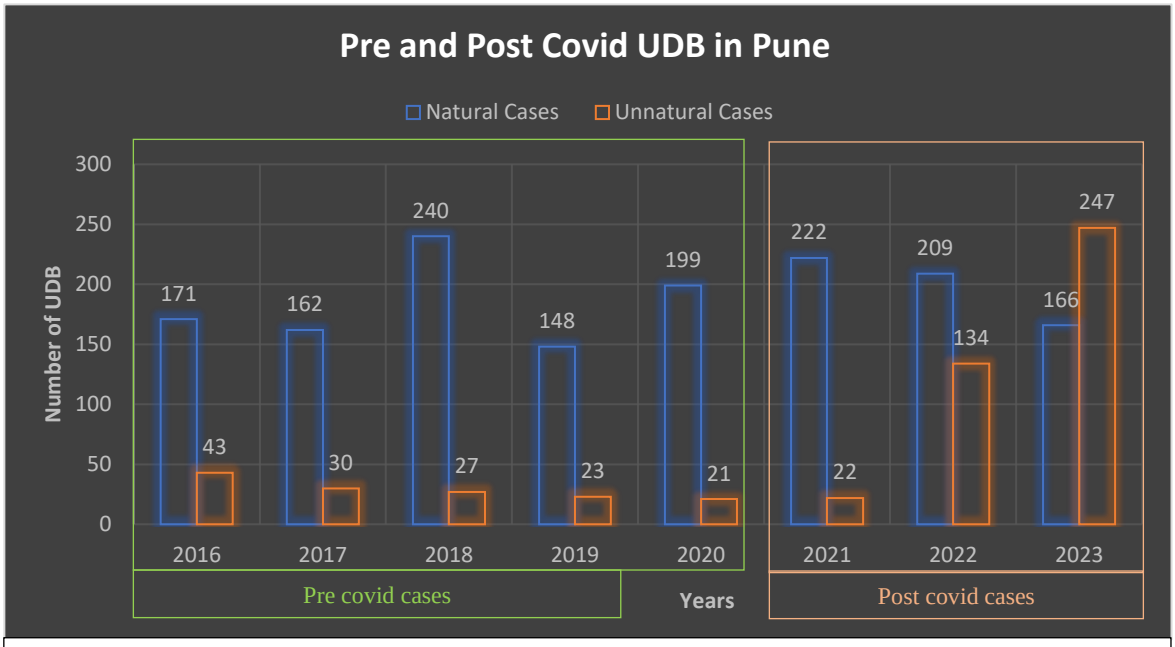


Figure No. 4.5: Pre and Post Pandemic UDB in Pune (2016-2023)

Prior to the advent of the COVID-19 pandemic in 2020, the annual count of unidentified deceased individuals, classified as 'Unnatural Cases' in Pune, exhibited minimal variation. The figures from 2016 to 2020 demonstrate a relative stability, with minor fluctuations.

However, the onset of the COVID-19 pandemic marked a significant shift in this trend. Commencing from 2021, there was a substantial change in the number of 'Unnatural Cases'. The data indicates an increase from 22 cases in 2021, escalating to 134 cases in 2022, and culminating at 247 cases in 2023. This denotes an increase exceeding tenfold within a concise span of three years.

4.2.3. Nagpur: :

Table No. 4.3: Pre and Post UDB cases in Nagpur.

Year	Natural Cases	Unnatural Cases
2016	**215**	**33**
2017	**165**	**59**
2018	**217**	**44**
2019	**226**	**76**
2020	**147**	**32**
2021	**153**	**47**
2022	**236**	**83**
2023	**165**	**138**

Source: Computed by the researcher based on official data

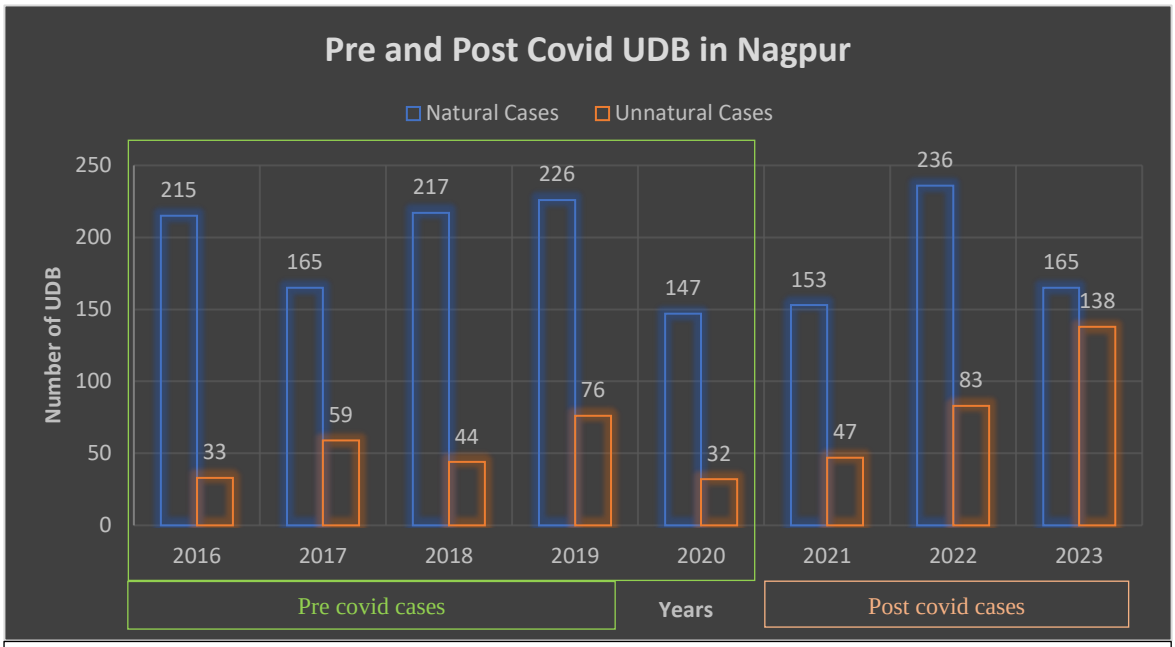


Figure No. 4.6: Pre and Post Pandemic UDB in Nagpur (2016-2023)

In the pre-COVID-19 pandemic era, specifically from 2016 to 2020, the count of unidentified deceased individuals in Mumbai, classified as 'Unnatural Cases', demonstrated minimal variation. The data during this period exhibited a relative stability with minor fluctuations.

However, the emergence of the COVID-19 pandemic in 2020 marked a significant inflection point. Commencing from 2021, there was a substantial change in the number of 'Unnatural Cases'. The data indicates an increase from 32 cases in 2020, escalating to 47 cases in 2021, followed by a sharp rise to 83 cases in 2022, and culminating at 138 cases in 2023. This denotes an increase exceeding threefold within a concise span of three years.

It's important to note that while this data suggests a correlation, further investigation would be needed to establish a direct causal relationship between these trends and the COVID-19 pandemic. Factors such as changes in reporting practices, population growth, and other societal changes should also be considered when interpreting this data.

In conclusion, the COVID-19 pandemic appears to have had a significant impact on the number of unidentified dead bodies, with a decrease in natural cases and an increase in unnatural cases. However, further research is needed to fully understand the extent and nature of this impact.

4.3. Monthly Average Analysis:

By calculating the monthly averages of unidentified bodies in Mumbai, Pune, and Nagpur, a comprehensive overview of the typical occurrence rates across the entire dataset was obtained. This average analysis provides a stable reference point for evaluating deviations and anomalies in monthly trends, facilitating early detection of unusual patterns that may warrant further investigation or intervention.

4.3.1. Mumbai:

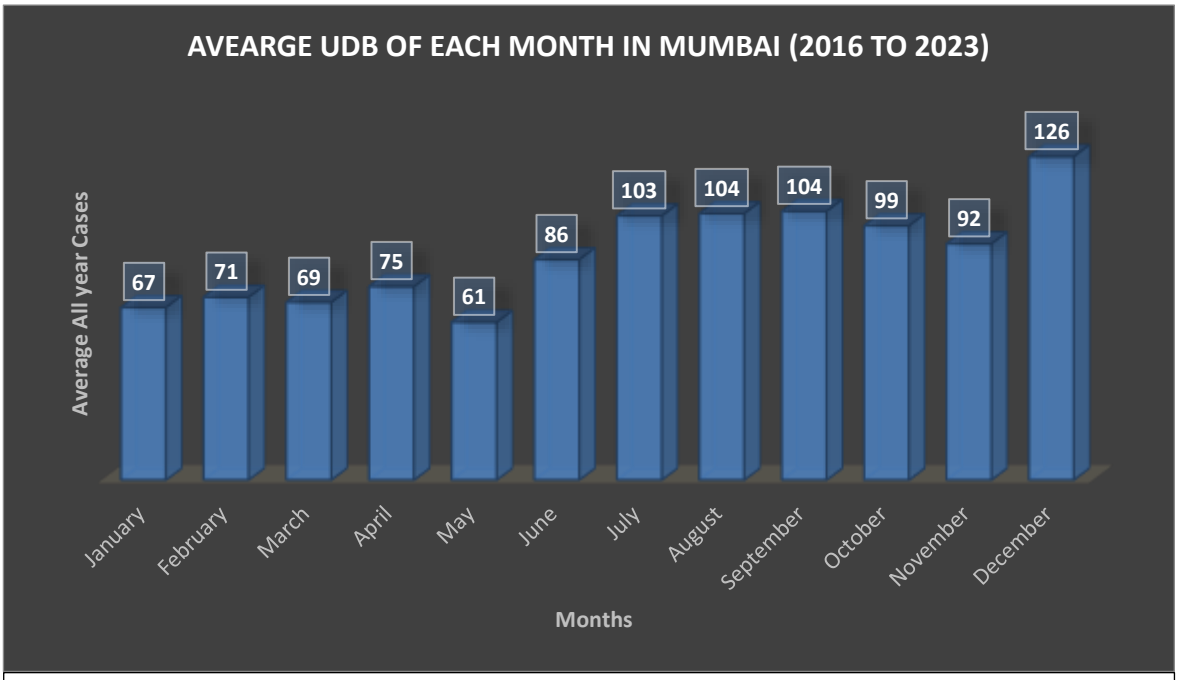


Figure No. 4.7: Average UDB of Each Month in Mumbai (2016 to 2023)

The graph titled "Average Monthly Number of Unidentified Dead Bodies in Mumbai (2016 to 2023)" offers valuable insights into the trends surrounding unidentified bodies in Mumbai city.

By analyzing this data, we can potentially uncover seasonal patterns. Perhaps there are specific months with a higher frequency of unidentified bodies such as December which has a higher number of dead bodies which is 126 also we can see that July to October has a higher number of cases compared to January to May which is the summer season, suggesting possible contributing factors like weather or seasonal population shifts.

4.3.2. Pune:

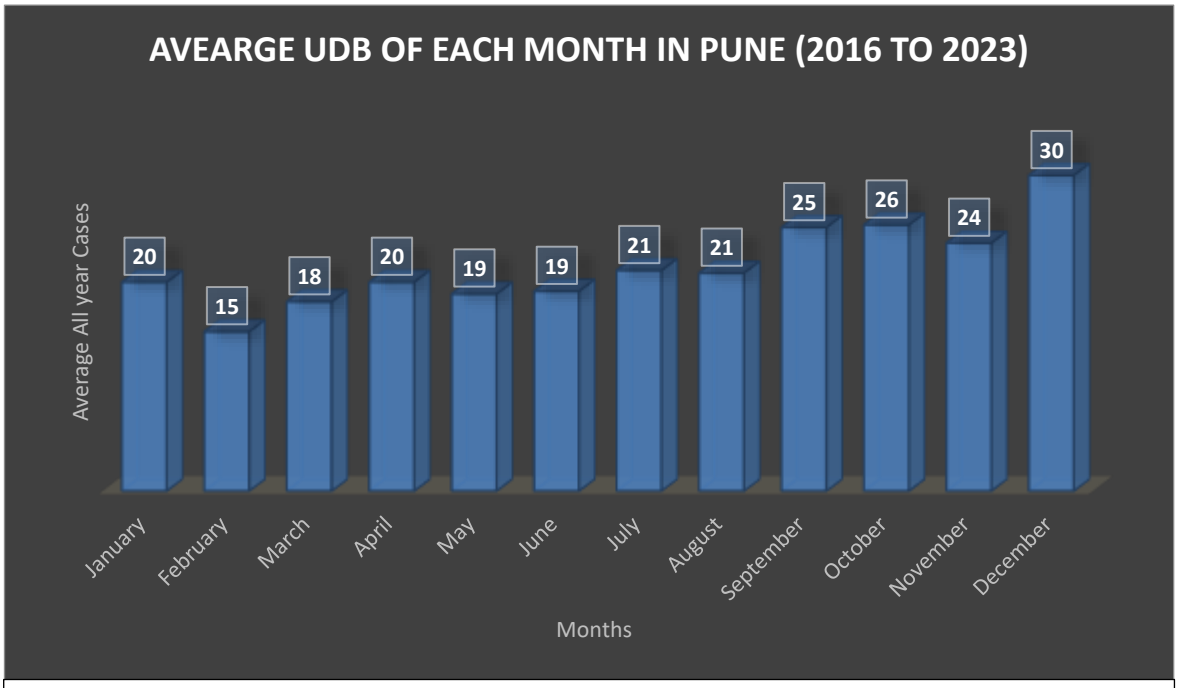


Figure No. 4.8: Average UDB of Each Month in Pune (2016 to 2023)

The figure no. 4.8 graph "Average Monthly Number of Unidentified Dead Bodies in Pune (2016 to 2023)" offers the trends surrounding unidentified bodies in Pune city. The graph depicts the x-axis as months (January to December) and the y-axis showcasing the average number of unidentified bodies discovered each month over the seven years.

By analyzing this data, we can understand the monthly and seasonal patterns of unidentified bodies in Pune. There are specific months with a higher frequency of unidentified bodies such as December which has a higher number of dead bodies which is 30 also we can see that June to November has a higher number of cases which is more than 21 cases each month, compared to January to May which is less than 21 each month, suggesting possible contributing factors like weather or seasonal population shifts.

4.3.1. Nagpur :

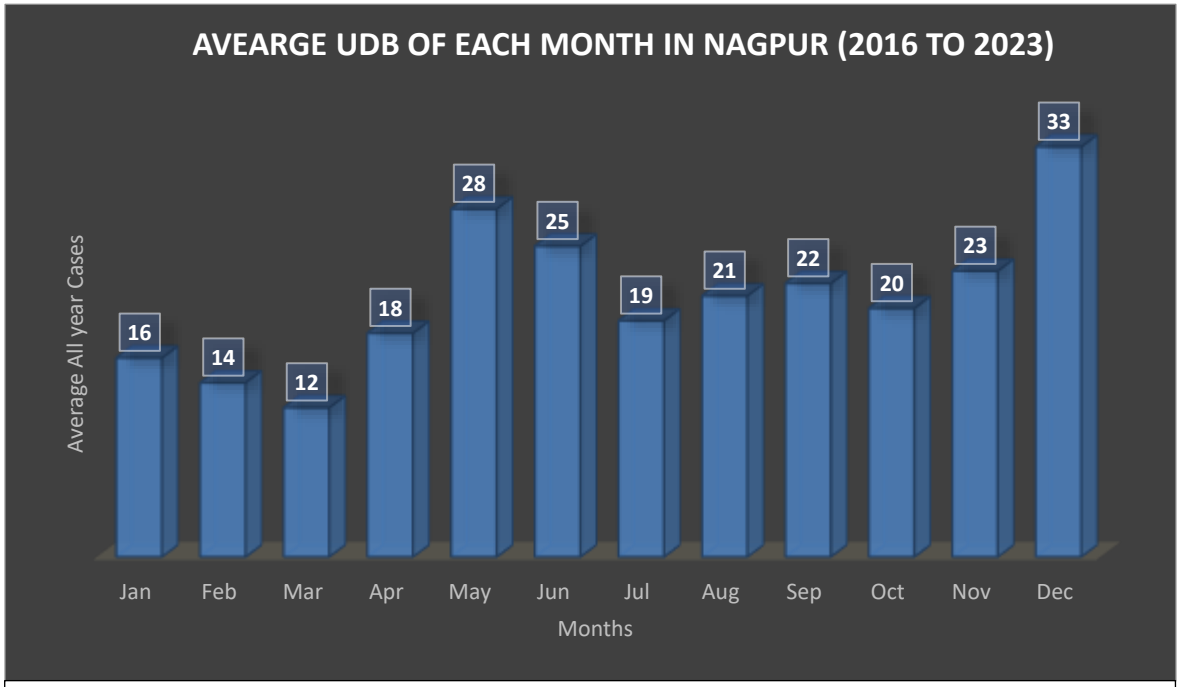


Figure No. 4.9: Average UDB of Each Month in Nagpur (2016 to 2023)

The graph titled "Average Monthly Number of Unidentified Dead Bodies in Nagpur (2016 to 2023)" offers a valuable information about the unidentified bodies in Mumbai city for the analysis.

By analyzing this data, we can easily uncover the trend and patterns influence by oerticular seaason or month. Perhaps there are specific months with a higher frequency of unidentified bodies such as December which has a higher number of dead bodies which is 33 also we can see that May month has high number if cases, suggesting possible contributing factors like weather or seasonal population shifts.

4.4. Mumbai UDB 80/20 Analysis:

ArcGIS Pro's Crime Analysis and Safety toolbox offers an 80-20 Analysis tool that capitalizes on the 80/20 rule (a large portion of problems come from a smaller set of causes). In crime analysis, this translates to a high number of crimes happening in a small number of locations. The tool helps identify these crime clusters, useful for finding "hot spots," prioritizing resource allocation, and understanding the spatial patterns of crime.

4.4.1. Mumbai 2016 to 2023 Total UDB 80/20 Analysis:

Figure No. 4.10: Mumbai 2016 to 2023 Total UDB 80/20 Analysis

This Map highlights the application of the 80/20 rule. It suggests that a significant portion (around 80%) of the unidentified deaths in Mumbai from 2016 to 2023 might be concentrated in a smaller portion (around 20%) of the police stations. These areas with higher number of total unidentified dead bodies represented by the darker red shades and denser markers in the map. This type of analysis is useful for finding hotspot regions.

This map shows that the Southern part of Mumbai is accounted for a majority of Unidentified dead bodies. In particular from 2016 to 2023, Nagpada police station has 394 UDB, Mahim police station has 354 UDB, and at Dongri police station, there are 280 UDB. From the total 91 Police stations,

Important Considerations: The exact percentages (80% and 20%) might not be explicitly shown in the image, but the concept is used to analyze the data. The visualization likely shows the total counts for the entire period (2016-2023). It doesn't necessarily represent the distribution within each year.

4.4.2. Mumbai 2016 to 2023 Natural UDB 80/20 Analysis:

Figure No. 4.11: Mumbai 2016 to 2023 Natural Cases UDB 80/20 Analysis

This Map (Figure No. 4.11) highlights the application of the 80/20 rule. It suggests that a significant portion (around 80%) of the Natural unidentified deaths in Mumbai from 2016 to 2023 might be concentrated in a smaller portion (around 20%) of the police stations. These areas with higher number of Natural unidentified dead bodies represented by the darker red shades and denser markers in the map. This type of analysis is useful for finding hotspot regions, but the concept is used to analyze the data. The visualization likely shows the total counts for the entire period (2016-2023). It doesn't necessarily represent the distribution within each year.

This map shows that the Southern part of Mumbai is accounted for a majority of Natural Unidentified dead bodies.

Important Considerations: The exact percentages (80% and 20%) might not be explicitly shown in the image, but the concept is used to analyze the data. The visualization likely shows the total counts for the entire period (2016-2023). It doesn't necessarily represent the distribution within each year.

4.4.3. Mumbai 2016 to 2023 Unnatural UDB 80/20 Analysis:

Figure No. 4.12: Mumbai 2016 to 2023 Unnatural Cases UDB 80/20 Analysis

This Map (Figure No. 4.12) represents the application of the 80/20 rule. Unnatural unidentified deaths in Mumbai from 2016 to 2023 might be concentrated in a smaller portion (around 20%) of the police stations. These areas with higher number of Unnatural unidentified dead bodies represented by the darker red shades and denser markers in the map. This type of analysis is useful for finding hotspot regions for taking prevention action, the concept is used to analyze the data.

This map shows that the Southern part of Mumbai is accounted for a majority of Natural Unidentified dead bodies. UDB.

The analysis shows that Bandra police station has most of the Unnatural UDB which as 151 after that MHB Colony police station shows 103 cases.

In this analysis we can see that Natural and Unnatural UDB has slightly different spatial occurrence of unidentified dead bodies but overall southern region of Mumbai are responsible for most of the Natural and Unnatural UDB cases.

Important Considerations: The exact percentages (80% and 20%) might not be explicitly shown in the image, but the concept is used to analyze the data. The visualization likely shows the total counts for the entire period (2016-2023). It doesn't necessarily represent the distribution within each year.

4.5 . Power BI Desktop Dashboard:

Through our interactive Power BI dashboard, we would like to offer a complete tool that can be used for the exploration and understanding of data analysis in Chhaya Foundation. This It features interactive visualizations including maps for the spatial distribution of unidentified bodies across Mumbai, Pune, and Nagpur police stations, stacked column chart for monthly breakdowns by cause of death, donut charts for monthly distribution comparison, pie charts for percentage of natural vs. unnatural deaths, and stacked column charts for cases by police stations. Users can filter data by city and year (2016-2023) for a detailed view.

This dashboard contains different components such as sliders for the cities and year data and different visuals are shown by the different types of graphs and maps. The dashboard contains all three cities' data such as temporal data from 2016 to 2023, monthly data percentage, monthly data, and spatial data shown on the map. This tool offers helpful data for the Chhaya Foundation to pinpoint actionable insights and they make their decisions with respect to the analysis.

4.4.1. Mumbai: (page 1)

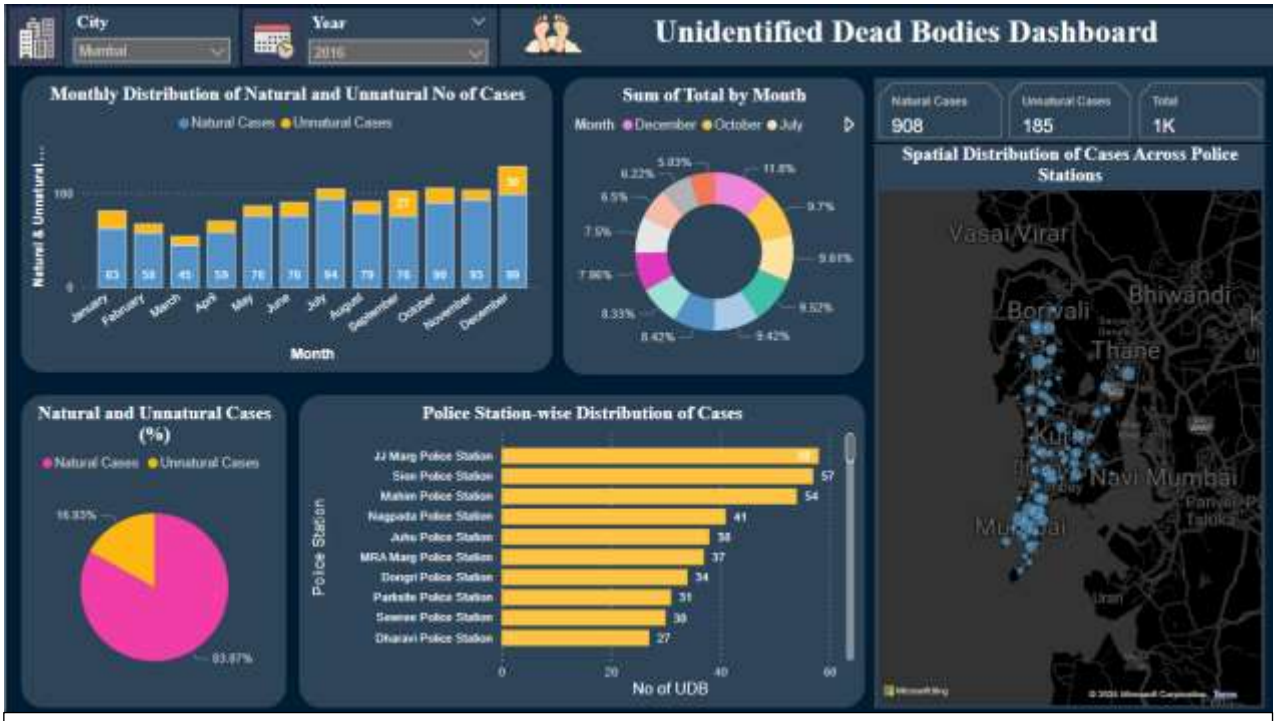


Figure No. 4.13: Dashboard Mumbai region: (page 1)

This section of dashboards that you can see when you select Mumbai in the drop-down slicer includes a slider with data from 2016 and the different visuals included in the picture are represented by different types of graphs and maps.

Here we can see that in the top left corner monthly distribution of cases is shown by Natural and

Unnatural cases. Besides that, we can see Monthly percentage-wise distribution. In the bottom part, we can see police station-wise distribution, and on the right-side spatial distribution of cases by police station.

4.4.2. Pune: (page 1)

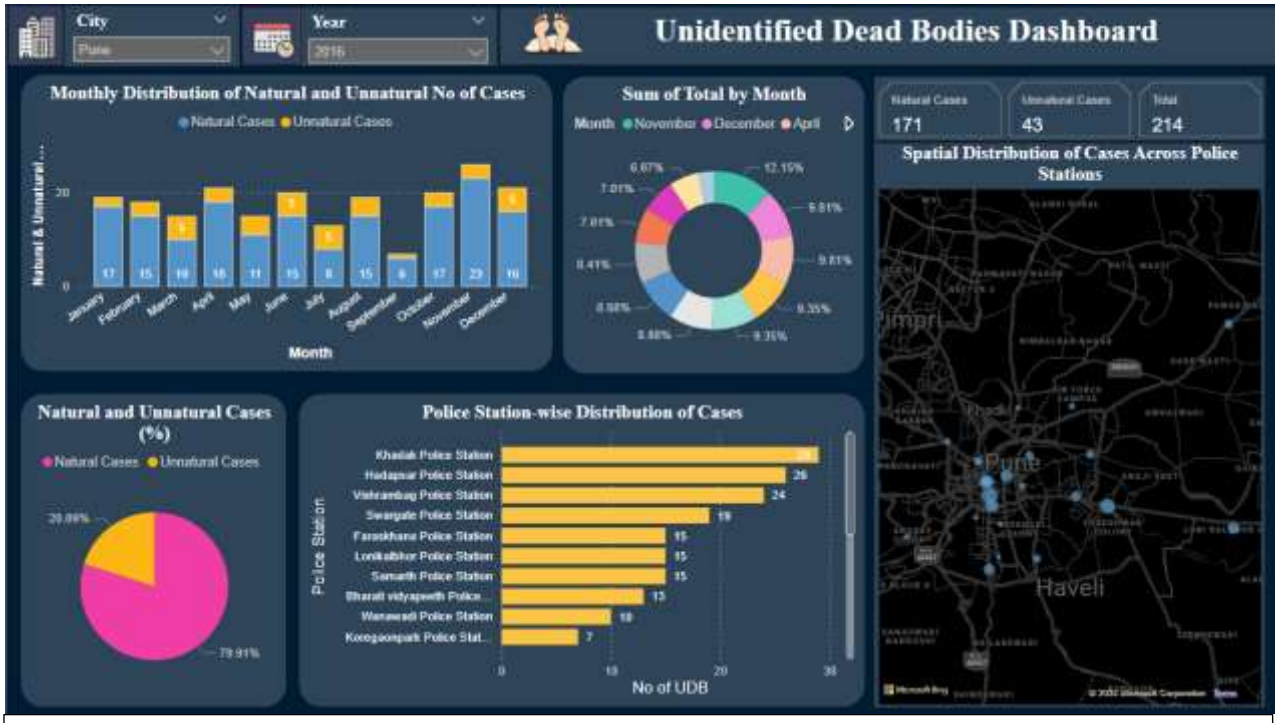


Figure No. 4.14: Dashboard Pune region: (page 1)

The above segment of dashboard can be seen when we select Pune in the dropdown slicer it contains different components such as a slider for the year data from 2016 to 2023 and different visuals are shown by the different types of graphs and maps. Here we can see that in the top left corner monthly distribution of cases is shown by Natural and Unnatural cases. Besides that, we can see Monthly percentage-wise distribution. In the bottom part, we can see police station-wise distribution, and on the right-side spatial distribution of cases by police station.

4.4.3. Nagpur: (page 1)

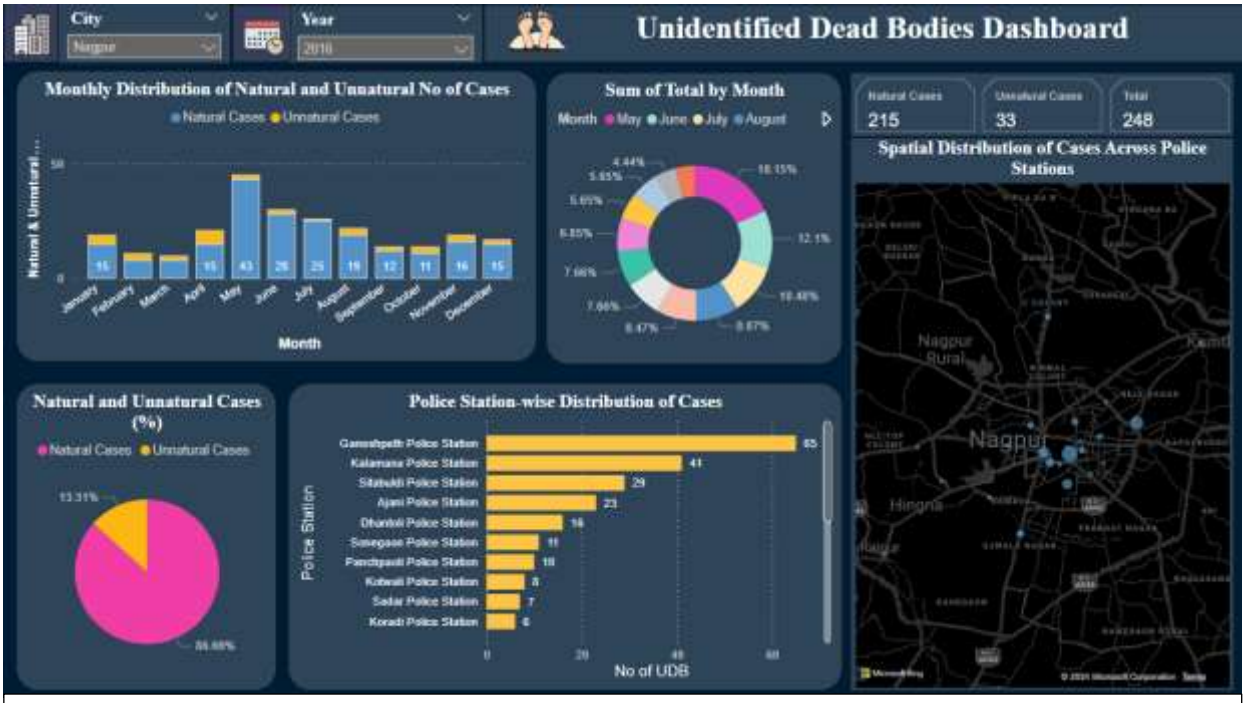


Figure No. 4.15: Dashboard Nagpur region: (page 1)

This particular section of dashboard can be seen when we select Nagpur in the dropdown slicer it contains different components such as a slider for the year data from 2016 to 2023 and different visuals are shown by the different types of graphs and maps. Here we can see that in the top left corner monthly distribution of cases is shown by Natural and Unnatural cases. Besides that, we can see Monthly percentage-wise distribution. In the bottom part, we can see police station-wise distribution, and on the right-side spatial distribution of cases by police station.

4.4.4.: Yearly Comparative Analysis (Page 2):

The page 2 our Power BI dashboard compares the yearly data for that city in order to understand data more deeply. The page consists of the components such as sliders for the city names and their corresponding years as well as scatter charts and maps to visualize different types of data. The dashboard consists of all three cities' temporal data from 2016 to 2023 and it contains. The page is consisting of 5 components namely the Stacked Bar graph, two Funnel diagram, Card, Line chart, and 100% Stacked Column Chart.

In the below picture of the page 2 dashboard, Mumbai city is selected and in the year slicer all years are selected as per the visuals are showing. As we have selected “Select all” in the year slicer all years from 2016 to 2023 are visible through different charts.

Figure No. 4.16: Dashboard for yearly analysis (Default): (page 2)

On the left side, we can see a stacked bar chart representing the year-wise number of Unidentified dead bodies. Besides that, we can see the yearly distribution of Natural and Unnatural dead bodies by Funnel chart. In the top right corner, we can see a number of Natural and Unnatural dead bodies and their total. Below that we can see a yearly distribution of Natural and Unnatural dead bodies by Line chart and below that we can see a yearly distribution of cases based on Police stations.

Figure No. 4.17: Dashboard for yearly analysis (Selected years): (page 2)

On the page 2 dashboard, we can choose one, two, or more than two years or we can also select all years using the "slicer" for comparison. Here, we have chosen 2017, 2020, and 2023 for comparison and therefore visuals have been changed from the previous one where all years were selected.

CHAPTER 5

CONCLUSIONS

Conclusions:

In conclusion, the findings of the research have provided valuable knowledge and understanding of the subject matter and have relevant implications for future research and practical applications.

In conclusion, the comprehensive analysis of unidentified deceased individuals across Mumbai, Pune, and Nagpur unveils significant shifts in the trends of natural and unnatural cases over the years. This comparative examination underscores a noteworthy increase in unnatural cases alongside a decrease in natural occurrences, indicating evolving dynamics in these cities' mortality patterns. Such insights are paramount for devising adaptable response strategies and allocating resources effectively to address emergent challenges in public safety and welfare. Understanding the temporal fluctuations in mortality causes aids in enhancing preparedness and interventions tailored to the evolving needs of each city.

Moreover, the impact of the COVID-19 pandemic on unnatural cases emerges as a focal point of concern, particularly evident in the stark rise observed in the count of unnatural deaths post-2020. While this correlation suggests a potential association between the pandemic and mortality trends, caution is warranted in attributing causation solely to the health crisis. Further empirical investigations are imperative to disentangle the complex interplay of factors contributing to the observed patterns, encompassing changes in reporting practices, demographic shifts, and societal dynamics. This nuanced understanding is pivotal for refining public health responses and bolstering social support systems to mitigate the broader repercussions of global health crises.

The interactive Power BI dashboard provides a user-friendly platform for stakeholders to explore these trends spatially and temporally, enabling informed decision-making and targeted interventions. While the COVID-19 pandemic appears to have influenced mortality dynamics, further research is needed to elucidate causal relationships. Overall, Power BI Dashboard reveal Spatio-Temporal patterns and high-risk areas. This data will be used for implementing preventive measures to reduce the incidence for the Chhaya Foundation.

In essence, the insights gleaned from this research not only shed light on the immediate trends in mortality but also underscore the need for sustained vigilance and interdisciplinary collaboration in navigating the multifaceted challenges posed by mortality dynamics and global health crises. By leveraging data-driven approaches and fostering cross-sectoral partnerships, stakeholders can proactively address emerging trends, fortify resilience, and foster healthier, safer communities for the future.

Limitations of the Study:

The study faced several limitations that impacted the analysis. Firstly, the accuracy of data sourced from the portal was inconsistent, particularly concerning the location data of unidentified deceased individuals. This information often only indicated the hospital location rather than where the bodies were found, hindering the study's ability to analyze spatial patterns effectively.

Secondly, the data was available exclusively in Marathi, limiting accessibility and understanding. Additionally, detailed demographic information such as age and gender were lacking. Moreover, the absence of real-time crime data posed challenges in accurately pinpointing crime locations and timings, restricting the study's ability to analyze temporal and spatial crime dynamics comprehensively. These limitations highlight the need for improved data accuracy, language accessibility, and real-time data sources for future research endeavors.

References:

Mukherjee, K., Saha, S., Karmakar, S., & Dash, P. (2024). Uncovering spatial patterns of crime: a case study of Kolkata. Crime Prevention and Community Safety. https://doi.org/10.1057/s41300-024-00198-4

Keyes CA, Mahon TJ, Gilbert A. Human decedent identification unit: identifying the deceased at a South African medico-legal mortuary. Int J Legal Med 2022; 136: 1889–96.

Raghavendra Babu YP, Joseph N, Kadur K. Mortality among homeless and unclaimed bodies in Mangalore city—an insight. J Forensic Leg Med 2012; 19: 321–23.

Ritter N. Missing persons and unidentified remains: the nation's silent mass disaster. Natl Inst Justice J 2007; 256: 2–7.

Mazzarelli D, Milotta L, Franceschetti L, et al. Twenty-five years of unidentified bodies: an account from Milano, Italy. Int J Legal Med 2021; 135: 1983–91.

Reid KM, Martin LJ, Heathfield LJ. Understanding the burden of unidentified bodies: a systematic review. Int J Legal Med 2023; 137: 1193–202.

Suwalowska, H., Ali, J., de Almeida, J. R., Fonseca, S. A., Heathfield, L. J., Keyes, C. A., et al. (2023). "The Nobodies": unidentified dead bodies—a global health crisis requiring urgent attention. *Open Access*. Retrieved from https://doi.org/10.1016/S2214-109X(23)00420-5

Reid, K. M., Martin, L. J., & Heathfield, L. J. (2023). Understanding the burden of unidentified bodies: a systematic review. *International Journal of Legal Medicine*, *137*(4), 1193–1202. doi: 10.1007/s00414-023-02968-5

McKinney, M. (2022). Tracking and estimating the commingling of missing U.S. service personnel: A GIS and forensic anthropological approach. Anthropology Department Theses and Dissertations. University of Nebraska - Lincoln. Retrieved from https://digitalcommons.unl.edu/anthropologythesis/29/

Parra, R. C., Anstett, É., Perich, P., & Buikstra, J. E. (2020). Unidentified deceased persons: Social life, social death and humanitarian action. In R. C. Parra, S. C. Zapico, & D. H. Ubelaker (Eds.), Forensic Science and Humanitarian Action: Interacting with the Dead and the Living (pp. 79-99). Wiley. https://doi.org/10.1002/9781119482062.ch6

Wankhede, M. N., Parchake, M. B., Pathak, H., & Hosmani, A. (2017). Study of demographic profile of unidentified dead bodies in central Mumbai region. Scholars Journal of Applied Medical Sciences, 5(1A), 57-61. DOI: 10.36347/sjams. 2017.v05i01.011

Yadav, A., Kumar, A., Swain, R., & Gupta, S. K. (2017). Five-year study of unidentified/unclaimed and unknown deaths brought for medicolegal autopsy at Premier Hospital in New Delhi, India. Medicine, Science, and the Law, 57(1), 33-38. https://doi.org/10.1177/0025802416680523