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The Impact of Student Mobility for Engineering College selection: pre and post COVID-19 era using GIS

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ABSTRACT
The Covid-19 pandemic has brought changes to society in several aspects of people's everyday life. One of them is the short and long-term impact on everyday mobility during the early stages of the pandemic and the post-pandemic period. This paper aims to study the effects on the mobility of UG engineering students for selection of Engineering Colleges in the pre and post-COVID-19 era. This study was done at Techno Engineering College Banipur, WB, India. This work utilized GIS to compare spatial distribution based on the home location of the students who have been taken admission between the 2017-18 and 2022-23 academic years. The paper intents to study the effects on students' mobility using mean centers and standard deviational ellipse between different academic years. The result indicates that students are given preference select colleges nearer to their home locations after the pandemic than in the pre-pandemic period. Depending on our understanding we suggest some possible policies to the college authorities regarding the admission campaign, that can be carefully implemented, both in the short and long-term to help student mobility effects more efficiently and scientifically.
Keywords— GIS, Standard Deviational Ellipse, Mean Center, Covid-19 pandemic, Student Mobility, Engineering College Selection.

1. Introduction

WHO (World Health Organization) declared Covid-19 as a pandemic worldwide on 11th March 2020[1]. Indian Government announced its first lockdown on 25th March 20220 for 21 days. Gradually that was extended in different phases from lockdown 1.0 to lockdown 5.0 up to July 2022[2]. Following the Government's instructions for "social distancing" and "physical distancing" to tackle the spread of the infection, all academic institutions were bounded to follow the "online" teaching-learning mode rather than the physical mode up to the end of 2021[3].

The Covid-19 pandemic has caused a huge impact on the higher education system worldwide in different aspects, particularly student mobility [4]. In the academic year 2020-2021, all major destination countries like US, UK, and Australia faced a loss in international student enrollment [6][7].

After COVID-19 people prefer to take admitted to near colleges rather than go far away from their home location also with the above context this study is set to examine the impact of student mobility on the selection of engineering colleges in the pre-and post-Covid era in India. The study adopted the GIS techniques for analyzing the home locations and spatial points of the students admitted in different academic years in the pre and post-pandemic situations focusing on the following questions.

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i. Is there any impact of mobility on the selection of engineering colleges in India?
ii. what are the different impacts in the early stages and the post-pandemic periods?

Many studies have shown that Indian higher education faced many challenges due to poor internet access, and proper electricity facilities in many villages [8]. Some studies aimed to understand the impact of faculty productivity due to work-from-home[9]. Several studies have comprehended the challenges of the Covid-19 pandemic higher education teaching-learning process in India[10].
Many articles articulated the adverse effect of student mobility on International higher education that has changed the international study market[11]. The Pandemic lost the Chinese student's perspective on the US in international education[12]. Some articles looked at the European context, and how the Covid-19 pandemic has impacted on the management of internationalized learning[13]. Ramzi Qwasmi utilized GIS to generate flow maps, flow charts, and themed maps of human mobility to predict the localized lockdown zone in Kuala Lumpur[14]. Public participatory GIS was used through the map-based online survey to investigate the changes in mobility of everyday life in the context of Sweden [15].
In Environmental Criminology the author's intent was to compare the spatial distribution of different property crimes in Chennai city using mean center points and standard distribution ellipse(SDE) using GIS[15]. (Ceccato et al.2002)[16] Conducted similar offense statistics in Stockholm city, Sweden using mean centers and Standard Deviation Ellipses of crime points[16].
Standard deviation arises as one of the classical statistical measures for drawing up the dispersion of univariate features around its center. Its evolution in two-dimensional space arrives at the standard deviational ellipse (SDE), which was first proposed by Lefever [17] in 1926. It is used for sketching the geographical trends of the feature concerned by summarizing both their dispersion and orientation.GIS is another system or tool for displaying and analyzing data related to positions on Earth's surface. It can be used for any information that can include Location. The location can be expressed in many different ways, such as latitude and longitude. Using GIS technology, we can easily compare the locations of different places in order to discover how they relate to each other. This paper utilized GIS to compare spatial distribution based on the home location of the students who have been taken admission between the 2017-18 and 2022-23 academic years in Techno Engineering College Banipur, W.B., India.

2. Experimental Methods or Methodology

2.1. Data

This study relies on the primary data obtained from Techno Engineering College Banipur, West Bengal, India. Academic year-wise students' residential location data were collected for three pre-Covid years -2017-2018, 2018-2019, and 2019-2020 and two post-Covid years 2021-2022 and 2022-2023.

2.2. Methodology

The location data of students' residences were entered using QGIS Desktop 3.4(Figure 1). Then latitude and longitude were generated for students' home locations. Then these coordinates were exported to GIS to analyze the Mean centers and Standard Deviation Ellipse areas of different academic years. Finally, output maps were prepared using GIS layouts for
analysis.

The spatial mean center is given as:

The *Weighted Mean Center* is calculated by multiplying the x and y coordinates by the weight for that feature and summing all for both x and y individually and then dividing this by the sum of all the weights.

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$$\text{wgt\_mean\_x} = \frac{\text{sum of (x coords * wgt)}}{\text{sum of all wgts}}, \quad \text{wgt\_mean\_y} = \frac{\text{sum of (y coords * wgt)}}{\text{sum of all wgts}}$$

For *Point* features the X and Y coordinates of each feature are used, for *Polygons* the centroid of each feature represents the X and Y coordinate to use, and for *Linear* features, the mid-point of each line is used for the X and Y coordinate.

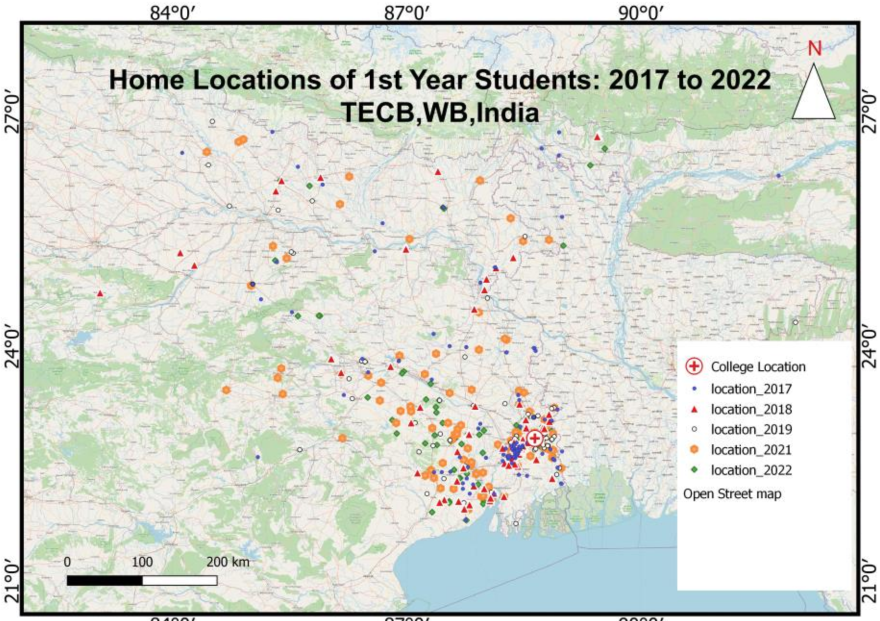

Fig. 1.

The Standard Deviational Ellipse is given as:

Standard deviational ellipse (SDE) has long served as a versatile GIS tool for delineating the geographic distribution of concerned features. You can calculate the standard deviational ellipse using either the locations of the features or the locations influenced by an attribute value associated with the features.

$$C = \begin{pmatrix} var(x) & cov(x,y) \\ cov(y,x) & var(y) \end{pmatrix} = \frac{1}{n}\begin{pmatrix} \sum_{i=1}^{n} \tilde{x}_i^2 & \sum_{i=1}^{n} \tilde{x}_i\tilde{y}_i \\ \sum_{i=1}^{n} \tilde{x}_i\tilde{y}_i & \sum_{i=1}^{n} \tilde{y}_i^2 \end{pmatrix} \quad \text{where}$$

$$var(x) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2 = \frac{1}{n}\sum_{i=1}^{n}\tilde{x}_i^2$$

$$cov(x,y) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y}) = \frac{1}{n}\sum_{i=1}^{n}\tilde{x}_i\tilde{y}_i$$

$$var(y) = \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2 = \frac{1}{n}\sum_{i=1}^{n}\tilde{y}_i^2$$

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Where x and y are the coordinates for feature i, $\{\bar{x}, \bar{y}\}$ represent the Mean Center for the features and n is equal to the total number of features.

The sample covariate matrix is factored into a standard form which results in the matrix being represented by its eigenvalues and eigenvectors. The standard deviations for the x- and y-axis are then:

$$\sigma_{1,2} = \left(\frac{(\sum_{i=1}^{n} \tilde{x}_i^2 + \sum_{i=1}^{n} \tilde{y}_i^2) \pm \sqrt{(\sum_{i=1}^{n} \tilde{x}_i^2 - \sum_{i=1}^{n} \tilde{y}_i^2)^2 + 4(\sum_{i=1}^{n} \tilde{x}_i \tilde{y}_i)^2}}{2n} \right)^{1/2}$$

3. Results and Discussion

Figure 2 reveals the relative measure to compare spatial distribution patterns of the student's mobility among different academic years using mean center points. Mean centers of all the years are located in almost the nearby areas. There is no such difference in the pre-Covid and post-Covid periods. But year by year they are shifting towards the south direction.

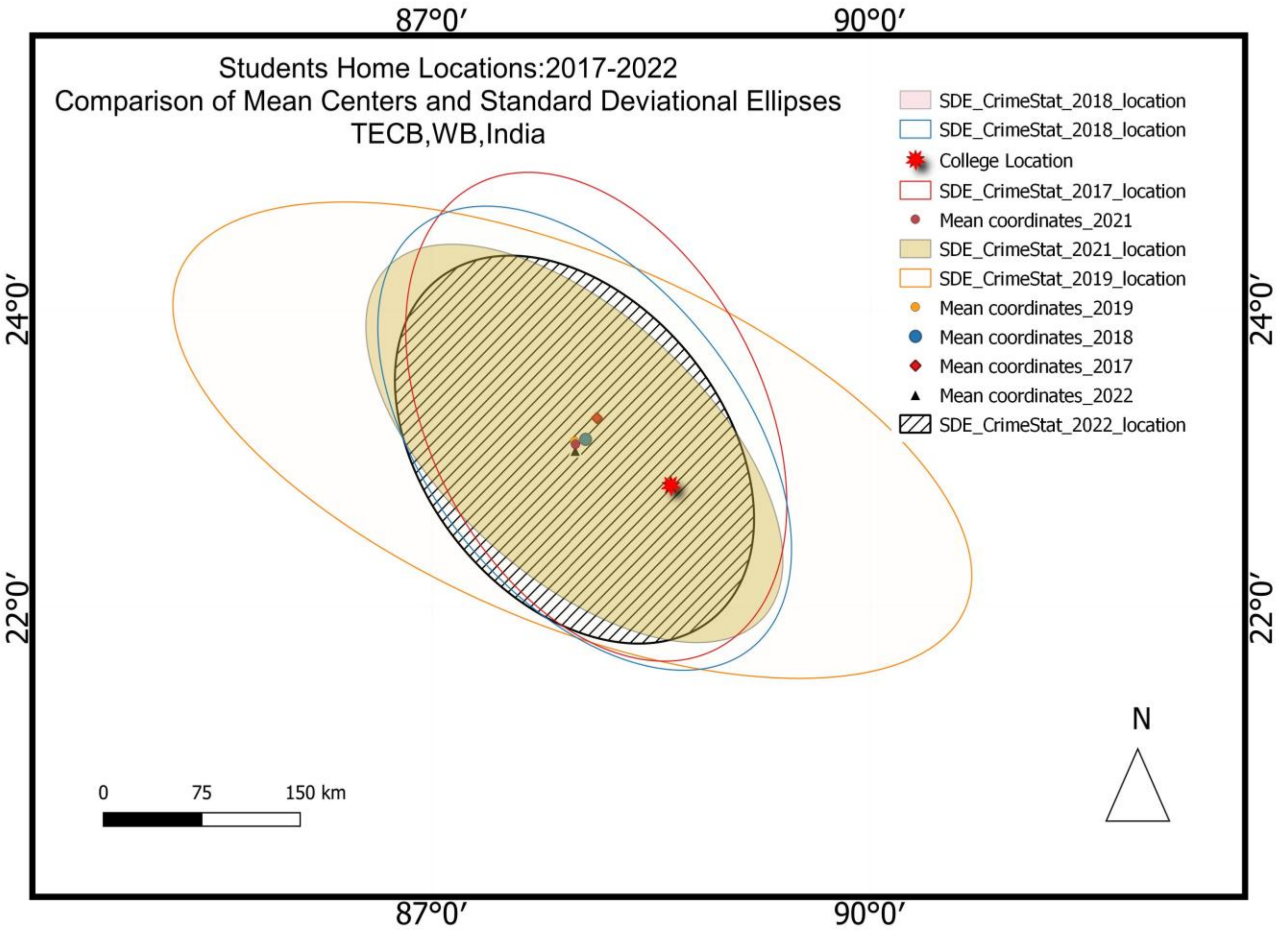

Fig. 2.

Figure 2 shows all five standard deviation ellipsis students' home locations in all the academic years. To understand the relative differences in dispersion and alignment of the student's home locations in different academic years, the subtle differences between the ellipses help to describe.

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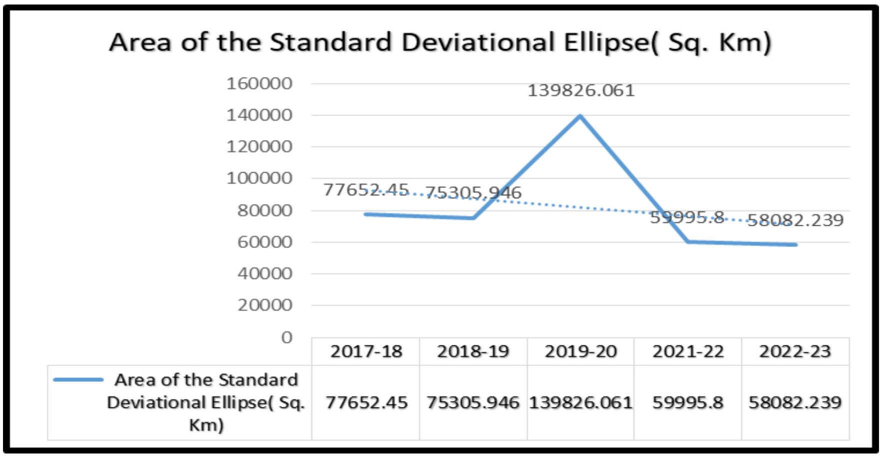

Fig. 3.

Figure 2 reveals that area of ellipses between pre-Covid years is different from post-Pandemic years in size. Figure 3 shows that during the pandemic period, in the academic year 2021, the size of the ellipse is smaller than the size of the ellipse of the pre_Covid year 2019, which is the largest one. That means that students preferred to take admission to near colleges rather than go far away from their home location. But figure 2 also reveals another very interesting observation that in the post_covid period in the year 2022, the size of the ellipse is the smallest one. Taking a case study of one of the West Bengal district colleges, this may conclude that in the post-pandemic era, the mobility of UG engineering students somehow has been restricted and that has also shown the impact on the selection of engineering colleges.

CONCLUSION

This research examined changes in Student mobility after COVID-19. Our research is important because it significantly contributes to the literature on the impact of the COVID-19 pandemic on Student mobility patterns. Our Research work signified that students are given preference to select colleges nearer to their home locations after the pandemic than in the pre-pandemic period. We can suggest some possible policies to the college authorities regarding the admission campaign, that can be carefully implemented, near to our college rather than going far away from the college location. Our study provides complementary high-frequency evidence. The economic costs of lockdowns fall instead disproportionately on working-age people. This analysis shows that parents is preferring the nearest college to their children rather than a faraway college. Consistent with survey evidence, this could be because parents are more concerned about the virus despite being less likely to develop severe health conditions.

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