# Spatial Analysis of Journey-to-School by Secondary School Students in Minna, Nigeria

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## Abstract

*Education infrastructure planning is an integral part of society amidst the rapid urbanisation experienced in Nigerian cities. This study analysed the Journey-to-School of public and private secondary school students in Minna, Nigeria. The study's objectives were to examine the spatial analysis of public and private secondary schools and the distance covered by the students from home to school in Minna. Quantitative data were collected from 8422 students in 107 schools comprising 20 public and 87 private secondary schools. Data collected were corroborated with geographic information analysis. The study reveals that the average distance covered (2.70km) by students attending public schools is more than the distance covered (2.07km) by students attending private secondary schools. The study further reveals that 53.19% of the students in public schools travel more than 2 km to school daily, but with the inclusion of private schools, the percentage of students travelling above 2 km to school daily was reduced by 10%. The study concludes that the cluster and the random distribution in private and public secondary schools are indications of poor education infrastructure planning. The study, therefore, recommends proper education infrastructure planning and that public schools should be provided in neighbourhoods where students travel more than 5 km daily to access secondary education*

***Keywords:*** *Spatial Analysis, Home-School Distance, Journey-to-School, Public Schools, Private Schools*

## 1,0 Introduction

Location and allocation principles are of great importance in facilities planning. They help determine the optimal quantity and location of facilities that will ensure maximum utilisation and distance minimisation. Insufficient supply of schools can lead to a lack of education opportunities for students and longer travel distances, while too many schools in one area can result in low enrolment rates, underutilisation and resource wastage. Longer home-school distances have been shown to have an impact on students. It has been found to lead to increased transportation costs **(He and Giuliano 2018)**, increased commuting time **(Idowu, 2016)**, and decreased student academic performance **(Mhiliwa, 2015)**.

By 2030, all girls and boys in Nigeria are expected to have acquired complete, free, equitable and quality primary and secondary education (United Nations, 2015.). This requires the establishment of schools in the right quantity, quality, cost and distribution in order to be accessible to the citizens irrespective of their economic status. However, studies (Tarkhnishvili *et al*., 2022; United Nations Educational Scientific and Cultural Organization, 2021) have shown that public authorities are not able to supply enough schools, hence the emergence of private schools to fill in the

gap, but at a cost. As comprehensively documented by Day *et al*. (2014), there is moderate strength evidence that private schools tend to be more expensive than state schools in terms of both school fees and hidden costs such as uniforms and books. However, because of the perceived higher quality of outcomes, parents who can afford the cost are prepared to enrol their children in these private schools. As noted by OECD (2012), one reason could be that parents believe that these schools offer a better education, an environment more conducive to learning, additional resources, and better policies and practices, and advantaged parents are more informed or aware of the differences in quality across schools.

Different researchers have examined the various dimensions of home-school distance from various angles. Mantovan *et al*. (2021) examined the home-school distances and the percentage of students who choose schools farther from their homes in Milan, Italy. They found that there is almost no difference in school proximity between native and immigrant-origin students. However, native students are more likely to attend schools that are farther from their homes. The analysis only considers students in the final year of lower secondary education.

In another study, Oneya and Onyango (2021) examined the perceived effect of distance-related variables on students' academic performance in community secondary schools in Rorya District, Tanzania. The study found that long distances travelled by students have negative effects on their academic performance. It leads to reduced teacher-student contact time, as students spend more time travelling to and from school. The sample size of 87 respondents may not be fully representative of the entire population of stakeholders in community secondary schools in Rorya District. The study relies on self-reported perceptions of school stakeholders, which may be subject to biases and inaccuracies.

In Nigeria, the spatial distribution and proximal model of secondary educational facilities in Oyo State, Nigeria's Ibadan South West, are the main focus of a study by Agbabiaka *et al*. (2020). With a higher concentration of schools in some wards than others, the results showed a dispersed pattern of school distribution. In general, according to their findings, the secondary schools' locations were found to meet UNESCO requirements for school placement. The research was dependent on self-reported information from students and school administrators, which could have included errors or biases. Adewuyi *et al*. (2022) conducted a study in the same city that revealed school clustering in certain areas of Ibadan and fewer schools in other parts. The study also found that students' mental abilities, academic participation, academic performance, communication with teachers, and feelings of insecurity during travel are significantly impacted by the distance they travel.

Aule *et al.* (2023) studied how accessible secondary schools are in various parts of Benue State. The study used geostatistical analysis. To examine the spatial distribution of schools and their proximity to populated areas, the researchers employed Geographic Information System (GIS) techniques. The study discovered that different regions of Benue State had varying degrees of accessibility to secondary schools. A further finding of the analysis was that there was an uneven distribution of schools, with a

higher concentration of schools in some areas than in others. Even though this study is extensive, with 8422 questionnaires administered in 120 secondary schools, distance estimation was based on students' perceptions. GPS only captured the school's location. The approaches used by the studies reviewed show that the average nearest neighbourhood analysis was not considered in determining the spatial distribution of schools. This gap was filled in this study; against this background; this study aims at analysing the Journey-to-School by Secondary School Students in Minna, Niger State. The specific objectives considered for this study are:

I.    To examine the spatial analysis of public and private secondary schools in Minna;
II.   To examine the distance covered by secondary school students from home to school.

## 2.0 Methodology

The study area was divided into 39 sub-units based on the existing neighbourhoods of Minna to ensure adequate coverage of schools. A Questionnaire prepared on Open Data Kits (ODK) was used as the instrument for data collection.    The ODK was preferred because it automatically captures the coordinates of points of interest. The Purposeful sampling technique was adopted because the class sizes were unknown and there is a vast variation in the number of students per class between private and public schools. At least five students were interviewed in each class from Junior Secondary School 1 to 3 to Senior Secondary School 1 to 3. The questionnaire asked about the gender of students, the mode of travel to school, and the neighbourhood in which their houses were located. The

coordinates of the schools were automatically captured, while the coordinates of the neighbourhood centres where the students' homes are located were captured from Google Earth during office work. The longitude and latitude coordinates were converted to Eastings and Northings, and thereafter, the origin and destination coordinates were converted to distances. Data were collected from 107 schools and responses were received from, 8871 students in the 107 schools identified. After data cleaning, 8,422 responses were accepted for analysis. This total may vary due to missing information on one or two of the variables.

The threshold distance of 2km was adopted as the ideal travel distance for a secondary student (Duze, 2011; Kanayochukwu *et al*., 2020). To this effect, a buffer of a 2km radius was created around the private and public secondary schools to ascertain the neighbourhoods in which secondary school students travel beyond the 2km mark.

## 2.1 Ethical consideration

A Parental and guidance consent form was given to students below the age of 18 years; upon the return of the signed consent form the students were allowed to participate in the research. The identity of students who participated in this research was protected; no student was coerced to participate in the research.

## 3.0 Data Analysis

## 3.1 Descriptive analysis

A total of 20 public and 87 private secondary schools in operation were found in the comprehensive survey carried out in the city of

Minna, central Nigeria. Table 1 reveals that 52.16% of the respondents in both public and private secondary schools were males while 47.84% of students were female in both private and public secondary schools. The number of students from sampled Classes one to six that is, Junior Secondary 1 (JS 1) to Senior Secondary 3 (SS 3) varied from 1,052 in SS3 to 1,633 in JS 1 as shown in Table 1

## 3.2 Mode of Journey-to-School

The majority of the students (42.0%) undertook the journey to school on foot, the second highest mode of transport was the tricycle as 2582 (30.7%) students used the mode. The choice of tricycles by 30.7% of the students can

be attributed to the acceptance of tricycles as a mode of transportation in all Nigerian cities (Adeyemi and Yusuf, 2019). The study reveals that 1689 (20.0%) of the students use motorcycles due to the opinion that the mode is fast. This perception was also shared by Igwe and Osisioma, (2023) who opined that motorcycles are fast at accessing roads and getting to one's destination in time. Other modes of transportation used by the students in the study area were private cars (4.6%), school buses (1.6%), taxis (0.1%) and bicycles (1.0%). The students' modes of transportation are explained in Figure 1.

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Table 1: Sample population by Gender and School Type

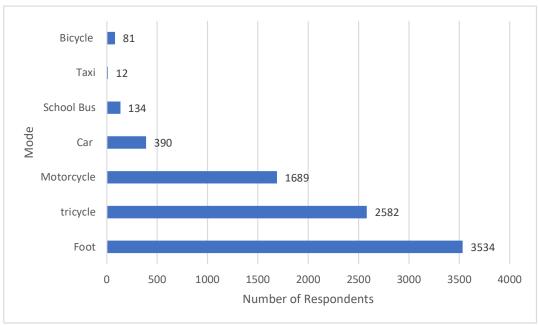| Variable | | Counts | % of Total |
|---|---|---|---|
| Gender | Female | 4029 | 47.84 % |
| | Male | 4393 | 52.16 % |
| Class | JSS 1 | 1633 | 19.39 % |
| | JSS 2 | 1624 | 19.28 % |
| | JSS 3 | 1580 | 18.76 % |
| | SS 1 | 1351 | 16.04 % |
| | SS 2 | 1182 | 14.03 % |
| | SS 3 | 1052 | 12.49 % |

Source: Authors analysis, 2023

Figure. 1: Mode of Journey-to-School
Source: Authors analysis, 2023

## 3.3 Data Analysis
**Spatial Analysis of Secondary Schools in Minna**
In explaining the spatial analysis of secondary schools in Minna the relationship between the secondary schools and bus stops, and the distance travelled to School by Gender in Minna was ascertained. Figure 2 depicts the service area of the bus stops within a five-minute drive in Minna. The study shows that the majority of the public secondary schools (14; 70%) were within five minutes travel time to the bus stop, while six secondary schools were outside the five minutes travel time distance from the bus stop. Similarly, the majority of the private secondary schools (54; 62%) were within five minutes travel time to the school, while 33 (38%) were outside the minimum five minutes travel time from the bus stop. This implies that students who travel by mechanical means (tricycle, taxi, school bus) may have to make part of their trip on foot for more than five minutes before getting their mode.

Pooling all the students together, the median distance travelled by male respondents from home to school was estimated to be 1.43 km per trip which was found to be lower than that of the female students (1.55km) as shown in Table 2. This difference was not found to be statistically significant ($U$=8,664,254.5, $p$=.096).

## 3.4 Spatial Variation of Distance Travelled by Secondary School Students in Minna

The spatial variation of distance travelled in the study area by respondents who attend public secondary school is presented in Figure 3. The result reveals that respondents who reside in Talba Estate, Gurara, Nyikangbe, Kpakungu, Barkin Sale, Sahuka Kahuta, Chanchaga, and Gbeganu travel above 5km from their home to the school. The lengthy travel distance embarked upon by the respondents in these neighbourhoods can be attributed to the lack of public secondary schools within their neighbourhoods (See Figure 3).
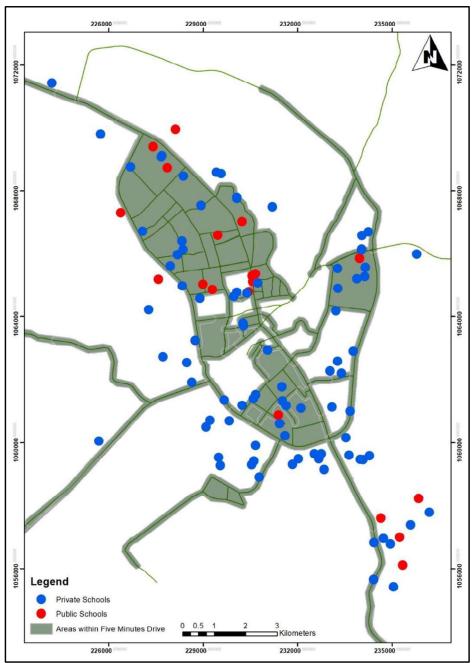
Figure 2: Service area map showing areas within 5mins driving distance from schools
Source: Authors Analysis, 2023

Table 2: Gender and travel distance to school

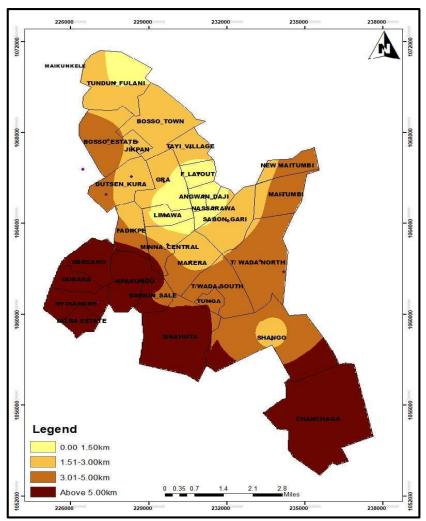| | Gender | N | Median | SD | Minimum | Maximum |
|---|---|---|---|---|---|---|
| **Distance** | Female | 4029 | 1.5514 | 2.2768 | 0.0138 | 14.9066 |
| | Male | 4393 | 1.4286 | 2.2627 | 0.0248 | 19.4215 |

Source: Authors field survey, 2023.

Figure 3: Public School Trip Length
Source: Authors Analysis, 2023

Respondents who take a daily trip of less than 1km daily from their homes to school are those who reside close to the public secondary schools. These respondents were located in Limawa, F-Layout, GRA, and Angwan Daji.

The buffer analysis (2kms) further reveals that only the residents in GRA, F-Layout, Bosso Town, Bosso Estate, Tunga, Jikpan, Dusten Kura Gwari, Dusten Kura Hausa, Fadikpe, and Maitumbi that would travel less than 2km daily from their home to school daily (Figure 4). This shows that students who live in the fringe neighbourhoods travel more distance to

attend secondary school education compared to their counterparts who live in the city core where there is a greater concentration of public schools.

The Average Nearest Neighbour Analysis for the spatial distribution of the public secondary schools in the study area reveals a random distribution pattern with a Nearest Neighbour ratio of 1.1199 and a Z score of 1.0259 (see Figure 5). This shows that no distinct effort was deployed in the distribution of public secondary schools across the city (Minna), that is, the schools were randomly distributed across the study area.
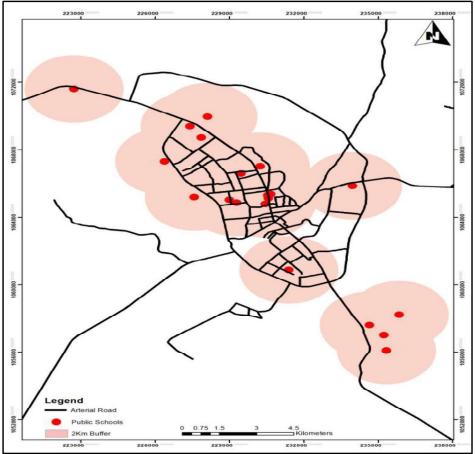
Figure 4: 2kms buffer of Public Secondary Schools in Minna
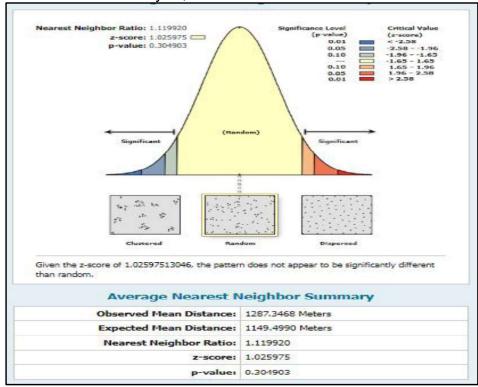Source: Authors Analysis, 2023



Figure 5: Summary of Average Nearest Neighbours of Public Secondary Schools
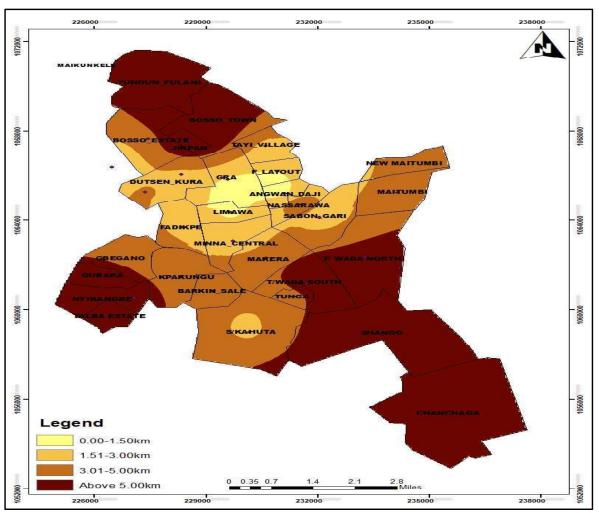Source: Authors Analysis, 2023

Figure 5: Spatial Variation of Distance Travelled of Private Secondary Schools in Minna

Source: Author's Analysis, 2023

Similarly, Figure 6 shows the spatial variation of the private secondary school trip length. The Figure reveals that respondents in private secondary schools in the core of Minna (Limawa, Angwan Daji, GRA, and F-Layout) tend to travel less than a kilometre from their home to schools due to the concentration of private secondary schools within their neighbourhood. Respondents in Chanchaga, Tundun Fulani, Sahuka Kahuta, Gurara, Nyikangbe, Talba Estate, Barkin Sale, Gbeganu, and Tundun Wada North travel for more than 5kms daily from their dwellings to school.

This finding is also corroborated by the 2 km buffer analysis of private

secondary schools in Minna. As depicted in Fig. 6, the average nearest neighbourhood analysis of all the private secondary schools in the study reveals a cluster distribution with a Z score of – 5.3530 and the nearest neighbour ratio of 0.7000. The cluster distribution of the private secondary schools in the study encouraged a 2 km travel distance from home to school within the city only.

On the other hand, the residents in the peri-urban neighbourhoods of the city are forced to take a trip of more than 5 km daily from their home to school daily (Figure 7).
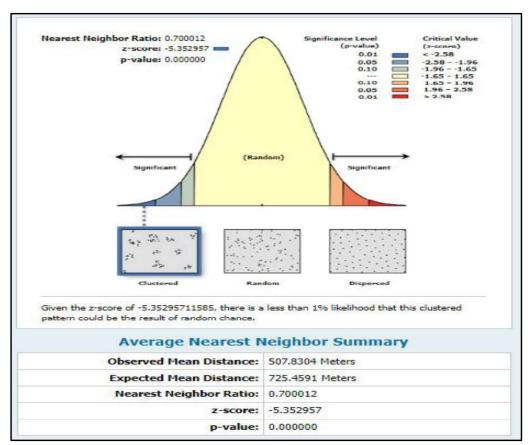
Figure 6: Summary of Average Nearest Neighbour of Private Secondary Schools
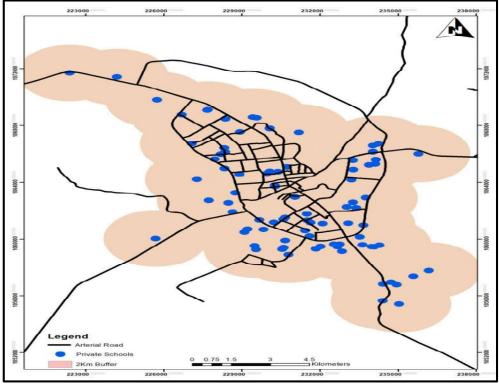Source: Author's Analysis, 2023



Figure 7: 2kms buffer of Private Secondary Schools in Minna
Source: Author's Analysis, 2022

## 3.5 Distance Covered by the Public and Private School Students

The study reveals that the average distance covered by students attending public schools (M =2.70km, Md = 2.19 km) is more than the distance covered by students attending private secondary school (M=2.07km, Md = 1.34km). This may be attributed to the high number and clustered pattern of private secondary schools compared to public secondary schools. However, the maximum distance covered by the public secondary school students (17.81 km) was less compared to their counterparts in private secondary schools, which covered a maximum distance of 19.42 km. Table 3 shows the distance covered by the students in public and private secondary schools in Minna.

**H$_0$:** There is no statistically significant difference in home-school distance covered by the Private and Public secondary school students

A Mann-Whitney U test was conducted to compare the home-school distance for Private and Public school students. The result shows that showed that the difference was statistically significant ($U$ = 7099552, $n1$ = 4324, $n2$ = 4093 $p$ = <.001). Thus, the null hypothesis is rejected.

## 3.6 Home-School Maximum Distance and Proportion of Marginalised Students

As shown in Table 4, of the 8,422 students in the sample, 56.56% live below 2 km of the school they are attending but when disaggregated by type of schools attended, Students attending private schools tend to live closer to their schools than students attending public schools. Also, 69.97.51% of private school students live below 2 km from their schools, compared to 48.45% of public school students.

Table 3: Travel Distance of Public and Private Secondary schools

|  | School Type | N | Mean | Median | SD | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| Distance | Public | 4093 | 2.6973 | 2.1888 | 2.2882 | 0.0870 | 17.8050 |
|  | Private | 4329 | 2.0732 | 1.3397 | 2.2105 | 0.0138 | 19.4215 |

Source: Author's field survey, 2021.

**Table 4: Number of students living below, within and above 2km distance of school**

| 2km |  | N | Below | % | Equal | Above | % | Median |
|---|---|---|---|---|---|---|---|---|
|  | Citywide | 8422 | 5012 | 59.51 | 0 | 3410 | 40.49 | 1.581 |
|  | Public | 4093 | 1983 | 48.45 | 0 | 2110 | 51.55 | 2.18 |
|  | Private | 4329 | 3029 | 69.97 | 0 | 1300 | 30.03 | 1.353 |

## 4.0 Discussion

The spatial variation of distance travelled by secondary students in the study area helps to understand the travel behaviours of students in Minna. Understanding the spatial travel variation of students in Minna can enhance the planning of education infrastructure. This assertion was affirmed by Mei *et al.* (2019), who were of the opinion that understanding the spatial characteristics of distance travelled by students to school provides a basis for improving accessibility to schools, which in turn can influence the enrolment of students.

The average nearest neighbourhood analysis shows that private and public secondary schools are concentrated in the city's core. At the same time, the peri-urban areas have fewer schools. This scenario implies that more students are attracted to the core of the city, whereas the peri-urban areas would have a weaker attraction because of the presence of few secondary schools. This means that the spatial distribution of both cluster and random distribution of secondary schools in the average nearest neighbourhood analysis for Minna is a reflection of poor education infrastructure planning. The average nearest neighbourhood analysis also reveals that secondary school students in neighbourhoods like Talba Estate, Gbaganu, Gurara, and Nyikangbe travel farther (above 5kms) to access secondary school education.

 It is believed that travelling above 5kms to school daily is usually accompanied by commuting stress, which can weigh students down. The demands of the roads can make parents and guardians apprehensive while looking forward to the safe return of their children from school (Duze, 2010). Travelling farther than 5 km implies that there is a need to bring a secondary school closer to the students in the peri-urban neighbourhoods. Having secondary schools near students is believed to be cost-effective and provides a long-term solution to increase access and retention of students in school (*United Nations International Children's Emergency Fund* [UNICEF], 2015).

The travel distance of public and private secondary schools in Minna further explains the distinction in travel characteristics of students in both schools. The study reveals that the farther the private secondary school is in Minna, the fewer students travel to those schools. This result is similar to the findings of Kanayochukwu *et al.* (2020); and Mei *et al*. (2019), who assert that the farther the school, the lower the percentage of students that will make a trip to school. The travel distance of private secondary schools in the study area further reveals that more private secondary school students (69.97%) would travel less than 2kms to school daily. The lower travel distance of private secondary school students can be attributed to the cluster distribution of the private secondary schools in the study area and its high number, which is four times more than that of the public secondary schools.

More students (51.55%) travel above 2kms for public secondary schools, unlike their private secondary school counterparts, where more students travel less than 2kms. This implies that more public secondary school students would have to rely on paid transport, and those who cannot afford paid transport will have to walk a long distance to school. The lengthy travel

distance of more public secondary school students can be attributed to the random distribution of the few public secondary schools in the study area.

## 5.0 Conclusions and Recommendations

The spatial analysis of private and public secondary schools reveals that a cluster and random distribution in private and public secondary schools indicate poor education infrastructure planning in the study area. The distance travelled by the large proportion of public secondary school students was not in line with the ideal distance threshold for secondary school students. Therefore, the study recommends that proper education infrastructure planning should be carried out before setting up new secondary schools within Minna in the future. A public secondary should be made available in neighbourhoods where students travel more than 5kms to access secondary education to reduce home-to-school travel distance. Further studies can be carried out on the spatial distribution of schools in Minna by using the multicriteria analysis to determine the best location to site a secondary school for ease of access by students.

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