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Assessing Independent Mobility of Children Indicators in Military Barrack Community of Nigeria

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ABSTRACT

Independent mobility of children assessment lacks a defined standard and measurement process. It is largely due to ways in which environmental context dictate relevant indicators. In a developing country like Nigeria, there is inadequate data and research in this area to inform a holistic assessment. Hence, this study employed multi-method data collection involving field survey, semi-structured interview, and survey questionnaire to assess independent mobility of children's indicators. Barrack spatial data was analysed using Landsat imagery and ArcGIS for objective measurement of indicators. Subsequently, 60 children from 3 NAF primary schools and 390 parents living in Sam Ethnan Air Force Barrack (SEAB) at Lagos participated. Consequently, their perception on destinations accessibility, road network connectivity, population density, land use, home geographical range, and average travel time validated objectively measured same variables. It was found that SEAB has 0.941 km^2 land area, high percentage (80%) of built up area, and population density of 42,480.315 per / km^2. Home geographical range indicated a catchment of school and playground within 100-700m and average travel time for walking to 3 primary schools are 5m.82s, 8m. 56s, 16m. 20s, and 8m.26s for children's park. Destination accessibility, population density, home geographical range, and travel time met the threshold of factor loading >0.7. The Land use and road connectivity are secondary factors excluded for failure to meet the threshold. Poor level of independent mobility, mobility restriction, closed destination accessibility associated with land use mix and short distances were found in barrack community. These findings contributed to the spatial dynamics of mobility nexus, and the perceived shift in the degree of children's independent mobility depends on these indicators.

Keywords : Mapping, Independent Mobility of Children's Indicators, Military Barracks

I. INTRODUCTION

Independent mobility of children has been defined as the ability of children to travel around their neighbourhood freely without adult's company (Carver et al., 2010b; Tranter and Whitelegg, 1994). Attempts has been made to identify and measure indicators of children's independent mobility in relation to various context in past studies. These include home range referring to how far a child can travel from their home, independent time outside explaining how many minutes a child can stay outside of home independently. It also defined independent journey to destinations as child's independent movement to specific destinations and parental license for children to know whether a child is allowed to travel independently by parents (Kyttä, 2004; Loebach and Gilliland, 2014; Villanueva et al., 2012a; Villanueva et al., 2012b). However, parental license cannot be measured like other indicators in this study as its rather perceived as intervening factor

to be further examined. This is largely due to the uniqueness of barrack environment, military regimental culture, and parental influences on barrack children. Similarly, in four previous studies, a systematic review on independent mobility of children was conducted (Bates and Stone, 2015; Malone and Rudner, 2017; Moghtaderi et al., 2012; Schoeppe et al., 2013). These studies focused on the link between independent mobility of children and health benefits. This means that children's independent mobility has been used as an explanatory factor of health outcomes. However, Malone and Rudner (2017) have provided a descriptive summary of children's independent mobility in relation to different socio-cultural and ecological contexts. On the other hand, this study draws on the relationship between barrack environment characteristics and independent mobility of children. Systematic assessment of relevant indicators in the military barrack towards promoting child-friendly environment in the unique cultural and geographic milieu was conducted.

Child-friendly barrack environment is vital for children's physical, mental, spiritual and social growth (UNICEF, United Nations International Children's Emergency Fund, 1989). However, some criteria for a child-friendly built environment was discussed in past studies (Kyttä, 2004; Nordström, 2010). Within this context, Broberg et al. (2013a) have offered an acceptable operational definition of child-friendly built environment using children's possibilities for independent mobility, and their opportunities to actualize environmental affordances. This study focused on assessing the children's independent mobility indicators in the military barrack environment in Nigeria. The findings from this research, therefore, contribute to the spatial dynamics mobility nexus in the literature. It explains relevant indicators of how children independent mobility changes with respect to changes in the barrack built environment (Priemus et al., 2001).

Military barrack refers to housing facility built to support military training and operations. Thus, it provides shelter for military equipment and personnel. Basically, a military barrack provides accommodations for one or more units. However, some complex barracks are built to sustain itself for long period. They are able to provide food, water and other life support necessities for residents while under siege. Barracks are usually extra-legal jurisdictions because they are not completely subject to civil law. Nevertheless, they can range from small outposts for military duties to complex military cities containing up to 100,000 people in a large expanse of land. The name adopted in any case depict the type of military activity that takes place at the barracks. In another way, barracks may refer solely to an establishment which is used by an army. It also applies to other sister forces such as marines, not including base used by either an Air Force or Navy. Barracks size is usually determined by its establishment status, function and population of personnel to be quartered. The roles of the military in national defence, internal operations, peace keeping and humanitarian intervention necessitated the establishment of many military barracks in the developing countries including Nigeria. Typically, the operation area is often restricted, only authorized persons are permitted access irrespective of whether is a military personnel or not. Military barracks community usually provide apartment housing estate with shared facilities for military personnel, offices and dining facilities. They also provide support facilities such as fast food restaurants, snack bar, gas station, religious centre (churches and mosque), schools, hospital or clinic, shopping and convenience retail stores, and beauty salon. Sporting facilities such as fitness centres, libraries, athletic fields, basketball hoops, child development centres automotive workshops, hobby or arts and crafts centres, bowling centres, and community activity centres.

In the barrack, it is difficult to select the most significant indicators that are measurable and achievable at the same time. Independent mobility of

children indicators lacks a defined standard and measurement process. Past studies used indicator selection frameworks such as criteria based, causal chains, and causal networks. These three frameworks have certain limitations and strengths. In a nutshell, indicators are pointers to evaluate progress, projects, and policies toward set goals and objectives. It has been defined by the Organization for Economic Cooperation and Development Countries (OECD) as statistical measures of social, environmental and economic policy sustainability (Haghshenas and Vaziri, 2012). As such, it helps in evaluating, simplifying, study trends, communicate issues and compare across places and situations (Boyko et al., 2012; DETR, 2000; Toth-Szabo and Várhelyi, 2012). Based on this, a set of appropriate indicators allow decision makers to monitor status, predict, and understand implications of the actions and inactions (Boyko et al., 2012; Gudmundsson and Sørensen, 2012; Henning et al., 2011; Rametsteiner et al., 2011). Consequently, there is a need to identify indicators to assess and ensure that independent mobility of children policy options is realized in various settings including barracks (Litman, 2007; Moussiopoulos et al., 2010; Zachariadis, 2005). This requires independent mobility of children's planning policy that ensures safe accessibility, home geographical range, travel time, and population density. Land use land cover change affecting children irrespective of their parent's socio-economic background and travel mode choice considered in the environment are same with barrack (UNEP, 2014).

Measuring independent mobility indicators of children therefore depends on ways in which environmental context is defined and contextual indicators are obtained (Kwan,2012; Marco *et al.*, 2015; and Bhosale, 2017). Similarly, place-based research is not achievable without a specific methodology and relevant indicators. Children represent a population of group that is much neglected in the city planning process especially the barrack planning. Their perceptions, which are different from those of adults, are usually not incorporated in the design of cities or barracks. The aim of this paper is to assess independent mobility indicators of children using GIS objective measurement and subjective approach to capture parent's perceptions of independent mobility in the barracks. Various indicators of sustainable independent mobility of children were identified for assessment in this study. Attempt was made to select the most relevant indicators that measurable and achievable at the same time in the military barrack context. Except for parental license that required negotiation between parent and children or to be examined as a mediating effect in predicting independent mobility of children.

II. METHODS AND MATERIAL

This study employed spatial data from the field survey method to generate barrack spatial map analysed in ArcGIS. Semi-structured interview for children's perception to rate children's independent mobility indicators and generate route map. Identified indicators were also subjected to parent perception and analysed using SPSS and SEM-PLS. Identified indicators from past studies and those peculiar to military barrack were factorised using component factor analysis and used to predict independent mobility of children in the military barrack.

2.1 Field Survey Method

In the first part, data collection was primarily by field survey method. The Geographical Positioning System(GPS) was used to obtain coordinates of destinations on ground (Kerr et al., 2011) and Landsat imagery remotely sensed for high resolution. The use of Landsat imagery remotely sensed for the barrack built up area, open spaces vegetation to determine land use land cover changes covered a period of 12 years between 2006-2018. The imagery was imported in ArcGIS, geo-referenced, and digitised for mapping of boundaries, locations, buildings, road connectivity, home geographical range, and destinations of barrack environment features. Classification of built up area, vegetation, and open spaces was carried out separately in ERDA 14. This was in line with

previous studies that found mapping to be useful for collecting data on home geographical range, time, and destinations of middle childhood aged 5-12 years. This involved objective measure of spatial data for analysis. Children are capable of completing activities involving home-school journey and visits to their local neighborhood play areas as opined by Risstto and Tonucci, (2002) and Veitch et al., (2008).

2.2 Semi-structured Interview

In the semi-structured interview, children living in the barrack were given 16 questions in the interview to assess their perception on independent mobility indicators in the barrack. The question included demographic profile, and children's understanding independent mobility. Moreover, the mapping portion dwelled on marking of local destinations, and preference route to school and destinations important for play. Children home address obtained from the participant and geo-coded using GIS. Layers of map for street network, residential, schools, and play area destinations were obtained. Children used coloured marker to locate their home, route they usually walk or cycle to and from school and play area. In addition, children wrote the names of their visited destinations in the demonstration map provided for them.

A total of 60 children involving 20 from each of the 3 NAF primary schools in the study area marked their home and preference routes to school and playground. Parents assisted the children in answering the questions and mapping. The mapping exercise was actually to test the children's ability and experience of barrack environment where they reside. Destination accessibility including road connectivity, home geographical range and average travel time were assessed objectively.

2.3 Survey Questionnaire

The third data collection method involved the use of survey questionnaire to elicit responses from parents' participant. A total of 390 questionnaires were retrieved (Krejcie & Morgan,1970) from 500 distributed. Parents living in the barrack assessed independent mobility indicators that were identified and objectively measured earlier. Secondary data from past literature therefore formed the basis for the questionnaire on independent mobility indicators. It covers the home geographical range, time and destinations where children relate in the military barracks. Permission was sought from the barrack commander for the administration of questionnaire. Furthermore, parental consent was sought with the assistance of head teachers on the parent and children participation in filling questionnaires. The data used were collected from primary and secondary sources. Quantifiable information from concerned population with adequate knowledge and experience relevant to the subject area (Knabe, 2012). These enables data on the opinion, experience and level of understanding of parent on independent mobility of children's indicators.

III.ANALYSIS AND RESULTS

3.1 Barrack Spatial Analysis and Objective Measures of independent mobility of children's indicators

Landsat imagery was imported into ArcMap 10.3 (ESRI) for mapping boundaries of the study areas, children's homes, primary schools, and play areas. Home geographical ranges from 100-700m in SEAB Lagos was considered. Pedestrian network (including bike paths and shared walking/cycling paths) around each child's home zones were confirmed to be non-existent. The travel time for walk were compiled (Mavoa et al., 2012). Distance between home and school along the most direct and walkable, cycle, and driving routes were measured. Satellite Images was acquired on March 2018 covering the total land extent of the barracks (see fig 2). Subsequently, the satellite image was geo-referenced to ensure points,

paths, lines distances and areas on the satellite image are as exact as they are on ground. The data utilized for this research was remotely sensed data and population data of the barracks. Landsat series imageries of two years (2006 & 2018) in 12-year interval acquired from the USGS Earth Explorer portal were used (see fig.9). The imageries were carefully checked to ensure that the same season was selected for the two different periods. Data analysis was carried out in two parts. First is the analysis of Landsat imagery and secondly the GIS mapping. The Landsat imagery was basically for classification to obtain land use land cover changes. On the other hand, the GIS mapping involved spatial analytical procedure and statistical analysis including buffering, overlay, and simple distance calculation. It also includes time for average walking, cycling, and driving to destinations in focus. Spatial statistics and ArcGIS software incorporated spatial statistics tools. Spatial data were displayed in study area maps. Independent mobility of children's indicators objectively measured include, the destination accessibility of children, home geographical range, and average time taken. The forth indicator identified through literature review is parental license. However, this indicator cannot be measured objectively. However, due to the uniqueness of the study area, the population density using the total built up area per persons, streetscape, and road connectivity were considered under destination accessibility. In addition to indicators from literature review, land use land cover changes over a period of 12-years was considered. It was discovered that changes in land use across both study areas have significant effect on the green areas which formed open space for children's play. This is therefore considered as an important indicator of independent mobility to play areas in the military barracks milieu of Nigeria. It also showed the rate of development in the built up area that have affected open space for children play in the barracks. Consequently, the changes hinder independent mobility of children in the residential area of the military barracks. Furthermore, objective measure of these indicators and evaluation using software formed the basis for the quantitative analysis of survey questionnaire and semi-structured interview in this study. This equally validated the results seeking parental and children's perception. These sequential methods of data analysis make the research adequately reliable, and validate the result. The data analysis was further classified into the destination accessibility of children, population density, home geographical range, and average time calculated.

Independent mobility indicators of children using GIS measurable spatial variables in ArcGIS software is essential in developing a policy framework of independent mobility that fits to military barracks. Indicators considered in this research include destinations accessibility, road connectivity, population density, home geographical range, travel time, and land use diversity. The acquired satellite image was Geo-referenced with the aid of coordinates taken from various points that are sparsely separated within the base. Thereafter, the image was digitized in various layers comprising of boundary, roads, buildings, locations amongst other relevant data. Digital boundaries were based on barracks fencing and delineation with average population size considered per persons.

Destination accessibility provides a measure of child specific neighbourhood destinations opportunities (Badland et al., 2015; Oliver et al., 2017). This becomes a driven index for a number of destinations in the barracks that reflect destinations that children regularly access. Fig. 3 showed the digitized maps and destinations in SEAB Lagos. It includes locations, road connectivity, and buildings designs. The

population density was also calculated in the study areas. Population density is the total population divided by the total land area of a place. It has a unit of persons per square kilometres (per/km^2). According to Daodu, (2004), the average number of people living in buildings within SEAB Lagos was found to be 9 persons in MOQ (bedroom bungalow), 5 persons in officers' duplexes and block of flats, 7 persons in airmen blocks (See Table 1). To calculate the average amount of people living in each of the houses, the average number of people in the buildings is multiplied by the total number of houses on the barrack. The total land area of SEAB Lagos is 0.941 km^2. Hence, the population density is 32,370 divided by 0.941 amounting to 34,399.573 per / km^2. The built-up area is 81% of the total land area of SEAB Lagos, which is 0.762 km^2. Therefore, the population density is 42,480.315 per / km^2.

Concerning the land use analysis, the data processing was in two parts. first, the stacked and composite map is clipped to the specific extent of interest. Thereafter, atmospheric correction was applied. This enabled easy processing of data. Haze correction was used to clear the cloud cover under the radiometric menu in ERDAS Imagery. In classification, acquaintance with the area of interest enabled easy sample selection and accuracy in output image. A ground-truth process was used (the process of verifying the integrity of the features on the imagery compared to its true representation on ground) in other words field-checking the mapping accuracy was necessary (Ghilani & Wolf, 2012). The second part involved the ArcGIS interface, the reference system was set to WGS 1984. Units set to meters and the coordinate system set to Universal Traverse Mercator (UTM) system. Using ArcGIS 10.3 software, the satellite images were imported and geo-referenced using the coordinates of points obtained (See Table 2). A layer (shape file) was added, set to polygon and renamed SEAB and NAF Base Kaduna to denote the boundary of the base. The added shape file was digitized (traced) along the boundaries of the barrack. Consequently, layers were added for the polygon (location of places and buildings) and line features (access roads). For each layer, the feature was digitized accurately to produce a copy of the feature to be worked on. For the locations, places like officer quarters, airmen quarters, mammy market, and schools within the base were digitized. For the buildings, each and every building within visible range from the barrack map was digitized. The Access roads, other roads and Airstrip were also digitized.

The main locations in view are NAF Primary School 1,2, 3, and 4 in SAEB Lagos. Layers with point features were created for these three locations respectively. Another point feature layer was created and labelled 'End Points', which was digitized at every point of access to the location features and it was also linked to either the access roads. Buffer zones were created from the Arc Tool box option for NAF Primary Schools 1,2, 2, and 3(see fig. 5, 6, and 7) as well as children's park (fig. 8). Intervals of 100, 400, and 700 meters obtained due to its small size or land mass. Four layers labelled 'Road Distances 1', 'Road Distances 2', 'Road Distances 3' and 'Road Distances 4' were created having line features (see fig.4), these layers were used in calculating the distances from the end points of all locations to NAF primary schools one, two, and three in SAEB Lagos. It was also used to calculate distances from the end points of all locations to Children's Parks. The attribute tables of the layers created above were accessed. Using the calculate geometry option, the distances between all the locations to all the NAF primary schools and children's park was assessed. Average Travel Time (ATT) obtained in ArcGIS using the average walking speed of children (5.43 km/hr or

1.5 m/s). The average cycling speed of children is (12.64 km/hr or 3.511 m/s) and the average driving speed within the base of (30 km/hr or 8.333 m/s). The time taken to reach all the Primary Schools and Children's Parks in SEAB was calculated and tabulated (see Appendix1). Results showed primary school 1 (ATT for walking is 5m.82s, cycling is 2m.84s, driving is 1m.33s), school 2 ATT for walking is 8m.56s, cycling is 3m.25s, driving is 1m.59s), school 3 (ATT for walking is 16m.20s, cycling is 7m.12s, driving is 2m.70s), children's park (ATT for walking is 8m.26s, cycling is 3m.91s, driving is 1m.43s). See fig 2 for the workflow for independent mobility of children in the barrack.

Table 1 : Estimated Population Density of Sam Ethnan Air Force Barrack in Lagos

Building Type (No. Persons)	**Av. Number of people**	**No. of Houses**	**Total**
MOQ Semi-Detached Flats and Duplexes	5	645 houses	3,225
MOQ (5 bedroom bungalow)	9	1,552 houses	7,760
SOQ (3 bedroom flat)	5		
Storied Building Apartment (One bedroom flat)	7	1,944 houses	13,608
Storied Building Apartment (2-Bedroom Apartment	7	1,111 houses	7,777
Estimated Number of People			**32,370**

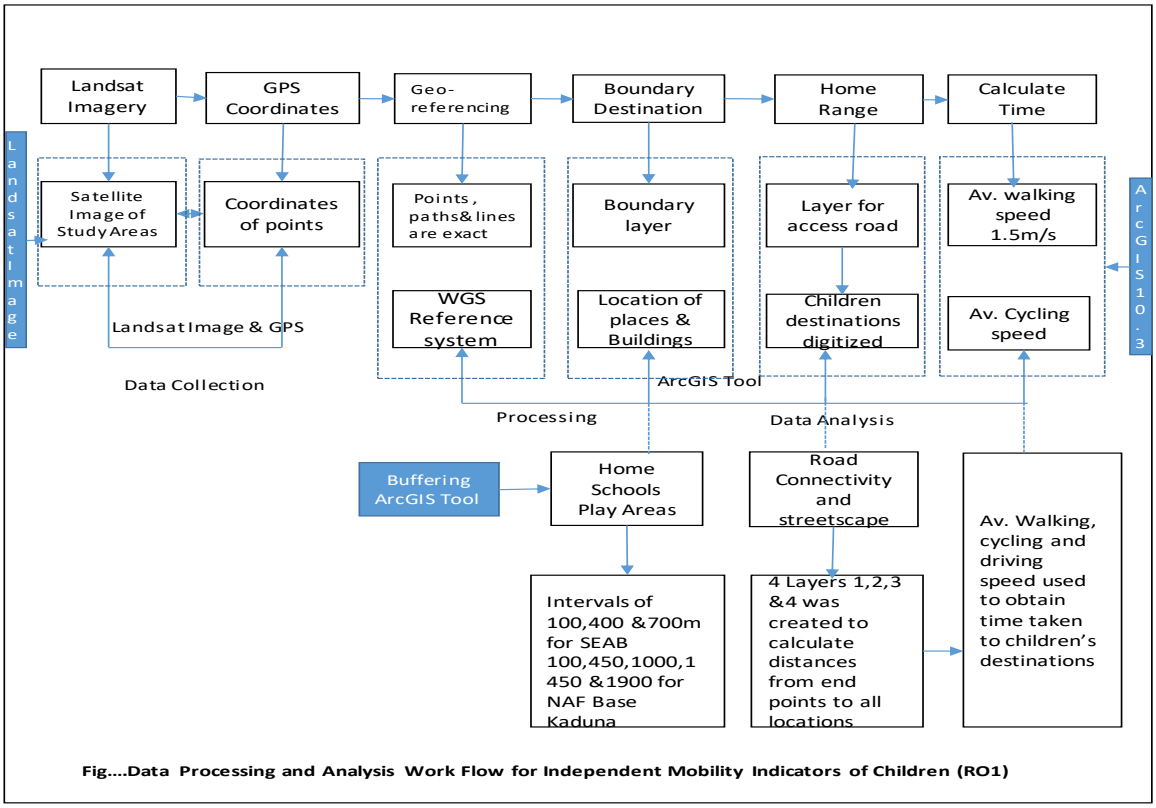


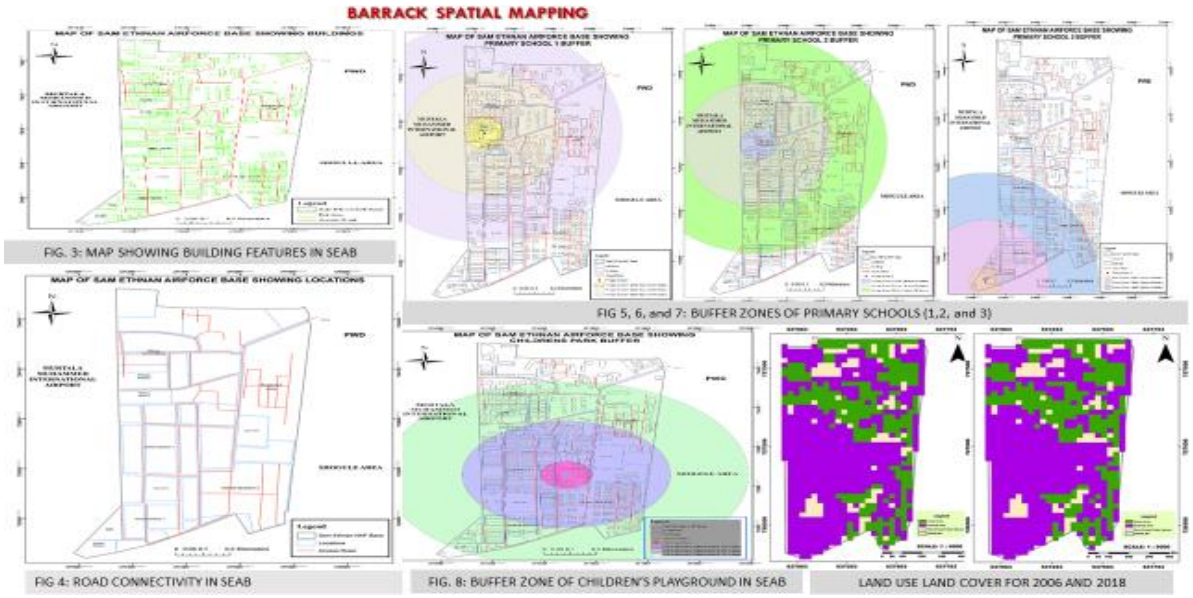
Fig....Data Processing and Analysis Work Flow for Independent Mobility Indicators of Children (RO1)

Fig 1 : Field Survey and Analysis Workflow for Independent Mobility Indicators of Children in Sam Ethnan Air Force Barrack

Table 2 : Summary of software and analysis performed

SOFTWARE/VERSION	ANALYSIS	DESCRIPTION
ARCGIS 10.4	Vectorization process of all land features for Sam Ethnan Air Force Barrack, database creation, buffer analysis and map embellishment.	The vectorization process converts all raster features of interest to an editable vector format. Database containing attributes of each digitized feature (area, perimeter distances amongst others), the buffer analysis was done on each road feature to show the width extent for streetscape features. These include walkway, bicycle lane, planting strip and street light areas and the availability of the features was verified based on this. The encroachment of buildings and structures into areas meant for streetscape features were also be checked
ERDAS 14	This software was used for all image processing.	Layer stacking, composite bands formation, classification, index analysis and change detection analysis conducted
MICROSOFT EXCEL 2018	Statistical representation of classified features	Representational charts for statistical output of some image analysis were carried out in this software for better comprehension.

Fig 2 : Satellite Image of SEAB in Lagos



3.2 Children Perception of Independent Mobility of Children's Indicators and Route Map

The perception of children relating to independent mobility indicators was carried out in a semi-structured interview. This was done in two sections. Section A covers the demographic profile of children while section B dwelled on mapping experience of children's route. The maps of the study areas produced were given to children during semi-structured interview to mark their home, school, play areas, and preference route to the school and play areas in the barracks. The preference routes marked were further entered into ArcGIS and measured with average time for walking calculated. However, it was to bridge the gap in parent's perception of issues on built environment and travel mode choice behavior that directly affect their independent mobility in the military barracks. The map provided for children enabled them to mark their home, school and play area location including preference route to school and play areas. These routes were imputed in ArcGIS for further analysis to obtain average distances and possible time it takes to walk, cycle or drive to those destinations.

3.2.1 Demographic Profile of Children

Section A contains demographic profile of children and section B dwelled on the assessment of children's ability to mark destinations accessible to them as well as preference route from their home to school and play area in the barracks. The children's demographic characteristics considered include children's sex, age, older sibling and level of education. On the other hand, assessment of independent mobility of children's indicators and environmental knowledge was carried out in section B. in section C, the mapping experience and abilities of children in the barracks was examined by allowing them to mark their homes, schools and playground as well as preference routes for further analysis.

3.2.2 Children Perception of Independent Mobility of Children Indicators in Barrack

The statistical analysis of the semi-structured interview conducted for children was to assess the independent mobility of children's indicators in the military barracks. This is contained in section B of the semi-structured interview. Using descriptive statistics to present results, 96.7% of children were of

the opinion that playground is not available for their use. Moreover, 41.7% play inside house, 35% use house yard, 20% play in football field, and 3.3% play in friend's house within the barrack. The travel mode to school and play area indicates 40% use of private car, 35% walks, 21.7% public transport, and 3.3% manage to ride bicycle after school. On parental license for independent mobility, 86.7% complaint of parental restriction, only 6.7% said they are occasionally allowed to work around without adult while 3.3% did not respond. Examining the level of freedom in barrack, 66.7 walk with adult, 28.3 walk with peers, only 5% walk alone. Rating the barrack environment, 57% filled that green along walkways to school is available but not attractive while 5% were of the opinion that traffic light is available. 100% representing all the 60 children agreed that destinations in barracks are accessible in the residential area mainly with road connectivity.56.7% believed that the barrack population is high while 43.3 were of the opinion that the population is low. 55% of children opined that distances from home to school and play areas are close while 45% felt that distances are far apart to destinations. 55% sees average travel time as short while 45% were of the view that average travel time is longer than what they can walk to school. In term of safety and security in the barrack, 80% felt that barrack is safe enough for them to walk to school and to play areas while 20% of children were of the view that barrack is not safe considering many factors. The house location, school, and play area after school, preference route walk, cycle, and driven to play area were marked by children in the semi-structured interview at SEAB. These are contained in section C. Participatory mapping attempts to engage children in the generation of personalized map. It is a way to both harness the value of children's knowledge about geographic space, and to concurrently empower the research participants. This is achieved by inviting them to engage actively in the representation and explication of their spatial environment. Engagement in the mapping exercise is a nuanced process substituting difficult to achieve textual methods. Findings from this participatory mapping in the context of 5-12 years old primary student demonstrate the potential of this research strategy. It is highly recommended for its effective implementation in barrack community and other settings in Nigeria.

Fig 9 : Children's route map

3.3 Parent's Perception on Independent Mobility of Children's Indicators.

This section answered the question how parents perceive independent mobility of children's indicators in military barracks. These indicators include destination accessibility, home geographical range, average travel time, population density, and land use. These indicators, were selected from past studies and new ones unique to barrack obtained from objective measurements. Exploratory Factor Analysis (EFA) was employed to prune down a huge number of variables into sizable and manageable factors for univariate or multivariate analysis (Pallant, 2013). It brings together items to form relevant structure for measurement model (Kline, 2015, Coubergs et al., 2017). The association and independency among items and data loading from other variables are further ascertained (Paschke et al., 2009, Wan, 2016). It calculates eigenvalues of matrices drawn from data in orthogonal paths, decreasing the dimensionality of the input dataset by examining the best structures. In EFA, the correlation between items not initially visualised from theoretical viewpoint is explored (Williams and Brown, 2010, Yong and Pearce, 2013). New relationship between observed and latent variables are discovered (Hair et al., 2012). The number of factors that describe underlying relationship among variables is a factor extraction procedure (Pallant, 2013). It was measured by Principal Component Analysis (PCA). The PCA was used to effectively summarise items into sizable elements for prediction (Huber,2009, Tabachnick and Fidell,2014). The EFA carried out in this study grouped variable into factors in which their validity was tested and analysed. Factor extraction was computed on principal component extraction, Varimax rotation, threshold for factor extraction of Eigen value >1. 0.4 value was recommended suppressed factor, meaning that any item having factor loading less than 0.4 was dropped (Paschke et al., 2009, Hair et al., 2012). Factors with loadings more than 0.7 were retained in this research as recommended by Joliffe (!972 and 2002).

Generally, results obtained in ArcGIS, children, and parent perception of independent mobility of children indicators are summarised based on indicators considered in this study. Concerning children's destination accessibility, all destinations digitised in terms of location and building features with focus on destinations where children relates (Home, School, and Play areas). Children in the barracks have little environmental knowledge of their homes, school, and play areas. They were able to mark destinations on the map provided with parent assistance. This showed level of parental restriction and control on children aged 5-12 years. The children's playground was abandoned which shifted their attention to football field and home yard. On the road connectivity, roads are well connected but pathways are not attractive and connected as revealed in the ArcGIS. Children marked shorter routes as their preference road to school but little confusion on play areas due to non-availability of structured playground and open spaces in SEAB. No attractive features on routes to school, the streetscape is bereaved of good walkways, traffic control facilities, parks, and bicycle lanes. Next is the home geographical range, closer children destinations, shorter distances, and route to destinations were digitised in SEAB. Considering average travel time, shorter distances correlates with less time to walk, cycle, and drive to destination. It encourages children's walking to school and play areas, driving speed in barracks is 30km/hour. The entrance and exit gates to barracks are closed at 12 midnights and opened 6am daily to ensure security. SEAB is densely

Populated with smaller land area. Finally, land use land cover changes clearly showed land use mix. Children are restricted to the barracks where they live, attend school, religious activities, market, shops, socio-economic facilities and often play. Using 2006 to 2018 Imagery, three classes identified include, the Built up area, Green/bare ground area, and vegetation. Change over 12-years was evaluated. Reduction in green/bare ground and vegetation is pronounced. Expansion of built up area increased population density while high residential and population densities can aggravate traffic volume and hinders independent mobility of children in the barracks

IV. FINDINGS AND DISCUSSION

The built environment subsuming barracks morphology explained by land use land cover changes, and road connectivity is often influenced by other variables. These includes of population density, land diversity, and destination accessibility, It is consistent with studies by Saelens and Handy, (2008); Ewing and Carvero (2010) and Helbich et al., (2016). The challenge of natural and barracks environmental determinants like open spaces for play areas, built up areas of home and schools are also significant variables as pointed out in Pont et al., (2009); Panter et al., (2010); Wong., (2011); Sallis et al., (2015) and Helbich et al., (2016). A mixed land-use neighbourhood such as barracks urban milieu with high population density in SEAB Lagos shows closer destination accessibility. This expression comes to play especially when destinations like mammy market, shops, schools, and play areas are considered. The trip distances are shortened by close destinations in SEAB as found in Van Loon and Frank, (2011). The buffer of the schools and playground in SEAB indicates in a distance of between 0-700m which connotes short distance trips from children's home. It summarily means that decreased destination accessibility promotes or hinders walking and cycling in a built environment. This is also consistent with findings in Saelens and Handy, (2008) and Helbich et al., (2016). A peculiar neighbourhood with pronounced land-use diversity makes trip connection by active travel (walking and cycling) more convenient. This home geographical range have impact on independent mobility of children in the barrack.

Concerning road network connectivity, more intersection yields a higher street connectivity which increases route opportunities for children. It was showed in the mapping exercise of children in the semi-structured interview where children marked their preference routes to school and play areas. It is in consistent with Giles-corti et al., (2011) and Helbich et al., (2016) studies. Children do not often aim to reduce travel distances, and their preference route decisions are influenced by other issues like safety, route attractiveness, and sometimes opportunity to meet friends as found in Harrison et al., (2014). The population density of the airmen quarters has influence on the traffic volume and independent mobility of children in the barrack. Interpreting the road connectivity digitised in SEAB, the population density also attracts more traffic with risk of pedestrian injury as found in Sirard and Slater, (2008). This clearly revealed that the ways in which barracks environmental context is defined and contextual variables derived influences independent mobility of children (Kwan,2012).

Poor level of independent mobility of children established in the military barrack as identified by various indicators considered. Mobility restriction was mainly that of parental license within the barracks. Parents decision is highly influential as clearly stated in the semi-structured interview with children and responses by parents in the survey

questionnaire. Consistent with prior work, we find that average travelled time (ATT) for driving, walking, and cycling is most strongly related to measures of accessibility to destinations. It also affected by variables such as home geographical range, land use land cover, and road connectivity in the barrack. Walking is most strongly related to measures of land use diversity, and the number of destinations within walking distance. In contrast to these previous studies, driving and cycling use are not related to proximity to transit and road network variables. Land use land cover change seems to be weak and regarded as a secondary factor. Surprisingly, it was found that population densities met the factor loading to be significant in measuring independent mobility of children in barrack. To reduce the number independent mobility of children indicators, a principle component analysis was performed with Varimax rotation and Kaiser normalisation in SPSS statistical package. It was in line with method used to factorise urban structural variables in Cervero & Duncan, (2003); Miles & Song, (2009); Song & Knaap, (2007); Yan et al., (2010). The principal component scores for every indicator was obtained as if principal components had been observed themselves. Thus, independent mobility of children had new measurable variables representing the loadings for each principal component. These measurable variables were to be used as dependent variables in predicting independent mobility of children in barrack. Simple descriptive analysis was used to explain children view of independent mobility and exploratory factor analysis for parent perception (Bromberg, Salminen & Kyttä ,2013).

V. CONCLUSION

In this study, significant relationships were found between objective measurement derived from ArcGIS, children, and parent subjective measures of independent mobility. Thus, findings showed that the perceived degree of children's independent mobility depends on the context, multi-methods, and assessment of indicators. These findings contributed to the spatial dynamics of mobility nexus, and the perceived shift in the degree of children's independent mobility depends on these indicators. Consequently, this contributed to the reliability and validity of findings on the measurement of independent mobility of children in the military barrack. The findings can be generalised in all barracks including the Nigerian Army, Nigerian Navy, Nigerian Air Force, Police, Immigration, custom, road safety corps, prison service and other housing estates that make up cities in Nigeria. Hence, independent mobility of children can be predicted by examining direct and indirect effects of barrack environment characteristics, travel behaviour factors and parental license in further studies. It is necessary especially when there is need to formulate policies and strategies for implementation of transit and child-friendly barracks in Nigeria.

VI. REFERENCES

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