

The Neighborhood Accessibility Framework: A Methodological Instrument to Assess Neighborhood-Level Determinants That Affect the Health of Urban Residents

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ABSTRACT: This paper introduces the Neighborhood Accessibility Framework as a methodological instrument to assess the neighborhood-level determinants that affect the lifestyle of residents and can lead to conditions like hypertension, cardio-vascular diseases, diabetes and obesity. Neighborhoods comprise land uses such as residential, commercial, leisure, transit, and retail for daily essentials. Residents access facilities and spaces in their vicinity and, in the process, build communities, which comprise the socio-cultural fabric of their neighborhood. Existing scholarship defines accessibility as a fundamental concept that determines the freedom with which one can participate in activities in their immediate environment. This translates into the ease with which residents can access shopping, cultural amenities, and primary healthcare, in addition to partake in activities of socializing and exercising within their neighborhood. This study is based on the premise that the aggregate of accessibility parameters in a neighborhood constitute exposures that affect the health of residents. Research on the correlation between urban environmental exposures and their effect on health outcomes reinforces neighborhood advantage, or disadvantage. In urban studies accessibility parameters have been studied independently vis-à-vis their correlation with health. Existing research does not account for interdependency between accessibility parameters and their cumulative impact on health outcomes. To methodologically assess these accessibility parameters, this study uses the Walkability Framework as a starting point to formulate the Neighborhood Accessibility Framework, as a comprehensive matrix of neighborhood-level determinants. The Walkability Framework theorizes the relationship between walkability and the built environment. The Neighborhood Accessibility Framework builds on this model to assess residents' perceptions of space, third places, density, parking, streetscape and experience, land use, connectivity, surveillance, pedestrian safety, and public transport in their neighborhood. The Neighborhood Accessibility Framework is a much-needed instrument that contributes to research methodology in inter-disciplinary research on urban-environmental design and public health.

KEYWORDS: Neighborhoods, Accessibility, Public Health, Urban Health, Methods, Environment

INTRODUCTION

Neighborhoods in urban areas are the link between the home and the city. In their neighborhood, people access the natural, built, economic and retail surroundings and transit to connect to the larger urban area for their daily needs. Access or lack of access to daily needs within the neighborhood has the potential to affect the health of residents (Sehgal and Toscano 2021). The neighborhood is a part of the exposome, which is a larger determinant of health. Every exposure outside the genes, the thousands of chemicals, drugs, built and natural components, psychosocial, cultural, socioeconomic, dietary, literary, auditory signals collectively form the exposome (Toscano et al. 2014; Wild 2012). The human phenotype, or external appearance including health and disease status is the result of interactions between the genome and the exposome (Guthman and Mansfield 2013; Toscano et al. 2014). Epigenetic research identifies the exposome comprehensively and provides evidence of the somatization or molecular and physical expression of unconventional exposures such as discrimination and stress (Guthman and Mansfield 2013; Toscano et al. 2014). The influence of place and geography on health is well known and neighborhoods embody the physical and social determinants of health, which lead to epigenetic changes that affect health and disease outcomes (Notterman and Mitchell 2015; Sehgal and Toscano 2021). Key findings from research on neighborhoods include their decisive role and effects on behaviors and socio-cultural determinants contributing to evidence beyond conventionally studied pollutants or toxicants (Notterman and Mitchell 2015; Roux 2016; Sehgal and Toscano 2021). A milestone has been the identification that neighborhoods affect multiple health outcomes via interdependent pathways (Roux 2016), which has changed the common belief and habitual inquiry on individually determined risk factors for disease. The pathways

that link health determinants in neighborhoods to outcomes are rarely linear and challenge the conventional exposure-disease paradigm, which is that a physical exposure leads to a measured and known physical dysfunction in the body (Toscano et al. 2014).

Studies on urban exposomes indicate its' exclusive effect on the health of residents (Andrianou and Makris 2018). Global environmental changes (GECs) such as climate change and associated events of droughts and floods are forcing migration and urbanization. Over 75% of the world's population is expected to live in urban areas by 2050. Demographic alterations, rapid urbanization and the concomitant overcrowding, land use changes, overburdened infrastructure, persistent effusion of toxins into the environment and urban sprawl are detrimental to health as they weaken the natural systems that the human civilization is built upon (Frumkin and Haines 2019). These phenomena expose urban residents to air and noise pollution, social stratification, chronic stress, deficient green, recreational and public spaces and strained public transport. The results are unhealthy behaviors (automobile dependence, poor eating habits and physical inactivity), dietary shifts, sedentary lifestyle, poor social capital and high risk of injuries, respiratory diseases and mental health disorders. The urban populations' vulnerabilities are exaggerated by incapacitated communities, social services and healthcare delivery systems (Frumkin and Haines 2019). Urbanization is one pathway via which GECs lead to diseases like hypertension, type 2 diabetes, cardiovascular diseases and obesity (Frumkin and Haines 2019; Sehgal and Toscano 2021). These diseases are referred to as common complex diseases given their global widespread prevalence, non-infectious nature, lack of a singular cause, their inheritability patterns, the involvement of multiple genes, and the role of the environment and lifestyle in their occurrence (Sehgal and Toscano 2021; Toscano et al. 2014). Prevention strategies for these diseases are often unsuccessful because they have a conservative focus on behavior change in individuals. Behaviors are only consequences and are secondary to the environment in which people act. The focus on individual behaviors is a counter-productive strategy if the environment provides no scope for healthy behaviors and lifestyle changes to those at risk of or suffering from common complex diseases (Frumkin and Haines 2019; Sehgal and Toscano 2021). These diseases have no cure, and all medical treatments require that the patients adopt lifestyle changes along with medications (Sehgal and Toscano 2021). Therefore, opportunities to access a healthy lifestyle are fundamental to prevent, treat and control the rising prevalence of common complex diseases. Walkability, social stratification, neighborhood poverty, green space and parks, air quality, noise, overcrowding, land use mix, risks of injuries, inadequate housing and salutogenic potential (ability to promote health and well-being) (de Jong et al. 2012) are factors in the urban exposome that have been studied and associated with common complex diseases (Frumkin and Haines 2019).

1.0 THE NEIGHBORHOOD AS AN EXPOSOME AND ACCESSIBILITY

The neighborhood is a cumulative of determinants that affect behaviors and consequently the health of residents. Determinants of health in the exposome rarely act in isolation and human health is an expression of the cumulative exposures and their interaction with the human genome (Thakur and Roy 2020). People are randomly exposed to, or they intentionally access the built, natural, socio-cultural, retail and economic components within their neighborhood. Access and accessibility within a neighborhood are both vital for the people living in a neighborhood. Existing scholarship defines accessibility as a fundamental concept that determines the freedom with which one can participate in activities in their immediate environment (Miller 1999). Accessibility within an urban neighborhood is a measure of the facilitation of access to all provisions in the environment (Alwadi, Khaleel, and Benkraouda 2021). This translates into the ease with which residents can go about their daily activities such as shop for their regular needs, socialize, find cultural and literary opportunities, find salutogenesis, access primary healthcare, exercise, and connect to the larger urban area. Accessibility to daily needs or the lack of it, influences behavior choices residents must make habitually. The behaviors people choose become their lifestyle and subsequently affect their health and susceptibility to disease (Sehgal and Toscano 2021). Thus, when we assess accessibility, we assess the choices and opportunities that people have rather than categorize their behavior as healthy or unhealthy and hold them responsible for their choices.

In the macro-urban space, the neighborhood is at the nexus where the global meets the local and therefore, urbanization and globalization affect the neighborhood. In the larger urban exposome, the neighborhood forms an exclusive exposure (Andrianou and Makris 2018; Sehgal and Toscano 2021). Neighborhoods are documented to affect safety, social capital, social cohesion, collective efficacy; behaviors of physical activity, diet, nutrition, alcohol and tobacco use, street violence and all these factors independently affect common complex diseases (Browning and Cagney 2003; Roux 2016; Sehgal and Toscano 2021; de Jong et al. 2012). There remain gaps in research that accrues neighborhood level determinants and their relationship with common complex diseases. This study is based on the premise that the aggregate of accessibility parameters in a neighborhood constitute exposures that affect the health of residents. The aim of this study is to address the gap in identifying the entire neighborhood as an exposure that affects health and susceptibility to disease among residents. The objective of this paper is to present a methodological instrument to assess the neighborhood-level determinants that affect the lifestyle of residents.

2.0 EXISTING FRAMEWORKS, MODIFICATION AND NEIGHBORHOOD LEVEL DETERMINANTS

2.1 The Walkability Framework

The Walkability Framework (WAF)(Zuniga-Teran et al. 2017) is an effective tool that theorizes the relationship between walkability and the built environment. It is a framework to measure the efficacy of the built environment to enable walking among residents of the neighborhood and thereby reinforce their health and well-being. It is based on the premise that walkability, promotes walking (for transportation or recreation) and health by providing an environment for people to be less sedentary, physically inactive and automobile dependent. Walkability focusses on active and sedentary behaviors and is a significant determinant of neighborhood accessibility. The Walkability Framework conceptualizes neighborhood design to include nine walkability categories of connectivity, density, land use, traffic safety, surveillance, experience, parking, greenspace and community. This paper uses the WAF as a starting point to formulate the Neighborhood Accessibility Framework (NAF), a comprehensive matrix of neighborhood-level determinants that together represent the neighborhood as an exposome.

The Neighborhood Accessibility Framework builds on the walkability model to assess residents' perceptions of access to space, third places, streetscape and experience, land use, connectivity, surveillance, pedestrian safety, public transport, density and parking in their neighborhood. The framework is modified in a way to include new factors and rework the existing ones to enhance the capacity of evaluating accessibility in the neighborhood. Space and public transport are new factors in the NAF, third places are a modification of the 'community' variable in the WAF, streetscape and experience are independent factors in the WAF and have been combined in the NAF, and traffic safety is modified to pedestrian safety.

The accessibility determines if people have opportunities to a healthy lifestyle and can be correlated with people's behaviors. The freedom with which people can access their neighborhood and participate in activities is a more perceptive assessment technique than actual behavior (Miller 1999). This includes the socio-cultural environment and people's ability to be in it as well as influence it. An inaccessible or poorly resourced neighborhood restricts people's access, they are likely to adopt sedentary behaviors or use automobiles, and they could experience loneliness, stress and feelings of constrain, all of which lead to poor physical and mental health. Perception of lack of social support adversely affects health more than its actual absence (Browning and Cagney 2003). As with WAF, accessibility can be assessed through people's perception of their neighborhood and sample questions are included in table 1.

2.2 The Neighborhood Accessibility Framework

Table1 presents the determinants that together represent the neighborhood as an exposure and that have the potential to affect health and wellbeing.

Table 1. The neighborhood level determinants that can be aggregated to represent the neighborhood as an exposure.

Neighborhood Determinants	Level	Provide accessibility to	Questions to assess residents' perceptions of access: <i>The neighborhood I live in:</i>
Space		<i>Open and enclosed public spaces for an active lifestyle</i>	-Offers me open space for a physically active lifestyle - Offers me open space for playing sports - Has a community gymnasium that I can access - Has a community swimming pool I can access for fitness and leisure
Third places		<i>Safe access to public spaces for social, cultural and literary opportunities.</i>	- Has cultural activities that I can be a part of - Has a neighborhood/ community organization that I can be a part of - Has an event space I can visit for theatre, arts, and cultural immersion - Has a religious facility I can visit - Has a library that I can use - Has a school that my children can go to - Is a close-knit neighborhood where everyone knows each other and socializes - Has green pockets, such as parks
Streetscape and experience		<i>Conducive environment to be outside</i>	- Is aesthetically pleasing - Is green with trees providing shade on footpaths - Is generally free from litter
Land use		<i>Multipurpose utilities required on a daily or emergency basis</i>	- Has a fresh food market that I can use - Has a fresh meat and fish market that I can use - Has a store I can buy groceries at - Has a health-care clinic I can go to - Has a store where I can buy sundry items I often need - Has corner stores for easy access to regular grocery needs - Has a 24-hour pharmacy - Has a hospital for emergency needs

<i>Connectivity</i>	<i>Pedestrian paths that connect to various destinations</i>	<i>- Has a good pedestrian path that I can use as I go about my daily activities</i>
<i>Surveillance</i>	<i>Safe access (for people of all genders, ages, and SES)</i>	<i>- Is safe for individuals of all gender to be out and about - Is safe for individuals of all ages to be out and about - Is safe for individuals of any socio-economic class to be out and about</i>
<i>Pedestrian safety</i>	<i>Access and safety (without injuries)</i>	<i>- Has crosswalks and regulated traffic and is safe for crossing streets - Has a good pedestrian path that the elderly and physically challenged can use</i>
<i>Public transport</i>	<i>Clean environment and the larger urban area</i>	<i>- Offers me public transport options for my need to connect within the city</i>
<i>Parking</i>	<i>Active lifestyle</i>	<i>*Must be assessed by actual neighborhood survey</i>
<i>Density</i>	<i>Conducive environment, safety</i>	<i>* Must be assessed by modern techniques to measure footfall, or pedestrian, vehicle and residential density</i>

The determinants in a neighborhood that affect health and wellbeing and must be accessible at all times include:

1) Space: Space, open or enclosed, for an active physical and social lifestyle is a part of public places and must be accessible to everyone without discrimination. Space is a determinant that includes all open spaces for sports and physical activities. Community or city funded gymnasiums and swimming pools are a part of space because these offer choices in terms of activity as well as indoor options when the weather does not permit being outside. Urban sprawl and overcrowding exhaust spaces and resources for maintenance of spaces, and constrain exercise behaviors, active access and socialization in the neighborhood. The resulting sedentary behaviors and mental health disorders increase susceptibility to common complex diseases (Sehgal and Toscano 2021; Frumkin and Haines 2019). Accessibility to spaces can be restricted for various reasons from lack of enough spaces, encroachment, lack of connectivity, or reasons such as privatization restricting access due to time limitations, costs or discrimination (Phadke, Khan, and Ranade 2011; Leclercq and Pojani 2021). Lack of public infrastructure is a challenge, and space is often compromised in fast-growing and underfunded urban areas.

(2) Third places: As people go about their lives and traverse in and through their neighborhood, they interact and build communities which, form the socio-cultural fabric of the neighborhood. Third places are instrumental to the socio-cultural fabric of the neighborhood. These are places within the neighborhood that people can walk to and can gather at for recreation. People spend most time at home (first place) and at work (second place) and third places provide opportunities for recreation (Oldenburg 1997). Third places also account for safety and surveillance in neighborhoods. Vanishing third places were first discussed by Ray Oldenburg in the late 90's. Key features of third places are i) proximity to the home for walkable access discouraging dependency on automobiles for travel and ii) opportunities other than technology for entertainment. Suburban neighborhood design post World War II, did not promote community interaction, lacked community space, and had transformed all that was 'local' into 'remote' (Oldenburg 1997) thus hampering accessibility. Third places are more threatened today across urban areas as not just entertainment, shopping and socialization are also increasingly digitalized. Digital dependency has increased exponentially with the increase in the reach of the internet and social media (Leclercq and Pojani 2021). Automobile and digital dependency are unhealthy behaviors that exacerbate a sedentary lifestyle and lack of interaction, which can lead to common complex diseases (Koyanagi, Stubbs, and Vancampfort 2018; Frumkin and Haines 2019). Accessibility to third places contributes to physical, social and psychological wellbeing, all of which contribute to prevention of common complex diseases. Sustained social networks require sound neighborhood structure (Browning and Cagney 2003). Third places promote community building capacity and likely have the same effect as public spaces in breaking the class-based socio-cultural dismemberment (Németh and Schmidt 2011). Research on public places, touches upon the potential of third places even though it does not use the same terminology. More research is required to include accessibility to third places without discrimination. Coffee shops and privatized public spaces may receive a heavy footfall (Leclercq and Pojani 2021), however, are these really third places and can people of all class, gender, caste, race, color, and ethnicity access these places globally? What is the difference when these places are contrasted with free to access beaches, lake sides, riverfronts, marinas, street markets, or market avenues that can be accessed at minimal or no cost? (Németh and Schmidt 2011) Discussion on women's right to loiter, access recreational spaces and have fun in Mumbai revealed that discrimination based on gender, religion and class reshape accessibility to these basic rights (Phadke, Khan, and Ranade 2011). These discussions must be mainstreamed so that debates on accessibility to third places do not remain restricted to their existence and privatization. Oldenburg's ideas must be explored, debated and critiqued to understand socio-cultural spatiality in neighborhoods. The Neighborhood Accessibility Framework offers potential to explore people's perception of access to third places.

(3) Streetscape and Experience: These are conducive factors that make an impression and include the weather, atmosphere and cues that affect the senses. Civic planning, aesthetics and infrastructure to function in the local weather are attributes that affect if and how people access their neighborhood. With climate change, urbanization, urban sprawl

and overcrowding, urban planning authorities can be pressed for funding to keep up the city space and neighborhoods. The absence of streetscape and experience can discourage active behavior in people and have a direct repercussion on obesity and cardiac health (Frumkin and Haines 2019).

(4) Land Use: This should be mixed rather than exclusively residential. The residential neighborhood should be supported with access to retail, essential and healthcare facilities. Retail is an essential aspect of daily life and includes grocery and departmental stores, fresh vegetable, meat and fish markets, corner stores for frequently bought items such as milk and bread, and healthcare facilities should include emergency care, primary healthcare units and 24-hour pharmacies. Apart from walking to these destinations, accessibility to these facilities with mixed land use allows residents to buy a variety of foods and access healthcare as per their requirement and easily. When these facilities are not located within the neighborhood, residents are burdened with purchasing things, lugging them and storing them. Non-availability of primary healthcare in the neighborhood can lead to a lackadaisical attitude in accessing basic services such as monitoring and maintenance of blood pressure and blood sugar and can have a detrimental effect on those vulnerable to common complex diseases. In populations with high prevalence of common complex diseases, the prevalence of cardiovascular diseases and emergencies such as heart attacks and strokes are more likely to occur. Lack of emergency healthcare services leads to greater morbidity and mortality and increases the burden of diseases.

(5) Connectivity: This accessibility factor assesses how well the neighborhood connects from within with pedestrian paths and street networks that maximize options and simplify walkability. Better connectivity provides motivation and safety for active behaviors and for being outside, and bolsters access to spaces, third places and utilities thus enhancing the aggregated exposure of the neighborhood.

(6) Surveillance: The traditional and effective method to evaluate surveillance is to assess for 'eyes on the street' (Jacobs 2016). Privatization of public spaces, gender, race, ethnicity, class and color prejudices however can curb accessibility. Accessibility could be restricted in a walkable neighborhood due to socio-cultural acceptance of discrimination and surveillance could be a factor that supports this. Surveillance is reflected in the diversity a place allows and by asking people about their ability to access their neighborhood. If residents of a neighborhood perceive safety from age, gender and class related crimes and can live and move around with freedom, then 'eyes on the street' are effective. Otherwise, this surveillance can be discriminatory to accessibility as is often perceived by communities such as the poor, females, other genders and people of color and ethnicity different from those dominant in the neighborhood (Phadke, Khan, and Ranade 2011). To put security above inclusion or publicness continues to be a threat to freedom and accessibility both of which affect health behaviors and are fundamental to physical, social and mental health. The newer systems of surveillance must be evaluated from people's perceptions because camera surveillance is only a secondary method of surveillance, and it rather helps in investigation of crime than to prevent crime and create comfortable spaces (Leclercq and Pojani 2021).

(7) Pedestrian Safety: Injuries are a leading cause of morbidity and mortality and increase the global burden of disease in urban areas (Naghavi et al. 2016; Frumkin and Haines 2019). Poor pedestrian safety can instill a fear of accessing the neighborhood among residents and adversely affect the prevention and treatment those vulnerable to common complex diseases. Urban sprawl, encroachment, traffic violations and poor maintenance of pedestrian paths, all restrict accessibility in a neighborhood (Sehgal and Toscano 2021). Lack of accessibility to pedestrian space and increasing automobile dependence may indicate that pedestrians are lesser citizens (Phadke, Khan, and Ranade 2011) and exacerbate sedentary and automobile dependent behaviors in populations.

(8) Public Transport: Transit is fundamental for urban residents to access the larger city area especially for livelihood, economic and trade purposes. Currently there are few cities across the globe which have a public transport network to support the urban population (Frumkin and Haines 2019). Studies indicate that once people own vehicles, they rarely use them discreetly and are usually automobile dependent even for walkable distances (Zhang 2006). Availability and quality of public transport are both essential for effective transit opportunities and city infrastructure (Network 2018; Handy and Niemeier 1997). Every neighborhood cannot provide facilities of higher education and jobs for most residents. Public transport directly relates to active commuting and is a sustainable way for urban populations to transit with minimal carbon emissions. Public transport probably provides the most effective choice for active commuting in a city as people tend to walk in short bouts which are evidently protective for cardiovascular health (Hamer and Chida 2008). The low carbon emissions contribute to better air quality and subsequently to better health. Transit stops within neighborhoods allow residents to commute actively and connect with the larger urban area without any stresses of driving or parking. Lack of transit or accessibility to it, forces people to be dependent on automobiles, which affect the users and the neighborhood because automobile dependency is strongly correlated with sedentary behaviors, increased vehicular density and greater air pollution, all of which adversely affect health and common complex diseases (Sehgal and Toscano 2021; Frumkin and Haines 2019).

(9) Parking: Vehicular parking within neighborhoods interferes with accessibility by disrupting design and walkability in a neighborhood and is inconducive to both (Newman and Kenworthy 1989; Zuniga-Teran et al. 2017). Parking can be assessed by ways other than participants perception because it is likely that in large cities with limited access to public transport, people would perceive it an essential requirement rather than an impediment to accessibility. Genuine challenges in access to public transport exist in many cities globally (Network 2018), and people depend on private vehicles to access the city (Sehgal and Toscano 2021).

(10) Density: is considered a positive factor to invite pedestrians and promote accessibility in neighborhoods and urban areas (Zuniga-Teran et al. 2017; Network 2018). This factor must be weighed against overcrowding that can be a

disincentive to accessibility in a neighborhood. With the exception of two cities, the most livable cities in the world are medium sized and some are small with a relatively low population density (Network 2018). More people may walk in megacities in LMICs even though the design and infrastructure are not conducive for them to walk. Thus, density and overcrowding must be differentiated and studied to analyze how they affect behaviors in the population.

It is suggested that the factors of density and parking must be done outside of the questionnaire. Footfall in public transit and public space (private or publicly owned), at intersections and residential density should be used as cues to measure and compare density and overcrowding. These assessments can be done via GIS mapping to reduce the number of questions and continue to keep the participants engaged without fatigue.

For assessing the neighborhood, questions are often cultural and can be included or excluded based on where the study is conducted. For example, in LMICs a laundry service maybe a privilege or not culturally adopted. Essential services such as banking are often accessed online, and the presence of a bank may not hold much relevance. Questions regarding post office, social services, municipality offices, salons and any other amenities should be considered based on the population being surveyed.

Neighborhood boundary or walking distance is a critical determinant of accessibility and studies use distance cut-offs ranging from 800 meters to 1000 meters or a ten-minute walk as parameters (Zuniga-Teran et al. 2017; Sehgal and Toscano 2021). Researchers must decide a radius of walking distance that would determine the periphery of the neighborhood for participants. For example, for children and a higher age group, walking a longer distance may not be the only criteria that defines their health. Sound design and aggregate accessibility in the neighborhood is likely to invite people of diverse ages, capacities and identities.

3.0 NEIGHBORHOOD ACCESSIBILITY SCORE

3.1 Participant perceptions and quantification

Accessibility to the neighborhood level determinants should be quantified and averaged to create a score of the neighborhood as an exposome. In urban studies accessibility parameters have been studied independently vis-à-vis their correlation with health. The average score accounts for the interdependency of the determinants.

The participants perceptions be recorded as affirmative (yes), negative (no) or unaware (don't know). The affirmative responses to each question must be summed for all respondents in a neighborhood. The percentage of affirmative responses should be scored on a scale of 0-5 and their frequency should be determined. If less than 50% of responses are in the affirmative, then the accessibility score is 0, 51–60% of affirmative responses should be scored as 1, 61–70% should be scored as 2, 71–80% should be scored as 3, 81–90% should be scored 4 and more than 90% should receive a score of 5. This is the *affirmative response score* for each question. (For example: Access to open space: *The neighborhood I live in, offers me open space for a physically active lifestyle*; 140 respondents' answer: Yes; Total respondents in the neighborhood 200; % of affirmative responses: 70; therefore, *affirmative response score* is 3). Questions in each category of the NAF should be grouped with their scores and the scores for the category should be summed (For example: Determinant: Pedestrian Safety: *The neighborhood I live in: Has crosswalks and regulated traffic and is safe for crossing streets, - Has a good pedestrian path that the elderly and physically challenged can use*, affirmative response scores are 4 and 0 respectively, and total score is: 4+0= 4). The summed scores should be averaged and scaled from zero to ten as shown in table 2.

Table 2. The Neighborhood Accessibility Framework: Factors evaluating accessibility in a neighborhood. Accessibility scores calculated from affirmative scores and scaled from zero to ten (scores are fake and written for example).

NEIGHBORHOOD ACCESSIBILITY FRAMEWORK				
Accessibility Category	Accessibility Score			
	Neigh 1	Neigh 2	Neigh 3	Neigh 4
1. <i>Space</i>	6	5	3	9
2. <i>Third Places</i>	7	3	2	8
3. <i>Streetscape and Experience</i>	9	3	4	10
4. <i>Land Use</i>	7	9	9	9
5. <i>Connectivity</i>	5	3	3	8
6. <i>Surveillance</i>	10	10	10	8
7. <i>Pedestrian Safety</i>	2	0	0	5
8. <i>Public Transport</i>	8	8	8	10
<i>Neighborhood Score</i>	54	41	39	67

The total score, a sum of all neighborhood level determinants represents accessibility in the neighborhood. It is recommended that each NAF determinant should be compared and discussed in a research paper. This will lead to a debate and discussion on how neighborhoods compare based on the perceptions of their respective residents.

3.2 Mitigate bias

Researchers must use geographical information systems (GIS) mapping to get an overview of the neighborhood and match it with the accessibility scores. Perceptions of the residents should be compared with accessibility measured with geographical tools or actual surveillance of the neighborhood. The framework can be used to compare residents'

perception of their neighborhood with walk scores calculated from the website using the Walk Score®, (<https://www.walkscore.com/cities-and-neighborhoods/>, accessed on Nov 10, 2021). This combination is an excellent tool for planners because the walk score uses a geographical system to assess walking routes, analyzes population density, road metrics such as block length and intersection density to assess pedestrian friendliness. The walk score is used in public health and urban planning studies. If participants' perceptions do not match with the walk scores, results must be used as an indication that the design and planning need to be evaluated to know the reasons for the discrepancy.

3.3 Ethics

The studies must seek Institutional Review Board approvals and care must be taken to protect data if personal information such as addresses have been collected.

4.0 SUMMARY AND APPLICATION

The Neighborhood Accessibility Framework is applicable to urban and suburban neighborhoods. It is a simple tool that can be used by qualified or trained researchers in the field of public health and urban design. As populations migrate to urban areas, suburbanization is integral with urbanization and accessibility is important for sustainable development. This framework can be used independently to assess the perceptions of residents regarding accessibility within their neighborhoods or it can be a part of a larger questionnaire which also assesses a risk factor or a common complex disease such as diabetes, high blood pressure or obesity (Sehgal and Toscano 2021). This framework will allow the researcher to assemble data about the many and diverse exposures that comprise a neighborhood. Studies on common complex diseases can use this tool to examine the role of the neighborhood in the increased prevalence and susceptibility to these diseases. A greater number of research studies on access, neighborhood design and planning are done in high income countries and small or mid-size cities (Sehgal and Toscano 2021). This study addresses factors of urban sprawl and rapid urbanization to inspire research in LMICs, megacities and emerging metropolises. The most significant contribution of this study is the discussion and inquiry into the role of the environment rather than in common complex diseases. Research using the NAF would provide evidence to transform the health and disease debate from the individuals' behaviors to the environment where exposures happen, and behaviors are developed.

CONCLUSIONS

As GECs propel migration across the globe, urban LMIC populations are at increased risk of common complex diseases (Sehgal and Toscano 2021; Naghavi et al. 2016). Decreased infrastructural resilience to weather patterns in poor economies and greater vulnerability to environmental effects in all urban areas requires urgent attention. The neighborhood offers potential for viable and sustainable urban design and development. The Neighborhood Accessibility Framework provides a comprehensive assessment of the neighborhood-level determinants, which can be useful in the design of health-promoting urban communities. The idea of accessibility provides city planners, policy makers and public health practitioners a window to intervene at a primary level and facilitate healthy behaviors through design and integration. Accessibility gives people the freedom from weighing every choice they make and the burden of being knowledgeable about the health repercussion of every choice they make. Urban exposomes offer maximum scope for sustainable development and living. Accessibility in urban areas will break the chain of events of hazardous environmental changes leading to poor health. The neighborhood provides an opportunity for a bottom-up approach to improving design, infrastructure and accessibility in an urban area and build resilient cities.

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