Unpacking the connections between transport and well-being in socially disadvantaged communities: structural equations approach to low-income neighbourhoods in Nigeria

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Abstract:

Introduction: Emerging interest in social issues related to transport in cities facing rapid demographic and socioeconomic transitions has led to increasing interest in the relationships between well-being and transport disadvantage. However, unpacking such links has been elusive at best, and mainstream research has not embraced the particularities and diversities of Global South cities as research settings. Most research has focused on subjective approaches to well-being and ideas of satisfaction with and quality of life.

Purpose: We propose a well-being framework tailored to the specific characteristics derived from transport problems faced by low-income urban dwellers . This concept, Transport Well-being, attempts to shed light on how transport may affect components of well-being such as access to key opportunities, ability to enjoy the built environment and security while travelling. We build on the person-centred framework (White, 2010), to examine Transport Well-being in its relational, material and subjective dimensions.

Methods: We use a quantitative dataset of a randomly selected sample of 570 adults in low-income informal settlements in the periphery of the cities of Abuja, Kaduna and Ibadan in Nigeria. Data is analysed using a structural equation model (SEM), which seeks to explain the links between second-level latent variable *Perceived Transport Advantage/Disadvantage* and *Transport Well-being.*

Results: We find a strong correlation between *Perceived Transport Advantage/Disadvantage* and *Transport Well-being* (0.652) with a model specification that reflects statistically significant associations, while finding marked differences between the three cities analysed. This suggests that incorporating multiple dimensions of transport and well-being and contextual issues of the Global South can lead to different interpretations of transport-related well-being and its relation with social and transport disadvantage

Conclusions: The structural equation model enabled us to incorporate variables that captured the spirit of conceptualisations of transport disadvantage and transport well-being and to explore their links under context-specific conditions for comparable population. Findings can inform differentiated policy definition and prioritization in contexts with limited resources and structural deficits in access and connectivity. Such a result is useful to de-construct the effects and intensity of urban transport as mediating factor in well-being.

1. Introduction

This paper applies a development-oriented definition of well-being tailored to low-income developing countries proposed by White (2010). White's *Person-centred framework* understands well-being as the intersection of material, relational and subjective dimensions necessary to live well (White, 2010). Such an approach focuses on how problems experimented by people might influence aspects of well-being in these three dimensions. Building on White's conceptualisation, this paper proposes the concept of Transport Well-being. Such concept, despite including some degree of subjectivity, moves away from standard transport research exploring well-being as happiness, quality of life and subjective measurements.

Our paper responds to Three objectives. First, it outlines a conceptual framework of transport well-being that can be applied to contexts with high levels of social and transport disadvantage in the global south. Second, the paper tests such a framework for transport well-being using primary data collected using purpose-built instruments applied in low-income communities in the cities of Abuja, Kaduna and Ibadan in Nigeria. Third, the paper provides evidence-based insights and reflections about the links between transport and well-being in different empirical contexts in the global south

Our conceptual framework and data speak to both mainstream perspectives to transport and more recent socially-oriented transport research and practice (see Currie et al., 2010; Lucas & Porter, 2016; Stanley, Hensher, Stanley, & Vella-Brodrick, 2011; J Stanley & Stanley, 2007). We illustrate the links between transport well-being, perceived level of transport disadvantage, and other relevant subjective variables using a Structural Equations Model (SEM) approach.

Research around international development agendas recognise that the delivery of well-being needs to be supported by structural functions of urban societies including essential services such as water, sanitation, transport and clean energy (Gupta & Vegelin, 2016; Pongiglione, 2015; Waage et al., 2015). Three decades of well-being research have led some authors to advocate for its consideration as criterion for the design and assessment of policy that complements traditional economic evaluation of prosperity and development (Adler & Seligman, 2016; Bache, 2020; Rao & Min, 2018).

Well-being plays a structural role in the global agenda for sustainable development adopted in 2015 by the United Nations. Such agenda is embodied by the Sustainable Development Goals (SDGs) -a set of 17 goals and 169 targets-, which seek to present a comprehensive and holistic vision of human development within a context of environmental sustainability (UNDP, 2016). At the centre of this agenda there are well-being-focused goals that build on SDG 3 (Ensure healthy lives and promote well-being for all at all ages) aiming to deliver individual and collective well-being by improving conditions for the development of health, human and economic capital and their distribution between individuals and countries (Waage et al., 2015). Transport plays an essential role in such goals, by influencing access to opportunities and the contextual conditions in which it takes place, as well as by being a driver of various risks and exposures that may affect health and well-being.

Different well-being definitions and measures have also become frequent inputs for planning and indicators of development outcomes at national and local scales, being sometimes elevated to rhetoric principles for development agendas at the regional and national scale (Awaworyi Churchill & Smyth, 2019; Bache & Scott, 2018; Guillen-Royo, 2018; Janet Stanley et al., 2010). For example, in Nigeria, a landmark development policy document for the country, the Nigeria Vision 20:2020, has improving the well-being of all Nigerians as guiding aim (Rigon, 2018). Similar concerns about well-being can be found across the

78　African union and various international programmes focused on the continent. The Agenda 2063 of the
79　African Union has 7 aspirations structured around overarching goals of shared prosperity and well-being
80　(African Union, 2019). In 2015 a High-level expert group facilitated by the OECD met to discuss conceptual
81　frameworks and statistical systems for tracking the evolution of multidimensional inequality and wellbeing
82　in Africa, placing the concept at the centre of local debates around monitoring of social and economic
83　development (OECD, 2015). Moreover, in 2019 the World Health Organisation and the African Union
84　signed a Memorandum of Understanding seeking to develop a partnership "to facilitate the necessary
85　political support, and implementation of country-level interventions, needed to improve the health and well-
86　being of people across the African continent" (WHO, 2019). Such partnership has led to key commitments
87　from multi-lateral organisations and national governments across Africa to strengthen health and social
88　development policies targeting well-being at all levels in the continent.

89　Despite a rationale to approach well-being as an integrator of development outcomes, there is no clear
90　consensus regarding the best definition or measurement applicable to different sectors under context-
91　specific circumstances (Atkinson et al., 2012). Research in urban transport suggests that well-being may
92　provide added utility and justification for transport investments to achieve higher benefits than what is
93　currently accounted for (Vella-Brodrick, 2011). However, there is little research about Africa and in the
94　global south in general in relation to transport and well-being (Chatterjee et al., 2019) with limited
95　application of well-being frameworks with a developmental perspective in rapidly growing cities. In
96　addition, understanding well-being in contexts like Nigeria entails a challenge because factors such as rapid
97　demographic change and stratified citizenship constrain planning and governance and become structural
98　drivers of social and spatial inequalities (Rigon, 2018).

99　We propose a model that incorporates elements of previous research (Currie at al., 2010; Delbosc and Currie
100　2011) under a developmental conceptualization of well-being. Our SEM specification assesses *Transport*
101　*Well-being* as a second order latent variable formed by first order variables such as *Relation with the*
102　*Environment* and *Security*. The first can be understood as the way people access what they consider as key
103　opportunities. The second, is defined as the perceived exposure to crime and traffic accidents at different
104　geographical scales. *Transport Well-being* is complemented by measures of cost of living and comfort in
105　the use of transport. The SEM model also incorporates a latent variable for *Perceived Transport*
106　*Disadvantage* that reflects transport problems experienced by residents of informal settlements. We set out
107　to find a correlation between *Perceived Transport Advantage/Disadvantage* and the proposed *Transport*
108　*Well-being* latent variable*,* with seeks to contribute to the literature about empirical links between such
109　concepts and inform future research and practice targeting socially vulnerable communities in our cities
110　and similar contexts.

2.　Defining a conceptual framework of transport well-being and transport disadvantage for urban Nigeria

2.1.　Placing transport and well-being research in a context of development: incorporating inequality and disadvantage

117　Well-being research in transport is much younger than wider research on well-being, development and

118 prosperity (Vella-Brodrick, 2011, Delbosc and Currie, 2011; Ma et al., 2018). A recent review of the
119 literature suggests that research in travel and well-being has focused on people's experiences and feelings
120 during and immediately after commuting, as well as on its long-term effects (Chatterjee et al., 2019). Such
121 focus has left empirical and conceptual gaps as the literature has found it elusive to establish and to
122 mathematically test consistent links between transport and well-being (Chatterjee et al., 2019).

123 A relevant precedent in the use of SEM for determining links between transport and well-being examined
124 transport disadvantage, social exclusion and subjective well-being in Melbourne (Currie et al., 2010). In
125 this model, subjective well-being was based on the 'Satisfaction with life scale' SWLS (Diener et al., 1985).
126 Currie et al.'s (2010) research found high correlation between social exclusion and well-being but did not
127 find strong links between transport disadvantage and well-being. Another study with a larger sample size
128 in Victoria using a similar SEM model specification led to similar results (Delbosc and Currie, 2011). More
129 recently, a study in Sydney used a similar SEM model to understand the impacts of neighbourhood
130 environment characteristics into transport disadvantage, social exclusion, health and SWLS-based personal
131 well-being (Ma et al., 2018). This research suggested that a walkable environment reduces mobility
132 problems and fosters social inclusion.

133 The predominant focus of research on the Global North have also widened research gaps on the conceptual
134 links between transport and dimensions of well-being. Limited assessments of transport-related well-being
135 in contexts of poverty and disadvantage in the literature have missed relationships with livelihoods and
136 social vulnerability (Awaworyi Churchill & Smyth, 2019; Levy & Dávila, 2017; Lucas & Markovich,
137 2011). These relationships underpin transport planning and social justice concerns in cities experiencing
138 rapid demographic, economic and technological transitions. In analysing the Nigerian case, Rigon (2018)
139 argues that a precondition for studying well-being in such a context is the recognition of its multi-
140 dimensional nature. Furthermore, it is necessary to identify what constitutes such dimensions of well-being
141 and their relative importance and levels of interaction.

142 Research on transport and well-being in development studies point at the material dimension playing a more
143 central role in people's lives than other aspects of well-being (Bloch & Papachristodoulou, 2014; Rigon,
144 2018; White, 2010). This is likely no different in the study of well-being related to urban transport in Sub-
145 Saharan Africa. In such contexts, the availability of resources for travel is often correlated with widespread
146 social vulnerability and structural deficits in material infrastructure and assets (Oviedo, Levy & Dávila,
147 2017). Other challenges for research and practice in developing contexts is that the availability of data and
148 familiarity with the case can lead to trade-offs in the choice of methods and levels of analysis. Context-
149 specific conditions can largely determine the scope and scale of well-being measures and debates in urban
150 settings in the global south (Rigon, 2018).

151 There is an implicit distributional and equity dimension in the analysis of transport and well-being that
152 aligns with research dealing with the intersection of accessibility, transport deprivation and social exclusion
153 (see Jones & Lucas, 2012; Levy, 2013; Reardon, Mahoney, & Guo, 2019; van Wee & Geurs, 2011). Earlier
154 research provide valuable insights from the analysis of the effects of mobility on the well-being of the
155 elderly (Banister & Bowling, 2004; Mollenkopf et al., 2005; Schwanen & Ziegler, 2011; Spinney et al.,
156 2009), and the effects of transport over connectedness, relatedness and satisfaction with life (Delbosc &
157 Currie, 2011; Pacione, 2003; Stanley et al., 2011; Vella-Brodrick & Delbosc, 2011).

158 The links between accessibility and well-being are also relevant from an equity and social justice
159 perspective. These in the literature have been defined differently depending on the context. Examples of

160 well-being applications in the literature include measures such as available free time (Lionjanga & Venter,
161 2018) and satisfaction with life (Makarewicz & Németh, 2018). Studies in recent literature have not fully
162 explored the links between accessibility and other dimensions and definitions of well-being. Evidence from
163 research on transport disadvantage and transport-related social exclusion suggests that mainstream goals of
164 connectedness and accessibility in transport planning arise from an insufficient understanding of the
165 relevance of transport in human life, pointing to well-being as a potential missing link (Stanley and Lucas,
166 2008; Stanley and Vella-Brodrick, 2009; Delbosc and Currie, 2011; Vella-Brodrick and Delbosc, 2011).
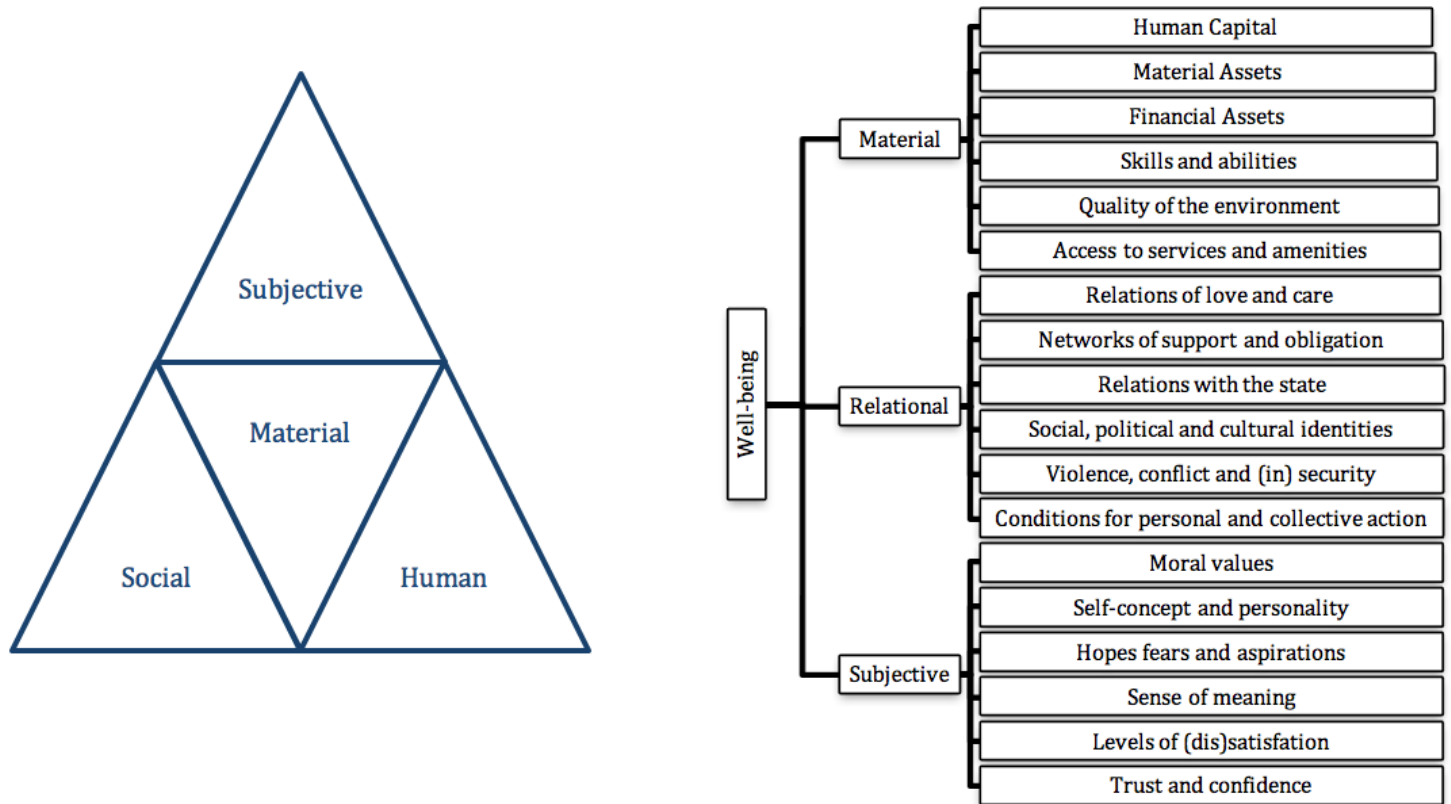
167 A key definition for the arguments of this paper is transport disadvantage. Transport disadvantage, similar
168 to well-being, is a multi-dimensional construct that focuses on the effects of lack of transport and other
169 external factors on individuals' ability to reach and be reached from places, leading to limited participation
170 in social, economic and cultural urban life (Hurni, 2007; Murray & Davis, 2001). This concept facilitates
171 analysis of transport problems and their effects on well-being. Transport disadvantage refers to the
172 marginalisation produced by the interaction between land use patterns, the transport system and individual
173 characteristics and circumstances (Currie & Delbosc, 2010). The spatial distribution of activities and
174 characteristics of transport supply can lead to groups in conditions of poverty or other forms of social
175 disadvantage to become transport disadvantaged.

176 Factors such as choice of residential location, spatial distribution of opportunities and inadequate transport
177 can lead to individuals becoming transport disadvantaged (Murray & Davis, 2001; Currie & Delbosc, 2010).
178 Schwanen et al. (2015) expand on this definition considering inadequacy of resources, opportunities and
179 safety as additional factors of transport disadvantage. The expanded definition suggest transport
180 disadvantage is "...a relational and dynamic outcome of a lack of access to basic resources, activities and
181 opportunities for interaction, of a lack of cognitive knowledge, know-how, aspirations and/or autonomy
182 regarding travel and its externalities, and of a lack of influence on decision-making in the context of
183 transport policy and governance" (Schwanen et al., 2015, pp 126).

184

2.2.   The person-centred framework

186 Our research proposes the adoption of a framework to link transport and well-being explored in earlier
187 research in urban Africa (see Oviedo, Levy & Dávila, 2017). The *Person-centred framework* (White, 2010),
188 considers three interdependent dimensions of well-being: material, relational, and subjective , whose
189 intersection implies the definition of well-being as "doing well, feeling good, doing good, feeling well" (p.
190 3-4). Figure 1 shows the three dimensions of the concept with the main sub-dimensions identified in the
191 literature and empirical testing from previous applications in Sub-Saharan Africa and Nigeria (Oviedo et
192 al., 017).

193 *Figure 1 - Well-being dimensions in the person-centred framework*

Subjective

Material

Social   Human

Well-being

Material
- Human Capital
- Material Assets
- Financial Assets
- Skills and abilities
- Quality of the environment
- Access to services and amenities

Relational
- Relations of love and care
- Networks of support and obligation
- Relations with the state
- Social, political and cultural identities
- Violence, conflict and (in) security
- Conditions for personal and collective action

Subjective
- Moral values
- Self-concept and personality
- Hopes fears and aspirations
- Sense of meaning
- Levels of (dis)satisfaction
- Trust and confidence

Source: Own elaboration based on White (2010) and Oviedo et al (2017)

2.2.1. The material dimension

The material dimension of well-being considers aspects beyond individual economic conditions, human capital (e.g. education and health) (Becker, 1962), and characteristics of the physical and natural environment. This includes the material assets necessary for achieving adequate standards of living and the skills, abilities and environmental conditions for securing such assets and so be able to 'live well' (White, 2010). This dimension is the most directly related to transport because it involves access to opportunities, services and amenities, as well as factors like health, (dis)abilities and quality of the environment. This dimension claims added relevance in contexts where travel conditions are inadequate for most urban citizens and negative externalities of transport undermine the quality of the environment and health of vulnerable populations (Oviedo, Levy & Dávila, 2017).

A central concept in understanding the relationships between transport and the material dimension of well-being is accessibility, which adds a wider dimension to the planning and management of transport (Halden, 2002). Accessibility allows assessing the interactions between transport supply and demand, land-use and individual characteristics for different social groups (van Wee et al., 2001). This concept also becomes instrumental in understanding how socio-economic positions, physical locations and power relations mediate individual and collective abilities for reaching opportunities.

Transport disadvantage is closely related with the material dimension of well-being. Location patterns of the urban poor in global south cities are often correlated with spatial and supply-driven segregation and

marginalisation, leading to a limited capacity for travel and to further deepening social, spatial and economic inequalities (Lucas, 2012; Lucas et al., 2016; Oviedo Hernandez & Titheridge, 2016; Schwanen et al., 2015). White (2010) argues that from a material perspective, lack of access associated with limited capacity for physical and virtual mobility can be correlated with measurable deficits in essential goods and services necessary to sustain health and well-being. Moreover, lack of access places disconnected people at a disadvantage in the development of skills and abilities necessary build and accumulate capital, and therefore to secure material well-being. Transport disadvantage can also explain the relationships between material and other dimensions of well-being as people in poverty often face limitations beyond the economic realm such as adverse topography, lack of supply, violence, crime and other elements that hinder movement and accessibility.

2.2.2. The relational dimension

The second dimension of well-being in White's (2010) framework refers to the relational aspect of good living. Personal and social relations are key in this dimension, which also incorporates social capital and experiences as requirements of a full life. The relational dimension is also connected with accessibility to social interactions and gender disparities in urban mobility. The latter in the form of relations of love and care and networks of support and obligation, which are strongly mediated by social positions determined by the intersection of social identities of class, gender, ethnicity, religion, sexuality, etc. (Levy, 2019; Oviedo Hernandez & Titheridge, 2016; Salon & Gulyani, 2010; Uteng & Lucas, 2017).

Accessibility and connectivity are pre-conditions for relatedness and social interactions in this dimension. This makes the availability of adequate transport and the capacity to make use of it, key preconditions that enable individuals to secure and maintain relationships. The relational dimension in the developmental definition of well-being in this paper also links transport disadvantage to social isolation and its associated effects in relation to mental health (Ettema et al., 2015; Rohde et al., 2016; Wang et al., 2017).

This dimension also incorporates relationships with the broader community and governance, key concerns for local development in socially deprived areas in the global south (Awuah, 2018; Beall, 2001). White's framework enables reflections around structural issues linked to transport. Such issues include relationships with the state, social, political and cultural identities, violence, conflict and (in)security, and conditions for personal and collective action to influence to shape the environment in which people live (White, 2010). Transport can provide conditions for the production and reproduction of inequalities in relation to cultural identities, violence and insecurity, which in turn constrain people's access to means of transport and physical connectivity.

2.2.3. The subjective dimension

The subjective dimension of well-being in the person-centred framework relates to perceptions, values and experiences (White, 2010). This dimension has been frequently studied in the transport literature, which finds its origins in the psychological literature (Awaworyi Churchill & Smyth, 2019; Ettema et al., 2015). Perceptions of people of their surroundings and their own life are central to this dimension, which are situated in a larger moral and social context. In the subjective dimension, self-concept and personality, hopes, fears and aspirations, sense of meaning and satisfaction, and trust and confidence are considered in the assessment of mental health and well-being.

The material, subjective and relational dimensions of well-being identified under the working definition adopted for this study are interwoven with different categories in which social exclusion can be detected

254 (Church et al., 2000). Some categories of social exclusion suggest that material and psychological well-
255 being can become a precondition for adequate mobility and thus attainment of relational well-being.
256 Moreover, inadequate travel conditions can hamper participation in society and access to essential assets
257 which can affect the three dimensions of well-being in White's (2010) framework.

258 Transport enhances attainment of essential needs and social interactions that can lead to heightened well-
259 being (Mollenkopf et al., 1997). Conversely, well-being can foster a broader range of mobilities and a wider
260 attitude towards transport options, which are related to the need to explore and discover (Pacione, 2003;
261 Delbosc and Currie, 2011; Stanley et al., 2011; Vella-Brodrick, 2011). This suggest a bi-directional
262 relationship between transport and well-being that could lead to either a positively or negatively reinforcing
263 cycle. Adequate transport may facilitate greater life participation and improved well-being associated to its
264 relational dimension (Metz, 2003), while an inadequate experience of transport can negatively affect quality
265 of life and satisfaction. Issues of affordability, suitability and availability of means of urban transport
266 become central under this perspective, suggesting relevance of policies and interventions influencing
267 features of transport services and infrastructure for the subjective dimension of well-being.

2.3.   Proposing a development-oriented definition of Transport Well-being and Transport Disadvantage

270 The Person-centred framework (White, 2010) facilitates conceptual reflections around implications of
271 transport for achieving a good life. The three intersecting dimensions in the framework point at transport
272 as a precondition for a broader set of well-being outcomes related to social and economic individual and
273 collective development. In this context, transport becomes a mediating factor in the relationships between
274 individuals, the built environment and the rest of society accessing urban spaces.

275 In White's framework, accessibility plays a key role in the development and accumulation of material,
276 human and social capital. This makes transport into an enabling element in the consecution of well-being.
277 This is consistent with debates around mobility and wellbeing as a dynamic and relational process that is
278 interdependent with the skills, abilities and assets of individuals (Levy, 2019; Oviedo, Levy & Dávila,
279 2017). Moreover, transport infrastructure and services mediate the relationship of individuals with the built
280 environment in the material, relational and subjective dimensions. It determines levels of mobility and
281 access to desired and valuable opportunities under different conditions of individual and collective agency.
282 Such agency is differential and it is as much a function of the safety and security of the spaces for mobility
283 as they are of the social identities of those making use of them (Anand & Tiwari, 2007; Day, 2001; Salon
284 & Gulyani, 2010).

285 Building on the three dimensions of the Person-centred framework we propose a definition of Transport
286 Well-being as:

287 *the degree to which conditions for transport enable mobility and access to valuable opportunities for the*
288 *development and accumulation of human, economic and social capital within conditions of safety,*
289 *security and comfort.*

290 Under this definition, the interpretation of valuable opportunities is context-specific, being bound to change
291 at different scales and across social groups. This definition of Transport Well-being enables analysis of the
292 degree to which infrastructure and services for transport and their interrelation with the built environment
293 enable conditions for different forms of mobility at all scales. The definition also considers how people
294 experience the road space and how walkable neighbourhoods and cities are perceived as elements of the

295 subjective dimension.

296 We expand the definition of Transport Disadvantage considering the research context and the links between
297 transport disadvantage and well-being highlighted in the literature. Lack of transport can impair physical
298 access to materially-relevant opportunities, affect disposable income and affordability, and constrain
299 relevant variables for subjective well-being such as autonomy and independence. Therefore, for this
300 research we define Transport Advantage/Disadvantage as:

301 *the availability of transport infrastructure and services that enable spatial and temporal autonomy under*
302 *conditions of affordability, convenience and independence.*

303 This definition approaches transport availability from a relative perspective, allowing distributional analysis
304 of structural drivers of inequalities in well-being, exposure to risks and mental health. The two working
305 definitions proposed are tested in the following sections using empirically measured variables and a SEM
306 model attempting to capture the spirit of both concepts through different constructs.

307

308 3. Methodology

309 We analyse the transport disadvantage and well-being characteristics from an extensive survey that built
310 on the main dimensions of the person-centred framework shown in Figure 1 and was conducted in socially
311 disadvantaged neighbourhoods of three Nigerian cities (Oviedo, Levy & Davila, 2017). Structural Equation
312 Models SEM, a suitable statistical technique for social phenomena analysis, is the main technique of
313 analysis in the paper. The model defines a latent variable for Perceived Transport Disadvantage and a
314 second-order latent variable for Transport Well-being, which is composed by other two factors.

315
316

317 3.1. Nigerian cities

318 Nigeria is a country facing rapid development and an increase in inequalities, by 2010 there were 112
319 million citizens living in poverty. It is also estimated that 57 million Nigerians lack access to safe water and
320 over 130 million are without access to adequate sanitation (Inequality in Nigeria, 2017). Three cities in as
321 many states of Nigeria (Figure 2) were selected for the detailed analysis of the links between transport
322 disadvantage and transport well-being: Abuja in the Federal Capital Territory (FCT), Kaduna, in Kaduna
323 state, and Ibadan, capital of Oyo state. Although not representative of all Nigeria's urban centres, cities in
324 Figure 2 seek to highlight differences that might arise from their location and urban trajectories. Abuja,
325 Ibadan and Kaduna have populations over 1.05, 2.8 and 1.99 million respectively. These cities are marked
326 by lack of appropriate infrastructure, unsafe conditions for pedestrian mobility, and a largely car-centred
327 mobility system (Ipingbemi, 2010).

328 *Figure 2 - Selected case studies in Nigeria*

329
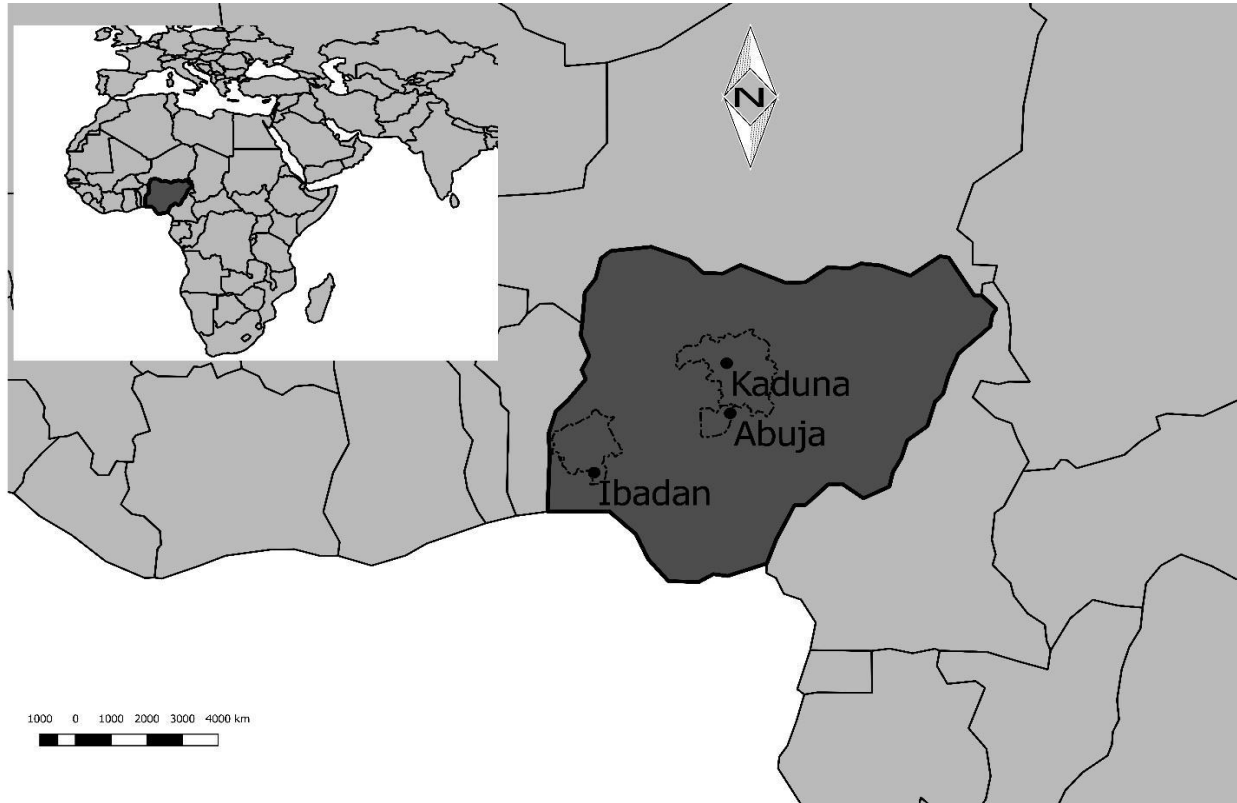
331 After independence (1960) the "oil boom" period (1960s and 1970s) and the recession time known as "oil
332 doom" (1980s and 1990s) played a major role in social development and urban growth of Nigerian cities.
333 During the oil boom, keeping Lagos as the nation's capital city became unsustainable, leading to the
334 creation of Abuja (founded in February 1973) as an orderly and modern new capital city. Abuja's growth
335 has been driven by formal supply of public transport and implementation of large corridors of road
336 infrastructure under rules of top-down master planning. Housing near Abuja's city centre is expensive,
337 leading to socioeconomic segregation and concentration of low-income populations in peripheral and peri-
338 urban areas. Abuja's master development plan outlines seven key principles linked to well-being: equal
339 access, equal citizenship, environmental conservation, the garden city, functional city, effective regional
340 development, and rapid national economic growth. Despite such objectives, the city has given priority to
341 economic growth and large investments in road infrastructure in the city centre and connecting with other
342 regions. Large infrastructure investments contrast with living conditions in most satellite settlements around
343 the city, which concentrate most of its low-income workforce. Today, Abuja is the most rapidly growing
344 city in Africa with an average annual urbanization rate of 8.3% (Abubakar, 2014). However, such growth
345 pales in comparison with the 20% annual urbanisation rate of Abuja's satellite settlement which can be
346 partly explained by large economic migrations from rural areas.

347 Kaduna was established by the British colonial government in 1913 (Bununu, 2015), emerging as one of
348 the first planned cities in the country despite marked by social segregation. As Abuja, Kaduna has a city
349 master plan developed in 1967, which never materialized and that was not reviewed until 2008 (Bununu,
350 2015). Kaduna's population growth rate is 2.6% per year. This has led to concerns for local authorities
351 regarding fast urbanization and supply of essential infrastructure and amenities to peripheral

352   neighbourhoods. Kaduna is marked by a multi-centric structure and socio-spatial fragmentation marked by
353   local geographies and social identities, particularly religion. This city poses challenges for the definition of
354   transport strategies stemming from a north-south divide in its urban, socio-demographic and economic
355   structure. These divisions arise from religious and socioeconomic differences that appear to have strongly
356   influenced the spatial distribution of the population.

357   Ibadan is the third largest metropolitan area in Nigeria after Lagos and Kano. It is the capital of Oyo state
358   in the southwest and a large industrial and educational centre. Different from Abuja and Kaduna, Ibadan
359   has followed a more organic development driven by economic activities such as trading, crafting and
360   farming (Ipingbemi, 2010). Ibadan has also been historically affected by the country's internal conflicts.
361   The city centre is in the south east and it is largely populated by indigenous groups. Rapid expansion of
362   residential districts is causing a physical separation from centres of economic activity (Ipingbemi, 2010).
363   Ibadan has a diverse socio-demographic profile and spatial distribution of activities, which is likely to
364   constraint travel practices and interactions. Moreover, its proximity to Lagos has shaped its economic
365   structure and spatial development, as well as recent land-use and transport plans.

3.2.   Survey data

367   1,196 surveys with randomly selected adults were collected in low-income informal neighbourhoods in the
368   peripheries of the three selected cities. Unfortunately, in many surveys some of the questions were not
369   responded or responded as "do not know". After removing these surveys the sample was reduced to 570
370   people (47.66% of fully completed surveys). The distribution of the sample is 177 in Abuja (20.53%), 237
371   in Ibadan (41%), and 156 in Kaduna (27.37%). Participants were between 18 and 72 years with an average
372   age of 31 years in Abuja, 37 years in Ibadan and 36 in Kaduna. Gender distribution was 56% male and 44%
373   female respondents for the whole sample, with the lowest participation of female respondents in Kaduna
374   (27%). Average income of the sample in Abuja is 12% above the legal minimum wage in Nigeria, while in
375   Ibadan and Kaduna it is 21% below and 6% above, respectively. Average level of education in the three
376   cities is secondary, with a higher prominence of higher-educated residents in Kaduna. In Kaduna, 17% of
377   sample had either a technical or high education degree. The survey was collected using a tailored
378   smartphone-based app and a citizen science approach for training local communities to collect data from
379   their peers with the guidance of trained enumerators. Detailed description of the sample, methods and
380   descriptive statistics can be found in an earlier study (see Oviedo, Levy & Davila, 2017).

381   In testing the conceptual model proposed, we focused on questions related with people's valuation of the
382   use of transport (1=Very Negative, 2=Negative, 3=Average, 4=Positive, 5=Very Positive), aspects of the
383   built environment and access at the neighbourhood scale (1=Very Bad, 2=Bad, 3=Average, 4=Good,
384   5=Very Good), at the city scale (1=Very Bad, 2=Bad, 3=Average, 4=Good, 5=Very Good) and the
385   identification of transport problems (1=Very Difficult, 2=Difficult, 3=Neutral, 4=Easy, 5=Very Easy). The
386   structure of the survey built on previous implementations of well-being-focused instruments in Nigeria, as
387   well as the experience of studying the links between transport-related social exclusion and well-being in
388   Australia (Bloch & Papachristodoulou, 2014; Bloch, Monroy, Fox, & Ojo, 2015; Currie & Delbosc, 2011;
389   Oviedo, Levy & Dávila, 2017). Different model specifications were used, incorporating several
390   combinations of variables. Table 1 presents a description of variables in the final model.

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Table 1: summary of the variables used in the model

Variable	Abuja		Ibadan		Kaduna	
	Mean	SD	Mean	SD	Mean	SD
Aspects in the use of transport						
Comfort	3.54	0.97	3.27	0.51	2.23	0.74
Safety from accidents	3.55	0.78	3.09	0.67	2.34	0.86
Safety from crime	3.54	0.81	3.08	0.71	2.29	0.92
Aspects of the Neighbourhood						
Availability of places of worship	4.12	0.74	3.28	0.86	3.22	0.99
Availability of shops	3.81	0.78	3.19	0.80	3.12	1.05
Cost of living	3.52	0.68	2.52	0.72	1.65	0.66
Safety from crime	3.20	0.78	2.92	0.66	2.06	0.78
Aspects of the City						
Availability of schools	4.03	0.69	3.23	0.91	3.61	1.07
Availability of shops	3.81	0.75	3.18	0.77	3.21	0.92
Facilities for walking	3.94	0.77	3.11	0.82	2.08	0.63
Quality of the roads	3.82	0.76	2.60	0.88	2.29	0.65
Safety from crime	3.58	0.70	2.89	0.63	2.36	0.76
Transport Problems						
Being able to change connections between transport	3.63	0.67	3.62	0.56	2.74	0.69
Being able to move around anytime you want	3.73	0.66	3.49	0.78	2.31	0.59
Finding Transport	3.83	0.59	3.77	0.60	2.64	0.60
Having transport available at night	3.57	0.89	3.42	0.77	2.32	0.54
Paying for your transport	3.71	0.66	3.72	0.74	2.99	0.81
Reaching your places quickly	3.76	0.64	3.72	0.70	2.44	0.64

3.3. Structural Equation Models SEM

Structural equation modelling (SEM) is a statistical framework based on latent variables and pathway analysis. A latent variable, or factor, is an unobservable variable that cannot be measured but affects the scores on observable variables, or indicators, and it explains correlations among observable variables. Second-order latent variables are latent variables formed by a set of latent variables instead of indicators. A SEM model is summarised using a diagram where factors are represented by an oval and indicators by squares.

In SEM, analysts define the number of factors introduced in the model, how factors affect indicators, and

what causal relationship take place between them. SEM requires a strong conceptual background and empirical knowledge that inform a clear set of hypotheses to test. These models help to understand patterns of correlations for measured variables and explain their variability.

SEM specifications use a maximum likelihood estimation method to find a set of parameters that best reproduce the variances and covariances in the data. These parameters are factor loadings, factor variances, factor covariances, indicator errors and, when specified, error covariances. A factor loading is the direct effect that a factor has over a specific indicator. Considering different variables operate with different scales, standardized values are commonly used to compare loadings of different latent variables.

An important aspect of SEM modelling is to evaluate the degree to which each variable is explained by the chosen specification, which is known as communality. Communality adopts a value for each indicator ranging between 0 and 1, which can be interpreted in the same way R-squared coefficients are interpreted in linear regressions. Many indices and cut-off thresholds have been proposed in the literature. Some of the most frequently recommended to include in results report are: Standardized Root Mean Square Residual (RSMR), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI). These are reported in the findings section.

4. Findings: proposed SEM Model for Transport well-being and Transport Advantage/Disadvantage

Our model includes two main latent variables: *Perceived Transport Advantage/Disadvantage* and *Transport Well-being* (second-order factor). The model calculates the correlation between such factors, which constitute one of the main results of the paper. This section summarises the SEM model specification, latent variables included, and the indicators selected and their rationale. Figure 3 shows the model diagram, latent variables are represented by ovals and indicators are represented by squares.

This model builds on the structure suggested by Currie et al. (2010) and Delbosc and Currie (2011a). Such research used SEM as main form of analysis and conceptualised relationships between well-being, social exclusion and transport disadvantage. We identify three main differences between earlier research and our work. First, our model does not explicitly consider social exclusion variables because our target sampling focused on already disadvantaged populations in peripheral informal settlements. Such population groups can be considered as socially excluded, and primary data reflects the conditions under which transport affects their well-being. Second, we incorporate a factor for *Perceived Transport Advantage/Disadvantage* with eight observable variables r including the "degree of experience of transport problems", while earlier research presented transport disadvantage as a disaggregated variable (Delbosc & Currie, 2011a; C. Levy, 2013). Finally, we propose an alternative definition for well-being building on the person-centred framework, which moves away from focus on quality of life and measures such as SWLS.

Figure 3 – Structural Equation Model Diagram.
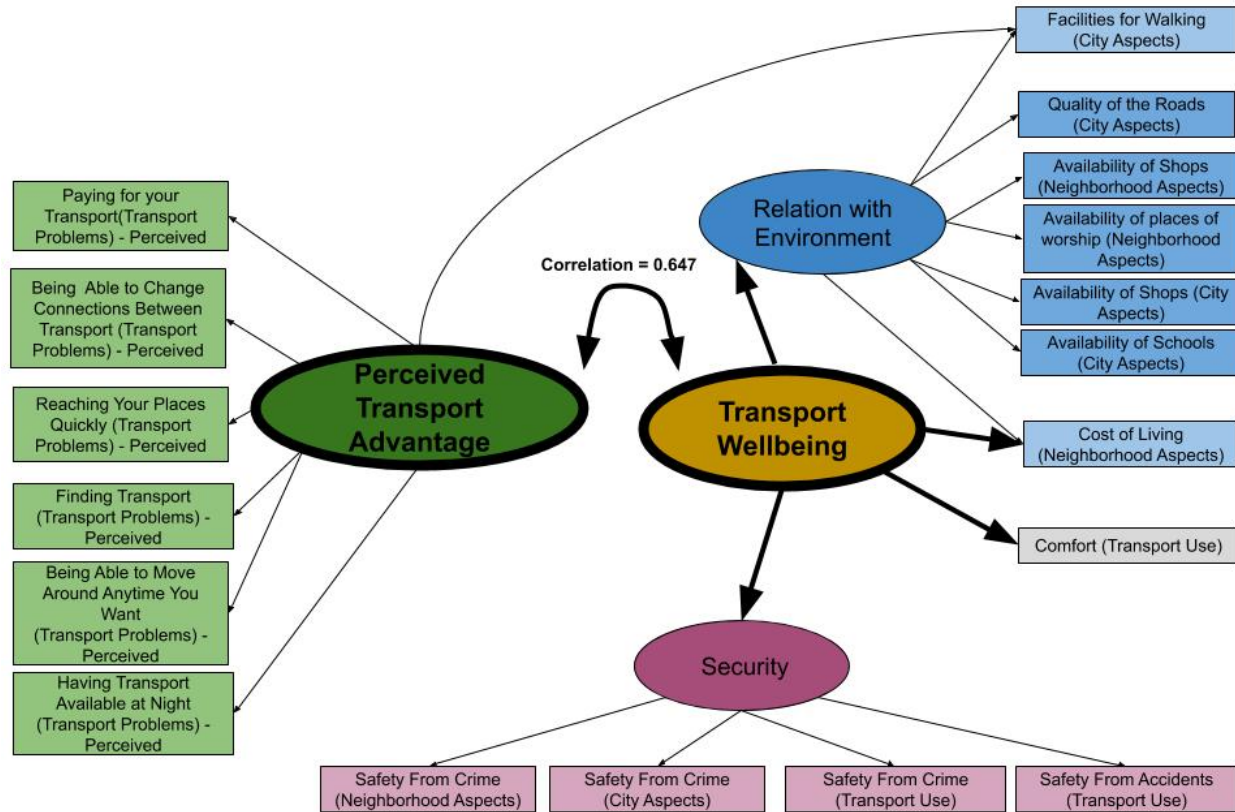
Transport Well-being is a second order latent variable in our model, which is explained by the two factors *Relation with Environment* and *Security*, and the indicator variables *cost of living* and *comfort in the use of transport*. The first factor encompasses how people perceive and experiment opportunities at the city and neighbourhood levels. *Relation with Environment* considers accessibility by questioning perceptions of availability of key opportunities at these levels. This includes indicators such as *availability of shops* (at the neighbourhood and city levels), *availability of places of worship* (neighbourhood level) and *availability of schools* (city level), which are relevant for material and relational well-being. Three other indicators are included in this factor: *quality of roads*, facilities *for walking*, and *cost of living*. Such variables reflect the degree to which transport enabled mobility at different scales, to which walking becomes essential, and the economic constraints that mediate people's access from a material perspective. The model includes cross-loading of specific variables to more than one latent variable due to their shared influence over specific dimensions of well-being. *Facilities for walking* has an influence on *Relation with the environment*, enabling different experiences that may influence other forms of access to opportunities such as shops, schools, etc. This same variable has a direct effect on *Perceived Transport Advantage,* as it can affect not only the ability or residents to navigate their local environment and access motorised transport, but also can become a relevant constrain for residents unable to afford transport, who become captive walkers, depending almost exclusively on such facilities for their mobility. A similar logic applies to the factor of *Cost of Living*. Considering the research context of low-income and disadvantaged groups, such a factor is

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460   expected to have a direct effect of *Transport well-being,* as well as it can mediate the *Relation with the*
461   *environment,* being a proxy for income and affordability, which influence availability of facilities and
462   opportunities.

463   Figure 3 shows the three indicators above are also part of other latent variables, which is not inconsistent
464   with conceptual discussions in section 2. Factor Analysis identifies and differentiates the effect that more
465   than one latent variable may have on an indicator. Therefore, our model suggests that the rating of *facilities*
466   *for walking* is both linked with T*ransport Well-being* and *Transport Advantage/Disadvantage*.

467   The Second latent variable, *Security*, highlights the importance of feeling safe in contexts where exposure
468   to theft and other crimes are frequent concerns in public space (Oviedo, Levy & Dávila, 2017). This factor
469   is explained by indicators such as *safety from accidents* (in the use of transport) and *safety from crime* at
470   the local, city and transport scales. Accounting for different spatial scales at which crime may manifest
471   enables a robust assessment of negative perceptions of security and their intersections with social identities
472   and social positions. For example, a woman may feel safe within her neighbourhood where she knows
473   people in the community but may experience fear as she commutes to other parts the city, which constrains
474   her access and mobility. Moreover, fear to vehicle accidents during commuting is included as traffic
475   accidents and fatalities are a regular concern among commuters. This is captured by the indicator *safety*
476   *from accidents*. The indicator *cost of living* also helps explaining *Transport Well-being* as it incorporates
477   part of the material dimension in White's Framework. The indicator of *comfort* in the use of transport refers
478   to the individual experience of transport.

479   The *Perceived Transport Advantage/Disadvantage* factor is based on survey questions rating *Transport*
480   *Problems*. Such observed variables are represented in a scale from 1 to 5, where 1 is "very negative" and 5
481   "very positive". A high value in *Transport Advantage/Disadvantage* suggests good conditions to move and
482   reach opportunities. A positive correlation with *Transport Wellbeing* is expected, suggesting that low levels
483   of transport advantage will decrease well-being. Our specification contrasts with earlier research modelling
484   transport disadvantage through principal component analysis using observed variables that reflect the
485   "degree of difficulty" in over 15 aspects of transport. Despite such complex specification, this research did
486   not find significant correlations with social exclusion and subjective well-being (Currie et al., 2010).

487   ## 4.1.   Structural Equation Model Results

488   Our model was fitted using the lavaan library (Rosseel, 2012) for the R programming language. Table 2
489   shows estimated loading values with their respective standard errors. A loading value indicates how factors
490   affect indicators, thus high values are preferred. The standard error complements interpretation of loading
491   values by providing information about its consistency.

492   Loading values are statistically significant for the proposed model. Almost all indicators load consistently
493   and strongly for first-order factors. For example, in the *Perceived Transport Advantage/disadvantage*
494   factor, *Reaching your places quickly* (transport problems) and *Being able to move around anytime you want*
495   (transport problems) have values of 1.56 and 1.58 (respectively)

496   Only two measured variables seem to have low loading values but are kept in the model because of a strong
497   theoretical foundation. The first is *cost of living* at the neighbourhood scale on the *Relation with*
498   *Environment* factor, with a 0.359 standardized loading. This factor captures the perceived access to essential
499   opportunities, which requires not only physical availability but also the necessary resources to materialize
500   opportunities. A large availability of shops does not necessarily mean people are in a position to pay for

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goods and services. Similarly, availability of schools is a pre-condition but not a sufficient guarantee that people will increase their education level. The capacity of people to transform opportunities into achieved well-being will largely be mediated by the cost of living. Another variable with low standardized loading is *Facilities for Walking* at the city scale in relation to the *Transport Advantage/Disadvantage* factor. We kept such indicator as it provides insights on difficulties for autonomous individual mobility. Walking remains the most frequent form or travel among the poor, and adequate facilities to do so can become a key determinant of transport-related well-being.

Loadings in the second order factor *Transport Well-being* are also consistency high with *Relation with Environment* being lower than the others (0.223). Theoretically speaking we were expecting a higher value. We think that the result is due to the nature of *Relation with Environment* where we did not include indicators related to public spaces, green spaces, or community cohesion.

Table 2: Structural Equations Model Results

Factors and Indicators	Loadings		
	Estimate	Standard Error*	Standardized
Transport Advantage/Disadvantage			
Paying for your transport (Transport Problems)	1	0.494	0.617
Reaching your places quickly (Transport Problems)	1.541	0.097	0.863
Finding Transport (Transport Problems)	1.302	0.085	0.816
Being able to move around anytime you want (Transport Problems)	1.47	0.097	0.804
Having transport available at night (Transport Problems)	1.312	0.095	0.705
Being able to change connections between transport (Transport Problems)	1.116	0.078	0.742
Facilities for walking (City Aspects)	0.71	0.067	0.345
Relation with Environment			
Availability of shops (Neighborhood Aspects)	1	0.687	0.749
Availability of places of worship (Neighborhood Aspects)	1.119	0.061	0.81
Quality of the roads (City Aspects)	0.997	0.065	0.679
Facilities for walking (City Aspects)	0.969	0.06	0.655
Availability of shops (City Aspects)	0.916	0.045	0.736
Availability of schools (City Aspects	1.047	0.061	0.752
Cost of living (Neighborhood Aspects)	0.519	0.054	0.359
Security			
Safety from accidents (Use of Transport)	1	0.768	0.862
Safety from crime (Use of Transport)	1.081	0.041	0.889
Safety from crime (Neighborhood Aspects)	0.821	0.041	0.733
Safety from crime (City Aspects)	0.707	0.041	0.653
Transport Well-being			
Security (Social)	1	0.851	0.851
Environment (Social)	0.235	0.055	0.223

Comfort (Use of Transport)	0.96	0.069	0.69
Cost of living (Neighborhood Aspects)	0.911	0.069	0.599

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515 Communalities have a similar meaning to R values in regression analysis, they provide a measure of the
516 extent to which the model explains a measured variable. As seen in the Table 3, the proportion in which
517 indicators are explained is reasonably good in general with some specific indicators showing very high
518 values. This is the case of *reaching your places quickly* (transport problems) with 0.74, *facilities for walking*
519 (city aspects) with 0.61, and *safety from crime* (use of transport) with 0.79.

520 *Table 3: Communalities*

Indicators	R-Square Value
Paying for your transport (Transport Problems)	0.38
Reaching your places quickly (Transport Problems)	0.744
Finding Transport (Transport Problems)	0.667
Being able to move around anytime you want (Transport Problems)	0.646
Having transport available at night (Transport Problems)	0.497
Being able to change connections between transport (Transport Problems)	0.551
Facilities for walking (City Aspects)	0.614
Quality of the roads (City Aspects)	0.46
Availability of shops (Neighbourhood Aspects)	0.562
Availability of places of worship (Neighbourhood Aspects)	0.656
Availability of shops (City Aspects)	0.542
Availability of schools (City Aspects)	0.565
Cost of living (Neighbourhood Aspects)	0.584
Safety from accidents (Use of Transport)	0.743
Safety from crime (Use of Transport)	0.79
Safety from crime (Neighbourhood Aspects)	0.537
Safety from crime (City Aspects)	0.427
Comfort (Use of Transport)	0.476

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522 Goodness of fit measures show results within reasonable margins (Hu & Bentler, 1999; Kline, 2015;
523 MacCallum et al., 1996). The model's SRMR is of 0.083 (minor to 0.10 is considered adequate and minor
524 to 0.08 is considered good), while its RMSEA is 0.092 (minor to 0.08 is considered adequate) within a
525 confidence interval between 0.085 and 0.098. TLI and CFI values are 0.884 and 0.903, respectively (above
526 0.9 is considered adequate). The goodness of fit measures are within acceptable thresholds or near to them.
527 Moreover, it is important to bear in mind that those measures are overall indicators that does not outperform
528 the theoretical concepts intended to express in the model and, considering also that estimated loadings are
529 statistical significant, we consider that results suggest the rationale behind the model can be accepted.

530 The positive results in testing the model support our interpretation of transport well-being as a second order
531 latent variable that builds on theoretical components in White's (2010) framework. These findings also

532 suggest that the specification of this first concept as manifested in two latent variables and specific
533 indicators is a reliable approach. Furthermore, in line in previous research, our findings suggest interpreting
534 transport advantage/disadvantage as a latent variable can incorporate a distributional dimension connected
535 to different experiences of transport-related problems.

536 The conceptual framework for well-being proposed allows linking conceptualisations of transport well-
537 being and transport advantage/disadvantage in contexts with marked conditions of deprivation and lack of
538 access. A high correlation score for transport advantage/disadvantage and well-being was found with our
539 model specification in comparison with previous research.

540 Such high correlation is perhaps the most relevant result of the model. The 0.647 correlation between the
541 latent variable *Transport Advantage/Disadvantage* and the second order latent variable *Transport Well-
542 being* constitutes empirical evidence of the complex interrelations between transport provision, individual
543 conditions and access and mobility as preconditions for well-being. This is relevant given the social
544 development perspective embedded in the definition of the concepts and the model.

545 Latent variables scales are similar, with higher scores referring to better conditions than lower or negative
546 values. The analysis of the three case study cities in Nigeria allowed us to identify differences for dwellers
547 in different locations (see Table 4). Kaduna is the city in the worst reported conditions in almost all areas,
548 this is consistent with the descriptive statistics shown in Table 1.

549   *Table 4: Factor scores across cities in the model with full sample*

Factors	Abuja		Ibadan		Kaduna	
	Mean	SD	Mean	SD	Mean	SD
Transport Advantage/Disadvantage	0.259	0.300	0.189	0.342	-0.581	0.253
Relation with Environment	0.501	0.426	-0.199	0.604	-0.265	0.579
Security	0.521	0.572	0.080	0.503	-0.713	0.614
Transport Well-being	0.476	0.439	0.107	0.293	-0.704	0.386

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551 Table 4 shows the *transport well-being* and *transport advantage/disadvantage* scores differentiated by city.
552 The correlation between our two main factors becomes clear in Figure 5, showing Kaduna in a further
553 trajectory of lack of access and mobility in comparison with the other cities. Mean values in the *transport
554 well-being* latent variable shown in Table 4 are highest in Abuja (0.48), positive in Ibadan (0.11) and both
555 negative and with a much higher comparative magnitude in Kaduna (-0.7). In a similar way, *transport
556 disadvantage* scores are higher and positive in Abuja and comparatively lower for Ibadan. The magnitude
557 of Kaduna is again the highest for this factor and the negative sign indicates the highest levels of transport
558 disadvantage of the three cities. Abuja and Ibadan are more similar, which can be partly explained by more
559 dynamic economies and a much larger level of public investment in infrastructure and connectivity.

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Figure 4 – Relation between well-being and transport advantage/disadvantage

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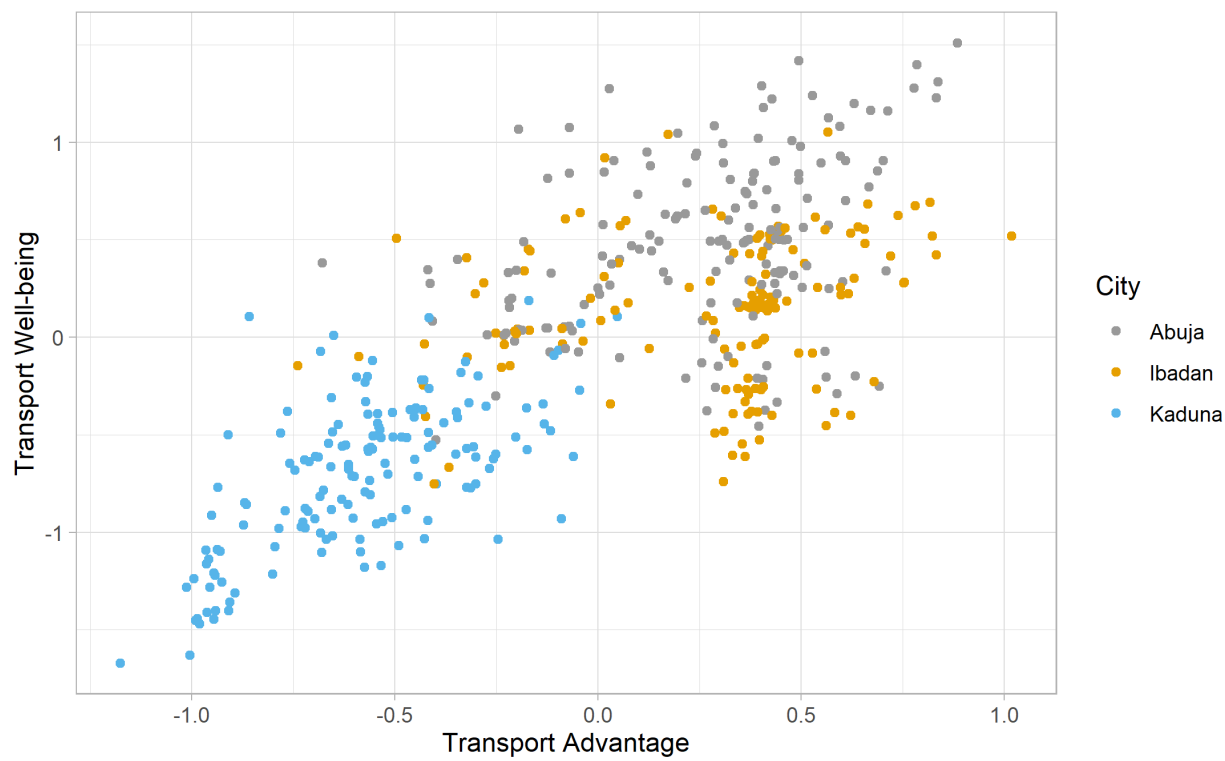
The boxplots in Figure 5 show the dispersion of the factors analysed and enable comparisons between cities. As shown, the *security* factor Ibadan has a much higher variability compared to the other cities. Abuja has the larger mean scores in all latent variables followed by Ibadan, which speaks to the role of structural connectivity and investment in the built environment in the observed scoring of aspects of material, relational and subjective well-being and advantage/disadvantage related to transport.
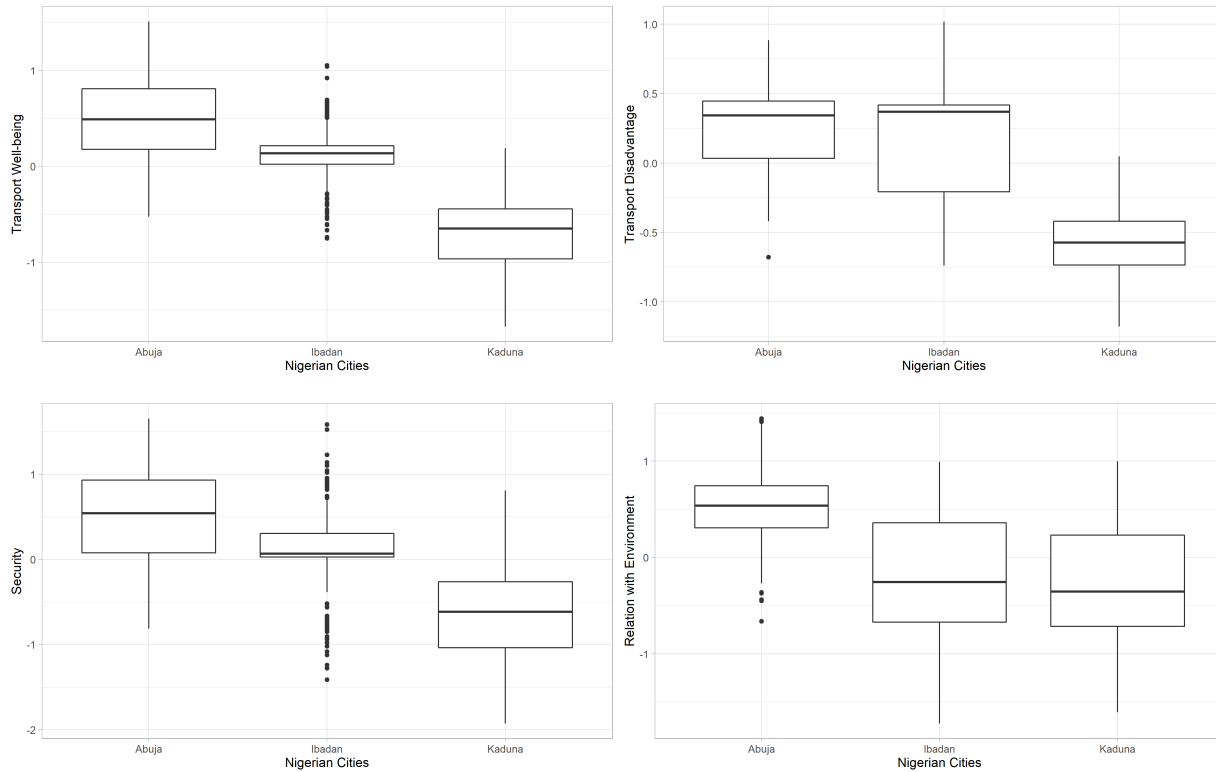
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Figure 5 – Latent variables boxplots by city

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Figures 4 and 5 show that Kaduna differs considerably from the other cities and that it accounts for almost all the correlation found in the model. This is a very interesting finding that suggests that despite expectations of a clear correlation between our latent constructs, context-specific conditions play a significant role on the links between transport disadvantage and transport well-being. To shed light on this issue we ran three additional independent models for each case study city, which found very different correlations between *transport advantage/disadvantage* and *transport well-being*. Kaduna shows a high correlation between the two factors of 0.852, while for Ibadan the correlation is -0.019 and for Abuja is 0.093. The strong differences in the correlation between the two factors in different contexts suggests links between transport burdens and well-being in low-income populations of informal settlements is stronger in populations experiencing a much higher comparative degree of transport problems and lack of material well-being as shown in Table 1.

The deconstruction of the different latent variables in our model specification show that Kaduna has the largest number of negative scores in indicators of material, relational and subjective well-being related to transport, and a much worse capacity to afford adequate standards of living than in the other cases. These findings suggest that when comparing seemingly disadvantaged populations, marginal differences in quality of life and availability of opportunities and key facilities can make a significant difference in how much transport disadvantage can influence the type of well-being defined in our study. Our hypothesis is that people facing more challenging transport problems perceive a more direct effect on their well-being. By the same token, what the lack of significant correlations between our two latent constructs in Ibadan

and Abuja suggest is that for low-income populations, a comparative better transport condition makes it less relevant for well-being than perhaps other more structural deficits in access to social and economic development infrastructures. This places transport as a necessary but insufficient condition for sustained well-being and the accumulation of social, economic and human capital (White, 2010). This does not reduce the relevance of the analysed indicators on *transport well-being*, instead, it suggests that people experience different levels of transport-related well-being, but this is not necessarily mediated by transport disadvantage.

5. Conclusions

In this paper we adopted a developmental approach for framing the links between transport and well-being in informal settlements of cities in Sub-Saharan Africa, using three cities in Nigeria as case studies. The paper sought to expand on earlier research in empirical settings the literature on transport and well-being has not yet fully explored. We build on the person-centred well-being framework to provide a development-oriented reflection on the implications of transport for well-being beyond the subjective and health dimensions. In the process, we proposed and tested adapted definitions of *transport well-being* and *transport advantage/disadvantage* intending to capture different dimensions of well-being and the complexities of addressing it in disadvantaged communities in cities of the global south. From this perspective, Transport Well-being is defined as:

The degree to which conditions for transport enable mobility and access to valuable opportunities for the development and accumulation of human, economic and social capital within conditions of safety, security and comfort.

Conversely, we defined transport Advantage/Disadvantage as:

the availability of transport infrastructure and services that enable spatial and temporal autonomy under conditions of affordability, convenience and independence.

The structural equation model enabled us to incorporate variables that captured the spirit of these definitions, finding a high correlation (0.652) between the two latent constructs proposed. However, marked differences in indicators related to transport disadvantage and material, relational and subjective perceptions of well-being suggest significant differences in the availability of opportunities and transport facilities and infrastructure in the three communities studied.

The SEM models ran for the disaggregated sample from each city shows that the correlation is strong only in Kaduna. This is the case that reported larger transport-related problems as well as the lowest capacity for affording adequate living conditions as suggested by the comparatively lower score on the indicator for cost of living. This suggests that despite our sample selection focusing on lower-income populations and informal settlements, structural conditions of the built environment and the distribution of opportunities that are more favourable can limit the influence of transport disadvantage on transport well-being. The variables analysed in Table 1 suggest more prominence to other essential lacks for social and economic development in determining transport well-being when perceived transport problems are less severe.

649 Our models suggest a stronger correlation than previous research between constructs reflecting transport
650 disadvantage and transport well-being as well as evidence of heterogenous effects in the links between such
651 constructs. Such a result is useful to de-construct the effects and intensity of urban transport as mediating
652 factor and a pre-condition for different aspects of well-being. Different indicators involved in definitions
653 and processes to achieve well-being are linked to transport, and intersect debates around accessibility,
654 equity and health. Such indicators align with one or more of the material, relational and subjective
655 dimensions of the developmental definition of well-being. Furthermore, by focusing on low-income and
656 perceivably disadvantaged populations, our findings highlight the role financial, social and physical aspects
657 of people's lives can make meaningful differences in the effect transport disadvantage has on transport-
658 related well-being.

659 From a methodology perspective, the use of purpose-built data collection instruments using technology can
660 contribute to collecting novel data that informs the estimation of robust latent attitudinal constructs.
661 Findings also suggest the need for a more comprehensive analysis of individual and collective aspects of
662 life beyond transport. The formulation of the research building on linkages and interactions suggested from
663 earlier research played a significant role in reaching formulations that expand on conceptual relationships
664 between transport and well-being under different context-specific conditions.

665 Our findings also have implications for the understanding of the urban and transport conditions in informal
666 settlements in Nigeria. The differences in findings in the three studied cities can inform policy development
667 and prioritisation as conditions and relationships between transport and well-being are not the same in all
668 informal settlements. At the strategic level, the differences in findings from comparable settlements in three
669 different cities suggest the need for different focus in relation to inequality and exclusion of populations in
670 similar conditions of poverty. The results place transport as a key differentiator in the quality of life of
671 citizens of informal settlements in Abuja, Kaduna and Ibadan. Furthermore, the primary evidence from all
672 case studies can inform decision-making and monitoring on the basis of the empirical and conceptual
673 proposals presented in the paper.

674 Various issues require further research. On the one hand, new model specifications and the exploration of
675 other SEM capabilities should be fully explored. For example, the loading of *Relation with Environment* in
676 *Transport Well-being* must be analysed including additional indicators. Moreover, the approach outlined in
677 the article and the structural model built needs to be tested in other developing contexts and for specific
678 social groups and identities. This may shed additional light on the hypothesis presented for the low
679 correlation observed in Ibadan and Abuja. New research building on these findings may enrich both the
680 instruments for data collection and techniques for analysis with context-specific social, economic, and
681 cultural considerations. Further research should also explore explicitly the links between transport
682 disadvantage and transport well-being and physical and mental health, which may find more meaningful
683 links as introduced in the conceptual discussion of the paper. Our findings also point at links between
684 *Perceived transport advantage* and *Transport well-being*, suggesting a correlation between the two
685 constructs. Given the complexities associated with socially vulnerable environments such as informal
686 neighbourhoods in Nigeria, there are other potential factors that may influence both transport disadvantage
687 and well-being such as poverty, inequality and structural deficits in other forms of infrastructure and social
688 support. The exploration of such relations will require further data and the integration of other forms of
689 literature that may complement current findings, which opens new possibilities for research.

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