Local Access to Bus Rapid Transit (BRT) in Saskatoon, SK: An Equity Assessment

Udit Narayan Pandey[1], Scott Bell[2], Ehab Diab[2], Daniel Fuller[3], Zoe Poirier Stephens[4]

[1]Thapar Institute of Engineering & Technology, Patiala, Punjab, India, unpandey07@gmail.com
[2]Geography and Planning, University of Saskatchewan, scott.bell@Usask.ca
[2]Geography and Planning, University of Saskatchewan, ehab.diab@Usask.ca
[3]Community Health and Epidemiology, University of Saskatchewan, dan.fuller@Usask.ca
[4] Centre de Recherche en Santé Publique, Université de Montréal

ABSTRACT

Active transportation is an important part of reducing human induced climate change. According to the Paris Agreement (COP21) the world's nations are expected to take meaningful action to reduce carbon emissions toward a goal of limiting global temperature increase to 2 degrees C this century, with a further goal of 1.5 degrees C.[1] Towards these goals, many cities are implementing interventions to increase active transportation modes (including cycling, walking, and transit use). This study is part of a larger examination of four Canadian cities' adoption, implementation, and assessment of active transport infrastructure.[2] For active transportation to have a meaningful impact it should meet social justice and equity goals in addition to those associated with the climate. We examine the socio-economic profile and composition of urban residential Dissemination Areas (DAs) in Saskatoon, SK adjacent to a proposed Bus Rapid Transit (BRT) intervention, to better understand the potential impact of BRT on the city's population (independent variable: Adjacent/Non-Adjacent). In addition to patterns indicating that equity-deserving populations are living in areas of the city that will be served by BRT; we also find an Eastside vs. Westside pattern for Indigenous populations in Saskatoon.

Independent variable: BRT Adjacent/non-Adjacent dissemination areas; Dependent variables: new Canadians, % Indigenous, >30% of income spent on housing; Patterns revealed: Core-Periphery and Eastside/Westside; unit of analysis: dissemination areas.

1. Introduction

Bus Rapid Transit (BRT) represents an important adaptation to existing bus transit.[3] BRT attempts to meet the transportation demands of urban populations by offering service with fewer disruptions on dedicated bus-only lanes with more frequent and reliable service (pick-ups/hour), improving users' overall experience and satisfaction. BRT is an attractive option for cities of different size, including mid-size cities because it provides rapid transit benefits in terms of capacity and speed that are comparable to rail-based transit systems without the cost associated with such systems.[4] Several features differentiate a BRT system from a conventional public bus system. These features include infrastructural, operational, design elements from vehicles and station configurations, and fare collection systems to transit signal priority systems and dedicated bus lanes. Therefore, meeting the requirements of BRT means that dedicated traffic lanes must be reserved for transit BRT-only use,[4] which is not allows easy due to physical or financial constraints. For example, in a city like Saskatoon, bisected by a river, such lanes would halve the capacity of the city's 4-lane bridges and be infeasible on its sole 2-lane bridge. With such constraints in mind, Saskatoon Transit has committed to implement some, but not all features of

BRT; their implementation is what we call BRT-lite and will not offer dedicated bus- lanes on most sections of the BRT system (Figure 1). Accepting the constraints imposed by bridge capacity and other issues, the current plan does allow future implementation of further BRT related features: preferential traffic light operation, dedicated lanes where such can be offered, and improved passenger access and payment.
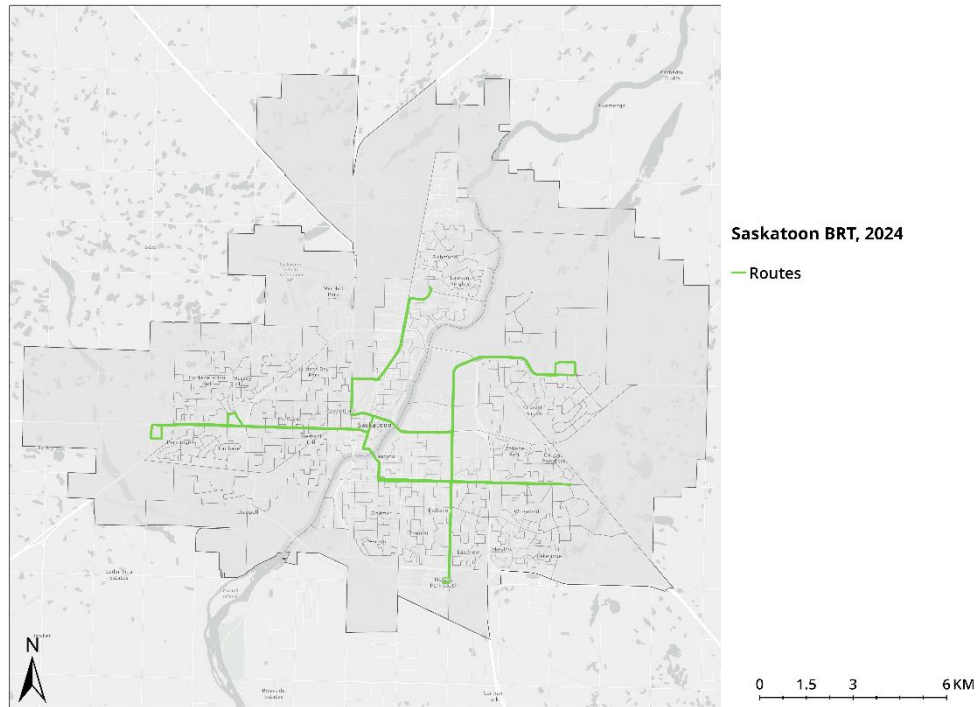

Figure 1: Saskatoon BRT (proposed for 2024)

This study examines the extent to which the proposed BRT system meets the needs of equity-deserving populations in Saskatoon. These populations include those experiencing high housing costs and instability, recent immigrants, low-income households (LIM), Indigenous people, and people with lower educational attainment. Previous studies indicated the importance of such segments of population within BRT systems catchment areas in supporting high levels of ridership in smaller and medium-size cities in North America.[5] To answer our research questions, we first mapped the arrangement of the proposed BRT service (Figure 1) and several census variables (Figures 2 and 3). The 1st law of geography states that "everything is related to everything, but near things are more related" and is why we can create maps of study areas (cities) using units of analysis such as census tracts or dissemination areas (DAs) with each unit getting a single colour that represent 100s or 1000s of individuals.[6] We have confirmed "1st law of Geography" patterns in Saskatoon SK in our target variables. The 1st law is a powerful means to better understand underlying causes of social deprivation that exist in urban spaces and can serve as a useful first line of inquiry in such equity-deserving populations. [7, 8, 9]

2. Methods & Data

We take a spatial analytic approach in this study. Using ArcGIS Pro 3.0.1, we mapped and summarized data for several census variables at the Dissemination Area (DA) level (units of analysis) of Saskatoon (Area of Study).[6] Spatial data was projected to UTM Zone 13N. Two

selections were used: first, we compared DAs adjacent to proposed BRT transit lines with those "not-adjacent;" next after observing the subsequent patterns, we selected DAs on the east and west side of the South Saskatchewan River to compare the two sides of the river. Historically, there have been systematic differences between the east side and the west side of the river in terms of poverty. Rivers, such as the South Saskatchewan that bisects Saskatoon, divide urban spaces. Notable in Saskatoon's history is the first traffic bridge, completed in 1907, which connected two previously separate communities. It was not until this first bridge was in place that the city became an amalgamation of communities on the west (Saskatoon) and east (Nutana) side of the river. The results presented below draw two comparisons: 1. East side/West side and 2. BRT-adjacent/non-adjacent.

2.1 Study site: Saskatoon, SK

Saskatoon is a mid-sized Canadian city in the great plains or prairie region of North America. The population is approximately 266,000 people spread across 225 km^2. The city is bisected by the South Saskatchewan River (running N-S) with 7 motor vehicle bridges providing E-W access. Of those 7 bridges all are used by the transit system, Saskatoon Transit.

2.2 Descriptive and Exploratory Spatial Analysis

Demographic data available from the 2016 Canada Census was used to characterize the population. The unit of analysis is dissemination areas (DA). DAs are the smallest spatial unit for which detailed demographic data is available in Canada. For all units of analysis, Statistics Canada suppresses detailed data by truncating counts to units of 5. This results in greater uncertainty for units with smaller populations and for variables with smaller counts. For instance, if a DA has 8 people of a specific census sub-population, the census data will report a value of 5 or 10 (random truncating or rounding). For this reason we avoided comparisons that would result in small counts. For instance we choose Recent Immigrants and intentionally did not look at recent immigrants from specific world regions or countries. See maps for visual representations of DAs in Saskatoon (figures 2 and 3 here and accompanying StoryMap for more).

Exploratory spatial data analysis (ESDA) was performed on the census variables for the City of Saskatoon.[11] This stage of the analysis is summarized in several maps, both here and in our accompanying StoryMap (link). From these maps, two spatial patterns emerge. Our hypothesis is that proximity to proposed BRT stops will be positively correlated with specific groups of the population that needs a higher quality of transit service. In addition, moving people from point A to B, BRT is also intended to help to achieve equity goals. This hypothesis is based on conversations with the City of Saskatoon and stakeholders. This input, coupled with the structural constraints of the road network, locations of destination and residents, and other parameters, were taken into consideration when considering the arrangement of proposed BRT services. We make the following assumptions: new Canadians, youth, and renters are more likely to avail themselves of transit services and be located in Saskatoon's core area. A second pattern was an East-West divide with the South Saskatchewan River as the boundary. This pattern was evident for % Indigenous and Educational attainment.
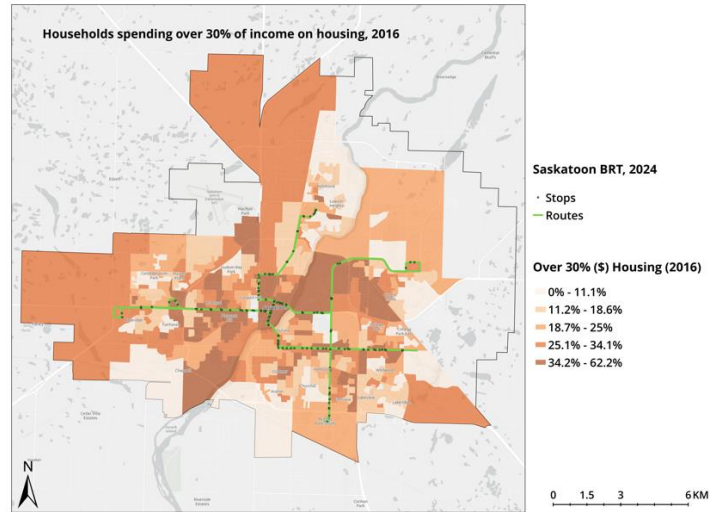
Figure 2: Over 30% of Income Spent on Housing

3 Results

3.1.1 Mapping Social Patterns with BRT Availability

BRT in Saskatoon is intended to provide high frequency and efficient transit solutions to residential areas associated with Saskatoon's core neighbourhoods and those residents' destinations. As a compact (shape) city that grows primarily at its edges, proximity of residential areas to central destinations (such as BRT stops) declines as distances from the city centre increases. Residents living near the cities' core are more likely to be within walking distance of BRT stops and route; those near the edges, less so. In the following section (and in an associated StoryMap) we report on the arrangement in Saskatoon of the following census variables: % Indigenous, % of the population paying more than 30% of income on housing (housing instability); Low Income (LIM); % of population who arrived in Canada in the last 5 years; and % of the population with a high school diploma (lower education).
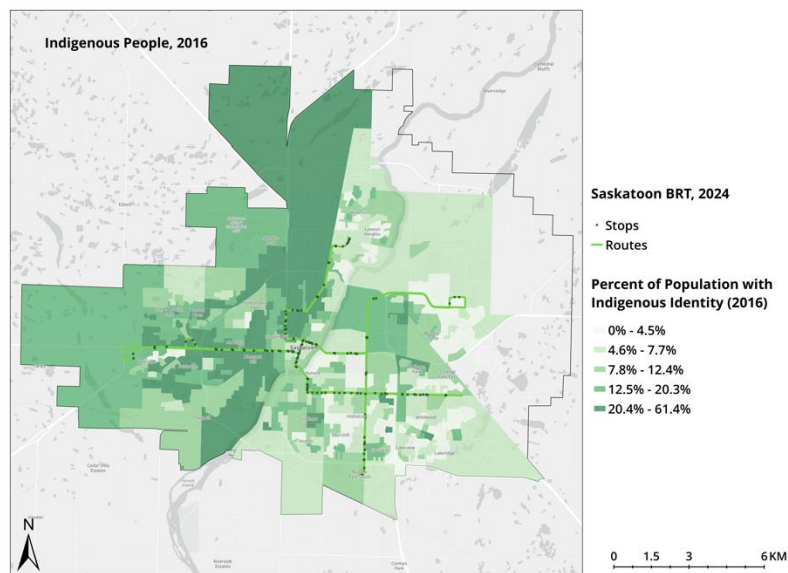

Figure 3: Indigenous population

Two distinct patterns emerge: 1. Core-Periphery pattern and 2. Eastside/Westside pattern.

Despite the 1st law, it can still be striking to see the presence of such strong geographic clustering, particularly about one's home. This clustering takes the form of the two above named patterns. For lower educational attainment and the Indigenous population, there is an East-West segregation of the population. We call this pattern **Eastside/Westside**. For recent immigrants, LIM (Low Income Measure), and >30% spent on housing there is a pattern of clustering along the primary transit "thoroughfares" that will be the backbone of the BRT. We call this pattern **Core-Periphery**.

The variables demonstrating the Core-Periphery pattern include recent immigrants and households spending more than 30% of their income on housing. The variables demonstrating the Eastside/Westside pattern include % Indigenous and % with a high school diploma. Saskatoon is bisected by the South Saskatchewan River that exists as a real barrier with several bridges providing access from one side to the other.

Following the mapping exercise, we were struck by the presence of these two patterns: Eastside/Westside and Core-Periphery. Therefore we calculated descriptive statistics for the collection of DAs adjacent to BRT and those not adjacent as well as for those DAs on the east side and west side of the South Saskatchewan River. Figures 4 and 5 presents in graph-form these means for six census variables.
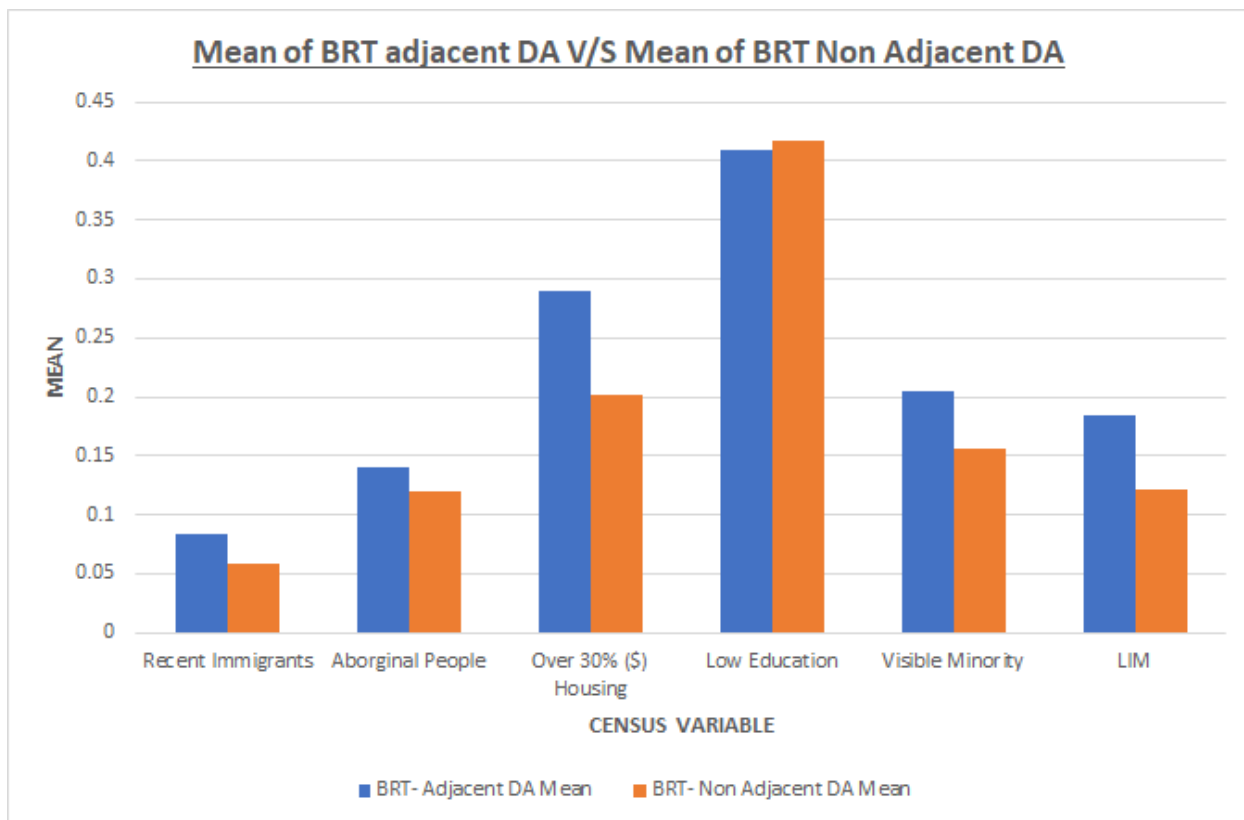

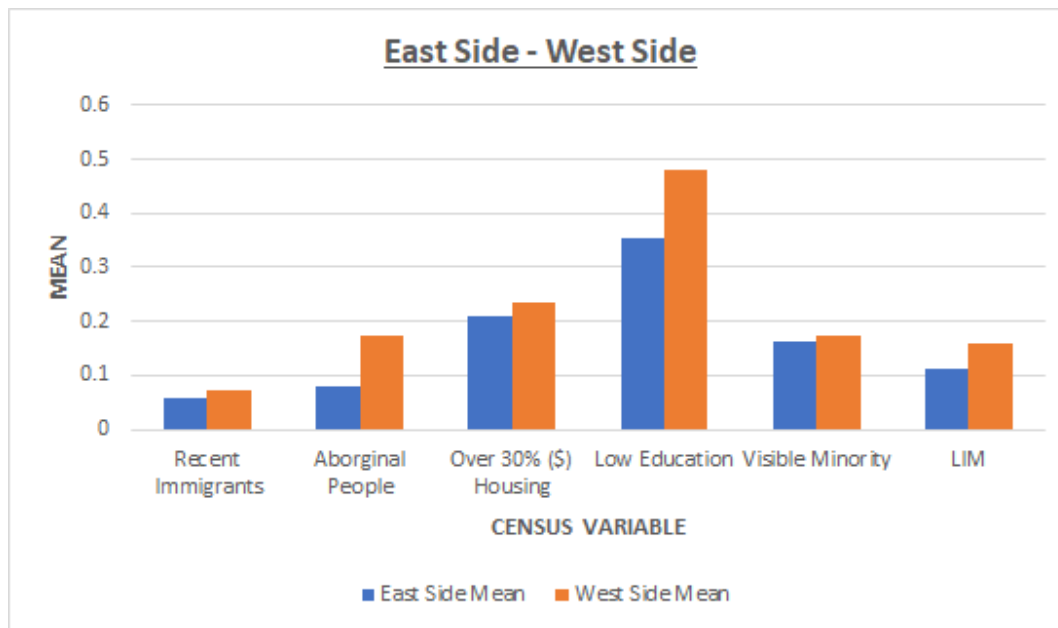Figure 4: This graphic demonstrates BRT-adjacent patterns

Figure 5: Eastside/Westside pattern

4. Discussion

The underlying social, educational, and housing patterns of Saskatoon follow two distinct patterns. Each pattern has associations with other structural arrangements in the urban landscape: the South Saskatchewan River is a dominant physical presence in the urban space and the Bus Rapid Transit (BRT) implementation plan closely follows other socioeconomic and immigration patterns in the city. The latter results from Saskatoon's principal transit/economic/social thoroughfares that run East/West and North/South and can be observed on either side of the South Saskatchewan River: both of these axes intersect in the downtown core. It is our interpretation that the East/West pattern has roots in the settlement of the urban space by historical marginalized populations, in particular, Saskatoon's Indigenous and Metis populations. As regards the recent immigrant population and high % of income spent on housing we believe the proximity to transit corridors and the presence of rental properties are the primary drivers of the association with these urban corridors. This results in equity-deserving populations in central neighbourhoods. Overall, the proposed implementation of BRT in Saskatoon will provide transit service access to equity-deserving populations.

Acknowledgments

References

1. Paris Agreement, available at https://www.un.org/en/climatechange/paris-agreement, accessed on November 11, 2022.
2. Kestens, Y., Winters, M., Fuller, D., Bell, S., Berscheid, J., Brondeel, R., ... & Wasfi, R. (2019). INTERACT: A comprehensive approach to assess urban form interventions through natural experiments. *BMC public health*, *19*(1), 1-11.
3. Racehorse, V., G. Zhang, A. Sussman, A. Jian, and T. Parker. Bus Rapid Transit System Deployment for High Quality and Cost-Effective Transit Service: A Comprehensive Review and Comparative Analysis. IET Intelligent Transport Systems, Vol. 9, No. 2, 2015, pp. 175–183.
4. Venter, C., Jennings, G., Hidalgo, D., & Valderrama Pineda, A. F. (2018). The equity impacts of bus rapid transit: A review of the evidence and implications for sustainable transport. *International Journal of Sustainable Transportation*, *12*(2), 140-152.
5. Sidloski, M., & Diab, E. (2020). Understanding the effectiveness of Bus rapid transit systems in small and medium-sized cities in North America. *Transportation Research Record*, *2674*(10), 831-845.
6. Bell, (2016). Scale in geography and cartography, Introduction to Geomatics. OpenPress, University of Saskatchewan.
7. Tobler, W. R. (1970). A computer movie simulating urban growth in the Detroit region. *Economic geography*, *46*(sup1), 234-240.
8. Vivier, P. M., Hauptman, M., Weitzen, S. H., Bell, S., Quilliam, D. N., & Logan, J. R. (2011). The important health impact of where a child lives: neighborhood characteristics and the burden of lead poisoning. *Maternal and child health journal*, *15*(8), 1195-1202.
9. Logan, J. R. (2013). The persistence of segregation in the 21st century metropolis.
10. Logan, J. R., Oakley, D., & Stowell, J. (2008). School segregation in metropolitan regions, 1970–2000: The impacts of policy choices on public education. *American Journal of Sociology*, *113*(6), 1611-1644.
11. Anselin, L. (2021). GeoDa (Spatial Statistical Program). *The Encyclopedia of Research Methods in Criminology and Criminal Justice*, *2*, 839-841.
12. Anselin, L. (1995). Local indicators of spatial association—LISA. *Geographical analysis*, *27*(2), 93-115.