

**Mixed-use intensification in Planning and Development:
Transportation in the Greater Toronto Area (GTA)**

by

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Abstract

Urbanization in the Greater Toronto Area (GTA) has increasingly focused on intensifying its built environment to promote sustainable urban growth. This approach emphasizes mixed-use development, integrating various land uses to encourage sustainable modes of transportation while promoting social and housing diversity. However, the literature indicates that reducing car dependency is challenging, especially in low-density environments where private transportation is the most convenient option. Additionally, critiques highlight the limitations of mixed-use intensification projects in fostering diversity. This paper examines the practice of mixed-use intensification in the GTA through a mixed-method approach, including a linear regression analysis and interviews with residents of mixed-use projects. The research aims to assess the effectiveness of reducing automobility and creating an inclusive urban environment under the mixed-use scheme. The findings reveal the limitations of mixed-use intensification in addressing suburban car culture and provide insights into residents' perspectives on these projects. The research highlights the importance of studying mixed-use intensification for future planning and development initiatives, offering valuable insights into their effectiveness, challenges, and areas for improvement.

Foreword

This major research paper is written to fulfill the requirements of the Master in Environmental Studies (Planning) Program. The paper explores the topic of mixed-use intensification practice in the Greater Toronto Area and the goals of reducing automobile dependency and fostering diversity. In the course of this Major Paper, I have utilized the knowledge and experience I have obtained during my time in the MES program. By leveraging this knowledge, I enhanced my understanding to foster new perspectives on urban and sustainable planning practices.

The three components of my area of concentration and the supporting learning objectives include the conceptualization of ‘land-use planning’, ‘urban sustainability’, and ‘equity’. The objective of my research is to acquire knowledge to support my area of concentration. The Major Paper has explored all three components. By engaging and researching the practice of mixed-use intensification in the GTA, I have developed a comprehensive understanding of Ontario’s current and past land-use practices and policies which guides and advances urban developments. In addition, my research on mixed-use intensification outlines the need for urban development practices to highlight practices that promote long-term urban sustainability, especially in the current climate crisis. Furthermore, my research has allowed me to identify certain inequities in the realm of planning and development. The literatures and case studies used to support the completion of this Major Paper have demonstrated the negative impact of mixed-use intensification on diverse social groups.

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Table of content

Abstract	i
Foreword	ii
Acknowledgements	iii
List of figures	iv
1. Introduction	1
2. Background	3
2.1 York Region.....	3
2.2 Policy Supporting Mixed-use Intensification.....	4
2.3 Downtown Markham.....	6
2.4 Vaughan Metropolitan Centre	7
3. Literature Review	9
3.1 Urban Sprawl.....	9
3.2 Mixed-use intensification.....	10
3.3 Density and Mode of Transportation.....	11
3.4 Suburban Built Environment.....	12
3.5 The Need to Move Away from Car Dependency	13
3.6 The Persistence of Suburban Car Culture	15
3.7 Critique of Mixed-use intensification	16
3.8 Gap in the Literatures.....	18
4. Methodology	20
4.1 Research Design.....	20
4.2 Quantitative	20
4.3 Quantitative Data Set: Transportation Tomorrow Survey (TTS 2016)	21
4.4 Qualitative	22
4.5 Limitations	23
5. Results	25
5.1 Quantitative Results: Density and Mobility.....	25
5.1.1 Automobility and Density.....	25
5.1.2 Walking and Density.....	26
5.1.3 Cycling and Density	27
5.1.4 GoRail and Density	28

5.2 Qualitative Result: Interviews	29
6. Discussion.....	39
6.1 Quantitative Result Discussion	39
6.2 Qualitative Result Discussion	41
7. Conclusion	48
8. Bibliographies.....	51

List of Figures

Figure 1. Downtown Markham Urban Form: Source: Phankiriya.....	7
Figure 2. Vaughan Metropolitan Centre. Source: Phankiriya	8
Figure 3. York Region Density and Mode of Transportation.....	25
Figure 4. Automobility and Density	26
Figure 5. Walking and Density	27
Figure 6. Cycling and Density.....	28
Figure 7. GoRail and Density.....	29

1. Introduction

Over the past few decades, development in cities on the periphery of Toronto, such as Markham, Vaughan, and Mississauga, have predominantly focused on urban developments through vertical expansion as a means of urban intensification. Cities are now departing from the traditional North American suburban model, characterized by outward horizontal expansion and low-density development. Growing concerns over the environmental and social consequences of urban sprawl have prompted the shift, as the old model is associated with inefficiencies and inequalities in transportation, pollution, degradation, and difficulty accessing services and amenities. Many scholars' work (Nechyba & Randall, 2004; Maoh & Kanaroglou, 2009) have extensively documented the adverse effect of urban sprawl, highlighting issues such as traffic congestion, pollution, and loss of green space. The suburban growth of the twentieth century witnessed profound changes in urban form driven primarily by automobile dependency and extensive road infrastructure investment. As a result, people could move away from the urban core and settle in non-built-up areas while maintaining their connections to work and other activities through private transportation. The urban configuration of the suburbs has allowed for automobile dependency, where most people heavily rely on using cars, which is by many held to be unsustainable for future generations (Pritchard, 2022; Buy & Miller, 2011; Buy et al., 2012).

Recognizing the unsustainable nature of low-density suburban development, cities are now pivoting towards strategies to intensify suburban areas into more compact, mixed-use developments. Terms such as new urbanism, complete communities, and transit-oriented developments have gained traction, advocating a shift towards more sustainable urban forms.

These approaches prioritize job-housing balance, mixed land use, pedestrian-friendly design, and improved public transit connectivity. Children can walk or bike to school, and adults can manage their daily tasks without relying on cars. A denser community layout facilitates better access to services and amenities for everyone. Transitioning suburban areas into mixed-use developments aims to boost social interactions and reduce dependence on private vehicles, ultimately enhancing social and environmental well-being. In the Greater Toronto Area, major urban developments such as Downtown Markham and the Vaughan Metropolitan Centre have followed mixed-use intensification principles by creating an urban space that offers inclusionary zoning, high density, and access to transportation services. Previous research (Chatman, 2003; Chen et al., 2008; Lewis, 2018) has shown positive relations between density and mode of transportation. Higher-density areas have been proven to impact lowering vehicle miles traveled and induce more use of other modes of transportation. However, the transition towards mixed-use intensification is challenging. One significant obstacle is the entrenched culture of car dependency prevalent in suburban areas. This is despite a growing awareness of the negative impacts of private automobile use on economic, social, and environmental sustainability.

This paper critically examines mixed-use intensification in the Greater Toronto Area (GTA), assessing its implications and performance in fostering sustainability by reducing automobile dependency and promoting diversity. By exploring the intricate dynamics in shaping sustainable suburban development and illuminating the challenges facing mixed-use intensified objectives, this study aims to provide insights into the relationship between density and mode of transportation in the GTA. The research scope focuses on the York Region area, which includes nine municipalities. Focusing on the York Region area aims to ensure that the research is concise

but still provides an overview of mixed-use intensification development processes for the GTA. Through a mixed-methods research approach, combining a Linear Regression analysis of transportation and density data with qualitative insights from interviews with residents, this study aims to answer key questions surrounding the effectiveness and viability of mixed-use intensification as a solution to suburban car culture. By addressing the following questions, the research endeavors to inform future planning and development initiatives in the Greater Toronto Area and beyond towards more sustainable and inclusive urban environments: (1) What is the relationship between density and mobility in the Greater Toronto Area? Does more density incentivize the use of sustainable transportation? (2) How do residents perceive the shift towards intensified built environments in predominantly low-density areas?

2. Background

2.1 York Region

York Region is a regional municipality in the province of Ontario, located north of Toronto, and forms part of the Greater Toronto Area. The region comprises nine municipalities, including Markham, Vaughan, Richmond Hill, Newmarket, Aurora, Georgina, Whitchurch-Stouffville, East Gwillimbury, and King Township. According to the York Region Census Profile 2021 (York Region, 2021), over 1.17 million people reside in the region of York, with a 5.5 percent increase in population since 2016. Regarding the transportation system, the York Region areas benefit from the York Region Transit (YRT) and GO Transit services, which connect many municipalities to Toronto and surrounding regions. When it comes to the built environment, York Region provides a diverse housing stock ranging from single-detached homes to large-scale condominium buildings. Most major mixed-use intensification projects in the York

Region area mainly concentrated in the municipalities neighboring the City of Toronto (Markham and Vaughan). Other municipalities still maintain low-density profiles, primarily characterized by traditional North American suburban neighborhoods with segregated land uses and scattered activities.

2.2 Policy Supporting Mixed-use Intensification

Undoubtedly, Ontario and many municipalities within Ontario are changing rapidly towards higher-density urban development and lifestyles. It's crucial to recognize that shifts in urban development patterns do not occur spontaneously; they stem from underlying factors that drive and incentivize changes in city planning and development practice. In the case of Ontario, The Planning Act is the main legislative document that sets out the rules for land use in Ontario, where municipalities within the province must conform to the land-use policies of the Planning Act. Section 2 of the Planning Act (*Planning Act*. RSO 1990, c. P13, s 2) describes how public authorities and local boards must have regard for the "provincial interest." Some of the provisions of the public interest support the principles and goals of mixed-use intensification. They include:

Planning Act, Section 2

- (i) the adequate provision and distribution of educational, health, social, cultural and recreational facilities;
- (j) the adequate provision of a full range of housing, including affordable housing;
- (p) the appropriate location of growth and development;
- (q) the promotion of development that is designed to be sustainable, to support public transit and to be oriented to pedestrians;

- (r) the promotion of built form that,
 - (i) is well-designed,
 - (ii) encourages a sense of place, and
 - (iii) provides for public spaces that are of high quality, safe, accessible, attractive and vibrant

In conjunction with the Planning Act, other provincial documents concerning Ontario's land use planning framework also provide directions for municipalities to support urban intensification. The Provincial Policy Statement (PPS) is issued under the authority of the Planning Act and provides policy direction on land use planning matters across the province. It promotes intensification as a priority for development, directing municipalities to focus on growth in urban areas and support a mix of land uses, including residential, commercial, and institutional uses. The PPS emphasizes the importance of compact, complete, walkable, transit-supportive, and economically vibrant communities. In the PPS, the Ontario government outlines ways to foster healthy, liveable, and safe communities through:

1. promoting efficient development and land use patterns which sustain the financial well-being of the province and municipalities over the long term;
2. accommodating an appropriate affordable and market-based range and mix of residential types (including single-detached, additional residential units, multi-unit housing, affordable housing and housing for older persons), employment (including industrial and commercial), institutional (including places of worship, cemeteries and long-term care homes), recreation, park and open space, and other uses to meet long-term needs;
3. avoiding development and land use patterns which may cause environmental or public health and safety concerns;
4. avoiding development and land use patterns that would prevent the efficient expansion of settlement areas in those areas which are adjacent or close to settlement areas;

5. promoting the integration of land use planning, growth management, transit-supportive development, intensification and infrastructure planning to achieve cost-effective development patterns, optimization of transit investments, and standards to minimize land consumption and servicing costs

The Planning Act and the Provincial Policy Statements are two examples of policy documents that support the practice of mixed-use intensification in Ontario. Other policies, such as the Places to Grow: Growth Plan for the Greater Golden Horseshoe and municipal Official Plans, also contribute to this framework. These policies collectively guide and shape the evolution of Ontario's urban landscape, directing it toward higher-density development that is both sustainable and economically viable. Provincial and municipal policies significantly influence and shape city planning and development practices, contributing to Ontario's shift towards higher-density development in its urban landscape. Through these coordinated efforts, the province aims to create vibrant, resilient, and inclusive communities that meet the needs of present and future generations.

2.3 Downtown Markham

Downtown Markham is a mixed-use, high-density urban center in the heart of the City of Markham. It lies between Highway 407 to the north, Highway 7 to the south, Warden Avenue to the west, and Rouge River to the east. The development is a master-planned community developed by the Remington Group in partnership with the City of Markham. The project began in 2005, and it is still under development. The projected number of residential spaces will hold nearly 10,000 diverse condominium units with 2.2 million square feet of retail space and 3.7 million square feet of office space. Integrating amenities and services in residential areas will allow residents to access their daily needs within walking distance. Regarding transportation,

Downtown Markham is equipped with the YRT VIVA bus services that run through the center to provide convenient access to Highway 7. Additionally, Downtown Markham is close to the GO Rail transit, which provides appropriate access to Downtown Toronto. The design of Downtown Markham also supports the comfort and safety for active transportation users with its bike lanes and connected streets.



Figure 1. Downtown Markham Urban Form: Source: Phankiriya

2.4 Vaughan Metropolitan Centre

Like Downtown Markham, The Vaughan Metropolitan Centre (VMC) is another mixed-use master plan development in the GTA. The VMC lies along Highway 7 and Jane Street. The development of the VMC began in the early 2000s to create a vibrant and transit-oriented urban

center. The final projection as of October 2023 establishes a target of 25,000 residents and holds 11,500 jobs by 2031, with a total of 17,891 residential units at full completion. The mixed-use development of the VMC integrates residential, commercial, retail, and recreational amenities designed for residents to live, work, and play. What makes the VMC stand out is the key features of transit infrastructure. The Vaughan Metropolitan Subway station plays a vital role in connecting its residents with the City of Toronto through the Toronto-York Spadina Subway extension, providing rapid access to downtown Toronto.



Figure 2. Vaughan Metropolitan Centre. Source: Phankiriya

3. Literature Review

3.1 Urban Sprawl

For the past couple of decades, urban development and growth for cities on the periphery of the City of Toronto (Markham, Vaughan, Mississauga) have focused on urban intensification in the form of vertical expansion. Traditionally, suburbs in North America, including the GTA, expanded their urban form through horizontal and low-density arrangements. Urban sprawl, characterized by the outward expansion of city development, significantly impacted the environment and social fabric. Nechyba and Randall (2004) have examined the consequences of urban sprawl in the twentieth century. They found significant issues relating to clear efficiency and equity concerns regarding traffic congestion, urban pollution, loss of landscape amenities and open spaces, and unequal provision of goods and services. Similarly, Maoh and Kanaroglou (2009) have noted that North American cities during the twentieth century underwent profound urban changes stemming from automobile dependency and continuous investment in road infrastructure projects. The combination of the two factors allowed spaces that were inaccessible to become part of the greater urban landscape, which led to changes in the spatial pattern of where people live and work. The shift in spatial patterns followed a trend characterized by the decentralization of population and employment from the urban core to the suburban landscape. The current suburban model's land use and transportation system are inadequate in terms of sustainability due to its contribution to the global environmental problems that mass consume non-renewable resources, resulting in deteriorating local air quality, and increased congestion (Maoh and Kanaroglou, 2009, p. 30). The suburban model of low-density and outward expansion

is unsustainable in the long run. Cities are now trying to combat the consequences of rapid urban sprawl from the previous development path.

3.2 Mixed-use intensification

As examined, the suburban model of low-density development and urban expansion has become problematic and unstable for the future. If the trend of low-density development and scattering of activities continues, it will result in greater environmental and equity issues (Nechyba & Randall, 2004; Maoh & Kanaroglou, 2009). In response, in the planning and development of the Greater Toronto Area, there has been an emerging trend since the late 20th century to intensify suburban areas into a more compact form of development (Brewer & Grant, 2015). Terms, theories, and concepts such as new urbanism, complete communities, 15-minute cities, and transit-oriented developments have been making their way across the world of city planning. These concepts follow the action of intensifying the city and providing more mix and integration of land uses. Jepson and Edwards (2010) have outlined some key land development principles for sustainable city development. Some of the fundamental principles on the list include job-housing balance, spatial integration of employment and transportation, mixed land use, pedestrian access, housing diversity, higher density residential development, social spaces, and inter-modal transportation connectivity (Jepson and Edwards, 2010, pp.421-42). Along the same line, Grant (2003) have highlighted the shift in paradigm due to the flaws in the suburban model of city expansion. The new vision of city developments is now advocating for well-connected street systems, narrow lots, high design standards, high-density, mixed-use civic centers, a mix of housing types and tenure, and pedestrian and transit-friendly design (Grant, 2003, p. 238). Gordan and Vipond's (2007) examination of traditional neighborhood development also emphasizes the shift in development path that encourages a more compact

form of development with mixed land uses, walkable neighborhoods, interconnected streets, and priorities for public spaces as the core principles in suburban neighborhood restructuring. The purpose and goal behind these principles are to provide places where people can obtain their daily needs without using automobiles. Children can walk and cycle to school; adults do not require cars to conduct routine activities. In addition, a more compact community will allow for greater service and amenity provisions for all residents. The changing vision of the suburban landscape to a more mixed-use intensification of development aspires to allow for greater social interactions and less reliance on private automobiles, which will greatly benefit the social and environmental well-being of spaces.

3.3 Density and Mode of Transportation

The theory and practice of mixed-use intensification advocate for increasing urban densities, especially in suburban areas where low-density developments dominate the growth pattern. As mentioned in the paper, the principles behind mixed-use intensification (mixed-use, high-density, inter-connected streets, and pedestrian/transit friendly) are trying to combat the dominant car culture in an age where environmental concerns are more important than ever. Chen et al. (2008) have examined the role of the built environment on transportation mode choices for a single trip. Their study confirms the built environment's critical role in shaping people's transportation choices and behavior (Chen et al., 2008, p. 297). Furthermore, the researchers emphasize that employment densities are more critical than residential densities. Chen et al. (2008) state, "In planning, these findings indicate that policies aiming to change people's travel behavior by creating mixed-use neighborhoods at the trip origin are not likely enough. A greater level of success may be realized by paying more attention to the attributes at

work or other locations in a tour" (Chen et al., 2008, p. 297). Along the same line, Chatman (2003) have examined how density and mixed-use at the workplace impact personal and commercial travel, as well as commute mode choices, and found that vehicle miles traveled (VMT) by cars significantly reduce in higher-density employment areas, with a lower likelihood of people utilizing cars (p. 199). Lewis' (2018) research on neighborhood density and mode of travel has arrived at a similar conclusion regarding how density plays a role in increasing non-personal vehicle mode of travel. The research indicates that vehicle miles traveled remains constant in most density spectrums. However, it begins to decline at the central city density level and significantly drops at the urban core level (Chatman, 2003, p. 163). Higher-density neighborhoods also demonstrate high levels of non-auto use. Research by Chatman (2003), Chen et al. (2008) and Lewis (2018) have demonstrated a relationship between density and the way people choose to interact and utilize different modes of transportation. This notion supports the theory behind the mixed-use intensification of increasing density to incentivize more people to use sustainable transportation rather than confining themselves to the automobile for work commutes and everyday activities.

3.4 Suburban Built Environment

Undoubtedly, technologies and new inventions change people's everyday lifestyles and attitudes. None stand out more brightly than the invention of automobiles as a form of private transportation. The mass production and consumption of vehicles has led to a culture heavily relying on these personal transports. Many scholars and urbanists argue that the mass consumption and accessibility to automobiles gave rise to the suburbs in North America. Harris and Keil's (2017) analysis on globalizing cities and suburbs argue that automobility permitted

urban dispersal. The suburb, in a sense, provides more family privacy, peacefulness, and spaces for recreation through a low-dense built environment. Private automobiles allow people in the suburbs to have the freedom to access amenities conveniently. Therefore, suburban life became immensely dependent on the use of automobility. Similarly, Filion et al. (2016) define 'dispersed suburbanism' as characterized by low-density development and geographical scattering of activities. It intensely relies on automobiles, adopting the dispersed configuration as the primary mode of transportation. The increase in connectivity between single-family homes and commercial buildings was made possible by automobility (Filion et al., 2016). Automobility still plays a significant role in suburban culture and its ties to a dispersed configuration. If the majority of people remains dependent on their private automobile instead of active mobility and public transit, a significant characteristic of the traditional suburbs will continue to persist.

3.5 The Need to Move Away from Car Dependency

The modern world has increasingly relied on private automobiles as the primary transportation method, especially in a traditional suburban context, where the built environment supports automobile culture. People living in the suburbs have difficulty navigating the urban environment without using automobiles due to the lack of public transportation services and the challenging environment to conduct active mobilities. Although there is no doubt that private automobiles provide people with convenience and privacy, it also comes at a high cost. Research by Pritchard (2022) has identified three negative impacts of car dependency. The first is economic sustainability, which stems from the cost of infrastructures to permit the use of cars (Pritchard, 2022, p. 1485). Additionally, there are other economic costs associated with car dependency. Road infrastructures and parking spaces use many urban spaces that could serve

other purposes. Another indirect cost in terms of economic sustainability is the cost of congestion, which reduces economic productivity. Secondly, car dependency has a detrimental impact on social sustainability from the potential social exclusion it creates (ibid). In certain areas, those without private automobiles have difficulty accessing education, employment, and healthcare compared to those with automobiles. This may lead to social exclusion, where individuals or groups are restricted from participating in certain activities. Lastly, Pritchard (2022) has identified environmental sustainability as one of the major costs of car dependency on a global and local scale. Since automobiles require fuel, the internal combustion processes greatly contribute to global greenhouse gas emissions (ibid). On a local scale, car dependency significantly impacts local air quality and noise pollution, affecting public health and well-being. Similarly, Kenworthy (2006) argues that one of the ways to make cities more eco-friendly is to de-emphasize freeway and road infrastructure in favor of walking, cycling, and transit infrastructure. Private transportation must be minimized to increase the quality of life for communities. Automobiles, as a form of private transport, are a significant cause of air pollution, noise, and transport death (Kenworthy, 2006, p. 73). Merriman (2009) state that private car use significantly impact social and cultural life. Scholars and practitioners must understand the complexity of automotive use and the desire of people that utilize their private transportation to create strategies that tackles increases in private, petrol car use and increasing CO₂ emissions. Another research study by Weber (1992) points out the negative implications of automobiles on society. Automobile emissions such as carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), and tropospheric ozone (O₃) can cause infections, chronic pulmonary irritation, and death in human beings and other animals (Weber, 1992).

3.6 The Persistence of Suburban Car Culture

Although many people realize and understand the negative impact of cars on human health, why are people still heavily reliant on automobile use? Do private automobiles serve more than just a mere form of transportation? Sheller (2004) argues that "Car consumption is never simply about rational economic choices, but is as much about aesthetic, emotional and sensory responses to driving, as well as patterns of kinship, sociability, habitation, and work" (Sheller, 2004). Automotive emotion is an essential factor when examining car-based culture's persistence. The implication of car ownership and use could signify more meanings than the fundamental reasons for convenience and reliability. Driving and car ownership induce a wide range of sensations, feelings, and emotions, such as excitement. Carrabine and Longhurst (2002) examine how young people interact with their cars. The research shows that respondents consistently spoke about the pleasure and complexities of driving in their everyday lives. Many respondents in their study expressed their feelings about wanting to become part of the "car-culture" and did not want to be left out while their friends enjoyed the freedom of private mobility. Another factor to consider in examining the persistence of car culture is the convenience and reliability of owning a private automobile. Buys and Miller (2011) research shows that convenience plays a significant role in transportation choices. Transportation choices are influenced and determined by what is perceived as the quickest and easiest option to get to a destination. People often see driving as more efficient compared to public transit. The respondents to Buys and Miller's research indicate that time consideration and convenience of automobility often outweigh other factors, such as environmental concerns. Similarly, a study by Buys et al. (2012) has found that public transit usage is low among seniors, with the car being the most dominant mode of transport. The research results indicate that the two critical barriers

to public transport usage are the convenience of private transport and mobility. Due to the difficulty of accessing public transportation, many participants choose to utilize private transportation simply because it is more convenient. Car dependency in the suburbs has become a significant issue in creating a sustainable city. The emotions and convenience of the private automobile have made it very difficult for societies to shift to other modes of mobility.

3.7 Critique of Mixed-use intensification

The traditional North American suburb can be characterized as segregated land uses and homogenous detached single-family homes. However, in the last few decades, planners and city officials have been focusing on mixing land use to create a more sustainable and resilient development. One of the main goals of mixed-use intensification is to provide diversity in housing types as part of the mixed-use scheme to combat the issue of urban sprawl and unsustainable developments. In theory, developing and building a mixed-use housing type would allow for more social diversity and opportunity value. However, Perrin and Grant (2014, p. 377) found that "housing types are often segregated in clusters, with limited mix within a block." In their studies, only a few developments have diverse housing types on the same block. Developers mostly group housing by size, density, and form. They usually cluster higher-priced housing together, while major roadways, open spaces, and parks create separations. As a result of partitions and grouping of home prices, ethnic clustering can be observed in some regions of Toronto and Vancouver with higher immigrant populations. In theory, mixing housing types will promote diversity and social interactions. However, there are some significant challenges in producing interactions among citizens. Perrin and Grant (2014) have found that suburban residents retain a certain level of interaction among one another, with few exceptions where neighbors find commonalities, such as having children in similar age ranges. Similarly, Brewer

and Grant (2015) also found that mixing housing types proved challenging for the Halifax Regional Municipality. Single-detached homeowners have a preference for living further away from denser housing clusters. Although policies and initiatives are in place to promote mixed-density housing, developers avoid mixing housing types because of aesthetics and consumer preferences. Complete communities' urban policies in many regions push for mixing in housing types to create social diversities and interactions. However, in practice, achieving the goal of mixing housing types has proved to be a challenge due to market forces and consumer preferences.

Another significant debate and critique of complete communities in the academic realm is the socio-economic homogeneity of residents. Although complete communities' principal promise diversity in the built environment and among dwellers, the outcome of such projects is often the opposite. Winstanley et al. (2010) focus on the critique of New Urbanism, which follows the same principles as mixed-use intensification. One of the major critiques and inadequateness of a New Urbanist project in Christchurch, New Zealand, examined by Winstanley et al. (2010), is the absence of diversity. The authors claim that New Urbanism neighborhoods have benefited select groups of residents. The cost of living in such desirable and livable developments may cause barriers for those with lower incomes. In the case of Christchurch, "Exclusionary practices and homogeneity of residents is also implied through the ways in which threats are perceived as coming from outside rather than from within" (Winstanley et al., 2010, p. 184). Similarly, Grant (2006) argues that mixed-use projects create a lack of diverse residents. The issues of affordability, equity, and participation are often neglected in the projects' development. "While new urbanism principles promise affordability and integration, to date, most projects have created expensive and exclusive enclaves" (Grant, 2006,

p. 170). As Grant (2006) examines, only a tiny portion of new urban projects provides inclusivity through non-market housing. The American Public Housing Renewal Program has utilized mixed-use intensification principles to improve and redesign its urban projects. This resulted in the loss of 60,000 affordable units (Grant, 2006. p. 170). The two pieces of literature above discuss the critique of mixed-use intensification projects due to the lack of affordability that directly resulted in the exclusion of certain socio-economic income groups. Although mixed-use intensification principles emphasize the importance of diversity, the practice and result of many projects under the umbrella of mixed-use intensification often result in the homogeneity of residents.

3.8 Gap in the Literatures

Although significant research and studies have been done on mixed-use intensification, many questions remain to be examined. Mixed-use intensification in the GTA is a new paradigm in planning and development. Therefore, more studies are needed on the outcome regarding the social impact of mixed-use intensified projects. As mentioned, mixed-use intensified projects aim to create well-connected urban spaces and encourage pedestrian and public transport users rather than accommodating private automobile users. However, have the principles of mixed-use intensification effectively achieved their goals? Has the number of people utilizing public transit and active mobility increased? Or does the suburban car culture still play a dominant role in how people mobilize around the city? How are residents in the Greater Toronto Area reacting to the newly built environment? Moreover, is this type of environment what they envision for their future? Addressing these gaps in the literature is crucial for informing future planning and development initiatives in the GTA and beyond. Comprehensive studies that assess the social

impact of mixed-use intensification projects can provide valuable insights into their effectiveness, challenges, and potential areas for improvement. By incorporating the perspectives of residents and stakeholders, planners can ensure that future urban developments align more closely with the aspirations and needs of the community, fostering sustainable and inclusive urban environments.

4. Methodology

4.1 Research Design

The methodology employed in this study utilizes a mixed-methodology approach by integrating quantitative and qualitative data analyses in the research process. The data set for the quantitative portion of the research uses cooperative data from the local and provincial governments, which surveys urban travels in the York Region area. The qualitative data utilizes primary data from interviews of residents of mixed-use projects in the Greater Toronto Area. The research design investigates three key aspects: the relationship between density and mobility, the social perspectives and impact of mixed-use intensification projects, and what form of interactions mixed-use intensification fosters.

4.2 Quantitative

In the quantitative phase of the research, I employed descriptive and correlational data analysis to examine the relationship between density and mobility. This quantitative component seeks to discover whether there is a significant connection between population density and modes of transportation in the Greater Toronto Area. Within the theory of mixed-use intensification, it is posited that areas characterized by higher population density and compact built environments are more likely to experience alternative modes of mobility, such as walking, cycling, and public transit, as opposed to private automobiles. Descriptive and correlational data analysis can identify whether an increase or decrease in population density will affect the percentage of modes of travel. The study uses a linear regression model to describe the relationship between the dependent and independent variables by analyzing the mode of transportation used in each municipality and their respective density levels within the Greater

Toronto Area. The alternate hypothesis (H1) in my research would be that there is a relationship between the independent and dependent variables, and my null hypothesis (H0) would be that there are no correlations between population density and mode of transportation. The functional form for the relationship between population density and mode of travel is,

$$Y = mX + b$$

where Y is the dependent variable (Mode of Travel), X is the predictor and independent variables (Density), m is the estimated slope coefficient, and b is the estimated intercept. To test the hypothesis, I used the p-value to test whether the result is statistically significant when the significance level is ≤ 0.05 . Therefore, the function form for the p-value is

$$p\text{-value} \leq 0.05$$

To analyze the relationship, I used Python applications to create a scatterplot graph and calculate the estimated slope coefficient and intercepts. Using Linear Regression Modeling, I can test my hypothesis of how density can induce more active and public transportation while reducing automobile usage.

4.3 Quantitative Data Set: Transportation Tomorrow Survey (TTS 2016)

The data sample used for this study is taken from the York Region Transportation Tomorrow Survey (TTS), 2016. The TTS 2016 is conducted through a cooperative effort between municipal and regional government groups to collect information concerning urban transportation and travel in the area under the Greater Golden Horseshoe. The variables in the York Region Transportation Tomorrow Survey, 2016, includes, but are not limited to, the total number of trips made by residents in 24 hours, number of trips by residents as auto driver in 24-hour, number of trips by residents by walk mode in 24-hour, number of trips by residents by

bicycle in 24-hour, and number of trips by residents by GO rail only in 24-hour. Other types of trips (auto passenger, taxi passenger, rideshare passenger, other travel mode, non GoRail transit trip, etc) are also included to make one hundred percent of total trips made by residents within 24-hours. This research will only utilizes trips made by auto driver, walking, cycling, and GO rail. The data are sorted according to their geographical location, which includes Newmarket, Richmond Hill, Markham, Vaughan, Aurora, Whitchurch-Stouffville, Georgina, East Gwillimbury, and King. For the analysis, I converted the mode of transportation (driving, walking, cycling, and GoRail) into a percentage by dividing the total trips for each mode by the total number of trips since the population size is significantly higher in certain municipalities. Due to the Covid-19 pandemic and lockdown in Canada, the latest TTS survey, which was supposed to be for the year 2022, has been delayed, and the data were not publicly available at the time of writing the research. Nevertheless, the TTS 2016 can still provide a clear picture of the relationship between density and mode of transportation in the Greater Toronto Area. For the density data, I utilized the Statistics Canada Census Tract, 2016, to find the population density in the York Region area, which is determined by the total population divided by total square kilometers (Population/SqKm).

4.4 Qualitative

For the qualitative segment of the research, I concentrated on eliciting the perspectives and travel behavior of the public regarding the urban growth trajectory associated with mixed-use intensification areas in the Greater Toronto Area. The qualitative segment of the research aims to gain insights into the public's opinions regarding the shift from low-density to high-density urban forms and whether higher-density urban forms encouraged the participants to be

more involved with active and public transportation. Using consistent survey instruments and procedures, I conducted online interviews with four residents of mixed-use intensification projects within the Greater Toronto Area. Conducting four interviews provided a balance between depth of study and practical feasibility, ensuring that the research could be completed within the given timeframe, while still providing meaningful findings. All participants are 18 or older and have diverse racial, ethnic, socioeconomic, and cultural backgrounds. This research utilized convenience sampling to select participants. Interviewees in this pool have no predisposition or predetermined reasons to partake in this research, reducing the risk of bias as outlined by Stratton (2021). The interviewees were selected from a pool of volunteers from personal networks and mutual contacts. The response yields valuable insights regarding the current performance of the mixed-use intensification scheme and whether the goals of reducing automobile usage are currently progressing in a positive manner. For the analysis segment of the interviews, I analyze the participant's answers. The transcript is broken down by specific topics, themes, and concepts, and the answers from participants are compared to identify similarities between each person's experiences living in a mixed-use intensified environment. Three research questions are examined for the qualitative segment of the research. (1) How are residents interacting with mixed-use intensified urban environment? (2) Has mixed-use intensification influenced resident's choices of modes of transportation? (3) What are some barriers and challenges to promoting sustainable transportation?

4.5 Limitations

Certain limitations in the study may take away from the accuracy and representation of the current discourse of mixed-use intensification in the Greater Toronto Area (GTA). One limitation of the methodology employed in this study is the dependence on data from the

Transportation Tomorrow Survey (TTS) conducted in 2016. While the TTS 2016 provides valuable insights into urban transportation and travel patterns in the York Region area, the use of data from a survey conducted several years ago may not fully capture the current discourse of urban movement in the Greater Toronto Area (GTA). Since urban environments are subject to continuous change influenced by population growth and infrastructure development, relying on older data may lead to outdated or incomplete conclusions. The delay in conducting the latest TTS survey due to the COVID-19 pandemic and lockdown measures adds to this limitation, as it restricts access to more recent and relevant data. The absence of up-to-date information may impact the accuracy and relevance of the findings, particularly in assessing the effectiveness of recent initiatives aimed at promoting sustainable transportation and reducing car dependency in the GTA. Additionally, while the qualitative segment of the research offers valuable insights into the perspectives and experiences of residents regarding mixed-use intensification, the sample size may be relatively small due to difficulty in finding research participants that specifically live in mixed-use environments. Conducting interviews with four residents of mixed-use intensification projects may overlook the diversity of opinions and experiences within the Greater Toronto Area. A more extensive and more diverse sample could provide a deeper understanding of the social impacts and challenges associated with mixed-use intensification initiatives. While the mixed-methods approach adopted in this study offers a comprehensive understanding of the relationship between density, mobility, and the performance of mixed-use intensification in the GTA, the reliance on outdated quantitative data and the relatively small qualitative sample size represents limitations that should be considered when interpreting the findings and implications of the research.

5. Results

5.1 Quantitative Results: Density and Mobility

I converted modes of transportation (driving, walking, cycling, and GoRail) into percentages by dividing the total trips for each mode by the total number of trips, considering that the population sizes are significantly higher in certain municipalities. For the density data, I utilized Statistics Canada's 2016 Census Tract to calculate population density, which is determined by dividing the total population by the total square kilometers (Population/SqKm). Figure 3 illustrates the statistical table used to examine the relationship between density and modes of transportation the York Region area.

Figure 3. York Region Density and Mode of Transportation

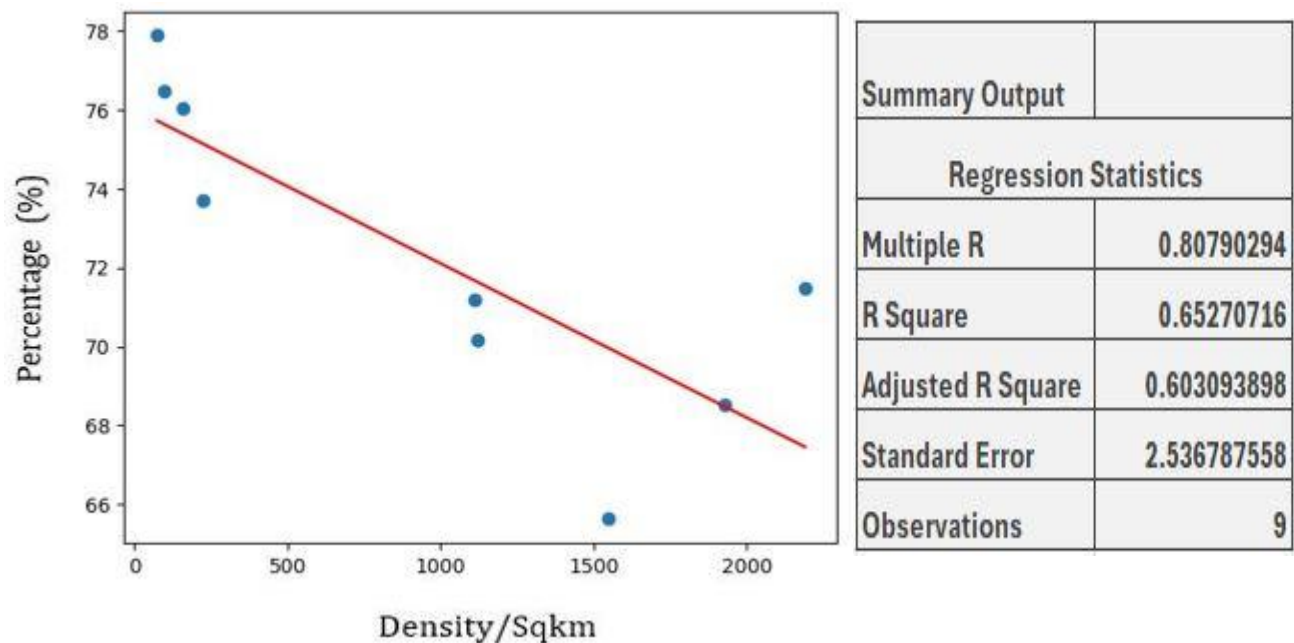
Municipalities	Density/SqKm	Auto(%)	Walk(%)	Cycling(%)	GoRail(%)
Newmarket	2,190.50	71.47	5.7	0.46	1
Richmond Hill	1,928.80	68.51	4.5	0.76	1.7
Markham	1,549.20	65.63	5.6	0.65	1.8
Vaughan	1,119.40	70.17	4.4	0.38	1.3
Aurora	1,112.30	71.18	3.8	0.73	1.8
Whitchurch-Stouffville	222.3	73.71	4.5	0.61	2
Georgina	157.8	76.04	3	0.29	0.26
East Gwillimbury	97.9	76.47	1.7	0.46	0.55
King	73.6	77.87	1.7	0.42	1.2

5.1.1 Automobility and Density

For automobiles as a mode of transportation, the mean percentage of automobile usage across all municipalities in the York region is 72.33 %. The municipality with the highest automobile usage percentage is the Township of King, with 77.33%, and the lowest automobile usage is Markham, with 65.33%. Noticeably, the lowest-density municipalities (Georgina, East Gwillimbury, King) represent the highest percentage of automobile usage, and the highest-density municipalities (Newmarket,

Richmond Hill, Markham) are all below the average automobile usage percentage. The result of the p-value for automobile usage is $0.0084 \leq 0.05$, which means that it is statistically significant. Therefore, there is a correlation between population density and the percentage of people who commute as auto drivers.

Figure 4. Automobility and Density

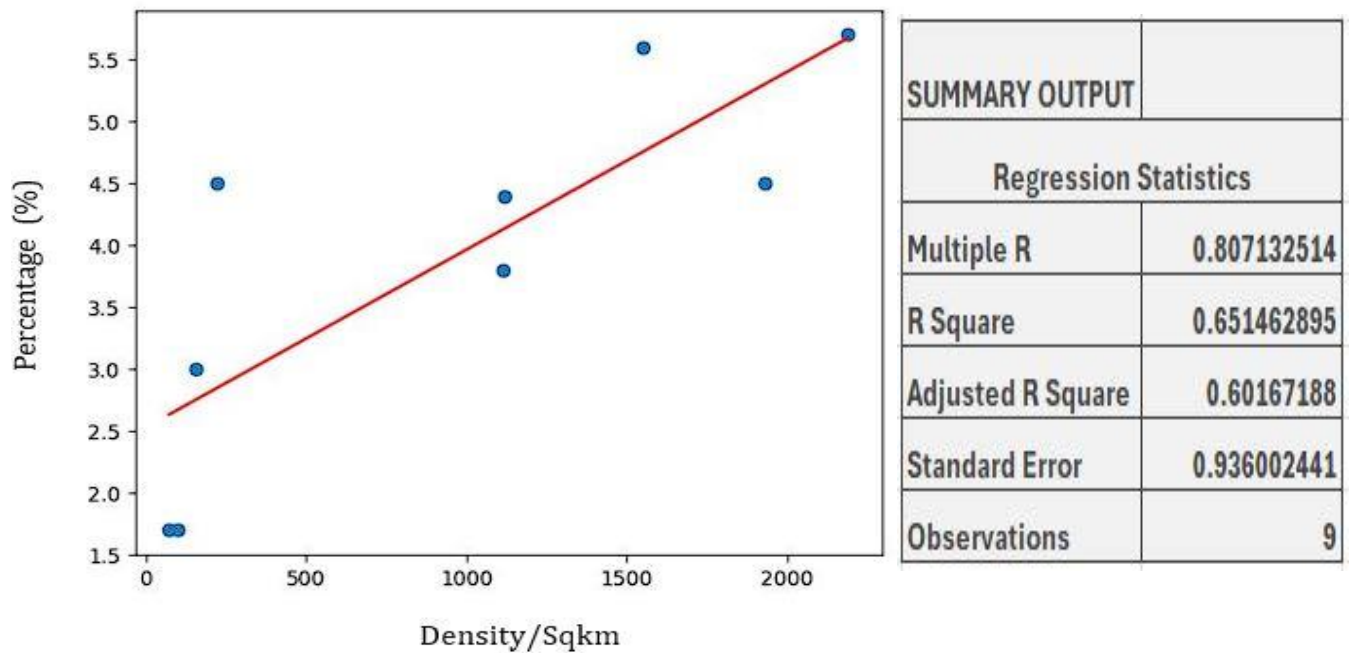


5.1.2 Walking and Density

For walking as a mode of transportation, the mean percentage of walking across all municipalities in the York Region is 3.87%. The municipality with the highest percentage of walking as a mode of transportation is Newmarket, with 5.7%, and the municipality with the lowest walking percentage is King, with 1.7%. Figure 5 illustrates a linear regression graph that shows a correlation between density and walking. As the density gets higher, the percentage of people who walk increases. The result of the p-value for walking is $0.0085 \leq 0.05$, which means

that it is statistically significant. Therefore, there are correlations between density and the percentage of people who walk.

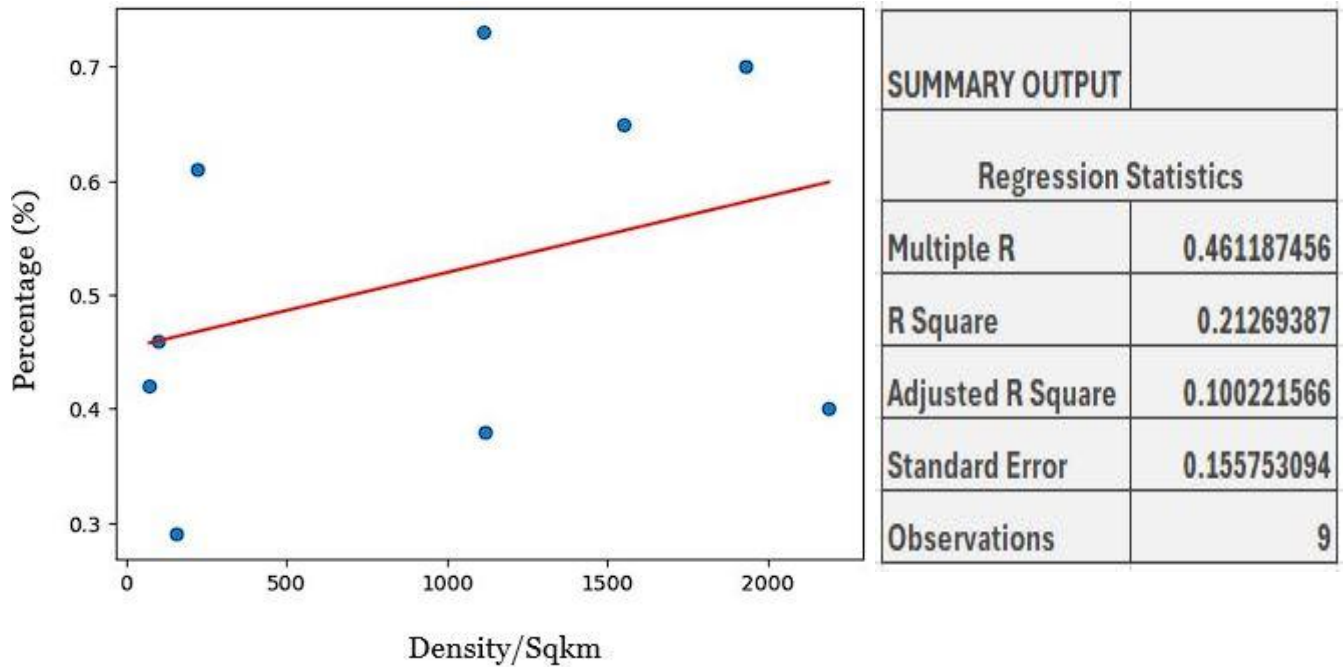
Figure 5. Walking and Density



5.1.3 Cycling and Density

For cycling, the mean percentage of people cycling across the municipalities within the York Region is 0.52%. The municipality with the highest percentage of people who cycle is Richmond Hill, with 0.76%, and the municipality with the lowest cycling percentage is Georgina, with 0.29%. Figure 6 indicates no patterns regarding the relationship between cycling and density. The municipality with the highest density (Newmarket) only has 0.004% more people who cycle than the lowest municipality (King), while the difference in density/sqkm is 2116.9. Density as indicator alone proved to have no correlation to the percentage of people who cycle.

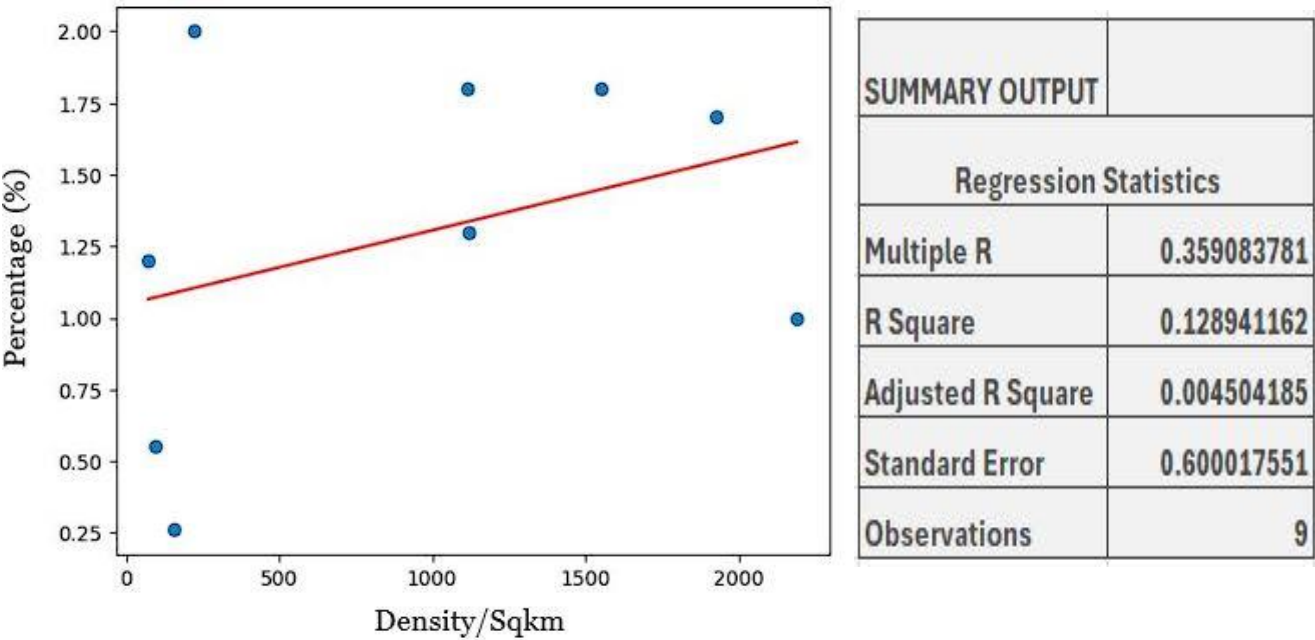
Figure 6. Cycling and Density



5.1.4 GoRail and Density

For GoRail as a mode of transportation, the average percentage of the total population in the York Region who utilizes GoRail is 1.29%. The municipality with the highest percentage of GoRail users is Whitchurch-Stouffville, with 2%, and the municipality with the lowest percentage of GoRail users is Georgina, with 0.26%. The scatterplot graph from Figure 7 illustrates no linear relationship between density and the percentage of people who uses the GoRail. The municipality of Whitchurch-Stouffville is among the bottom four municipalities with the lowest density. However, Whitchurch-Stouffville represents the highest percentage of people who uses GoRail. Interestingly, Newmarket has the highest density among all the municipalities across York Region, but the number of people who uses the GoRail is only 1%, which is lower than the average.

Figure 7. GoRail and Density



5.2 Qualitative Result: Interviews

The analysis of the interview data revealed that respondents demonstrate commonalities when it comes to their favorite aspect of living in a mixed-use environment. Every participant of mixed-use development shared that convenience has greatly enhanced their daily life.

Resident 1: *The convenience of having stores, restaurants and entertainment in general at your doorstep is a huge bonus, especially for someone in the age between 25-40. These locations will also have the advantage of having accessible public transportation close to your home.*

Resident 2: *My favorite aspect of living in a mixed-use development is the convenience that it provides. With a busy work schedule, I don't always have the time nor patience to go from one location to the next. I live a lifestyle wherein time is of the essence; having said this, the convenience of mixed-use development provides me the opportunity to, for example, run my various errands in one central location. This convenience allows for a healthier work-life balance as the convenience factor also saves on timing and I am able to make room in my life for personal enjoyment.*

Resident 3: *Convenience: Knowing and planning my day knowing everything is less than 5 minutes away. Not having to worry about missing or forgetting to pick/buy etc and having to go back to a place 10-15 minutes away, depending on rush hour. Everything is more accessible at a shorter distance. Usual trips that require planning can now be easily summed up in the "on the way home" type of planning. For me for example the grocery store, bank and drug store are all across the street from my place. Whatever errands I may have to run for the day, I can easily be at ease knowing my core needs are across the street.*

Resident 4: *I love the area that I am in. I used to live in a small town. Being in a newer area with more options and things to see, gives me more options to enjoy the surrounding amenities.*

When the respondents were asked "Can you describe your typical daily transportation routine?; What modes of transportation do you primarily use to get around?; What factors influence your choice of transportation mode on a daily basis?"; the result indicated that all respondents still heavily rely on their private automobiles to get around. One respondent mentioned that accessing public transportation is a challenge, another respondent spoke about

using the car as the most convenient option to get to work, and one respondent mentioned the use of a hybrid vehicle for a more fuel efficient travel.

Resident 1: *Where I live, public transportation is not ideal, and we do not have many options. So, I use my own vehicle to commute to work everyday.*

Resident 2: *My typical daily transportation routine is a car—I drive my own vehicle and therefore this makes it the primary use to get around. The factors that influence my choice of transportation daily is the location of my residence in relation to my place of work. My workplace is quite far from my home; furthermore, the city in which I reside does not have a convenient mode of transportation other than driving my own car to get to my workplace. While gas prices are high the time it would take for me to get to my workplace from home is double if I were to take public transportation due to the bus routes being quite indirect. While my husband drives an electric vehicle, we cannot carpool as he works in a completely opposite direction as my workplace; we do, however, carpool on weekends when possible or for our outside-of-work activities. Since I work Monday-Friday, ultimately saving time is a greater factor than cost when it comes to influencing my choice of transportation daily.*

Resident 3: *Car: I did recently move out; my current residence is 10 minute drive to work. With everything being so close, driving is best as I always have space in case I pick anything up.*

Resident 4: *My day changes day to day, depending on if I need to be downtown, or in Etobicoke and sometimes outside the GTA. I mainly use my car to get around. I was using a lot of gas from my last vehicle which sparked me to have to look into getting a more fuel efficient car. I currently now have hybrid and it is working very well so far as it has been over a week now and I haven't even hit half my gas tank yet.*

Interviews with participants of mixed-use residents also revealed some positive notes on public transportation and active mobility. Most residents are given more options and easier access to sustainable transportation. However, many are still using their private vehicles to get around due to convenience factors.

Resident 1: *When I previously lived in a mixed-use area, there was far more options to take advantage of public transportation. But I always used my vehicle as my main way of commuting.*

Resident 2: *I spend most of my time throughout the week at work and unfortunately due to the doubling of time it would take me to get there, public transportation is not a suitable mode for*

me to get there. Therefore, I have not changed my transportation behavior or feel like I have been given more transportation choices as the route to get from my home to my workplace is indirect and limited. I will admit, however, that although I do not make the trip to downtown Toronto from my home in Bradford often, I do rely on public transportation when I do. While it takes more than an hour to get downtown, I choose public transportation for this journey as its more cost-effective (I do not have to worry about parking fees in addition to gas) and I usually go on the weekends and therefore can afford the time to make the trip.

Resident 3: *Transportation options have been more accessible. YRT, Go train/bus are now walk able distances if I chose not to drive. As well as winter time, it's a 7 minute drive to go train/bus station to get to the city. The bus ride is simple, stop outside my building straight shot down highway 7.*

Resident 4: *It has opened my eyes more to a lot of different types of places to go and eat. Being so close to 3 major highways is also very key. Hwy 7, 404 and 407. Where I am it allows me to be able to walk to places, having transit so close by and frequent timing for transit is key if I was to ever take transit. I am able to use multiple highway choices. I mainly will use the 407 if I am heading to Vaughan and Etobicoke. Going downtown the only option I have is using the 404 and DVP. DVP is not ideal as we all know it is just backed up from morning to late night due to traffic and closed lanes at night for construction. I do not take public transport as I don't like that my time is dictated on their schedule when I can drive myself around.*

When the interviewee of mixed-use residents was asked about things they wish they can change in their area and how they may overcome some of the issues, responses indicated a variety of issue with regards to public transportation, privacy, and scenery. The most common changes that residents wished for is relief of traffic congestion. Surprisingly, many residents were happy with the number of green spaces in their respective area. The respondents were not able to overcome some of the issues they mentioned but accepted as a lifestyle the choice of living in a denser environment.

Resident 1: *Prices of homes tend to be higher for smaller square footage homes. And traffic was a huge inconvenience for myself. There are greens paces available in mixed-use areas, but to me it is not the same as your own backyard from a traditional residential area. I do not feel these were challenges, but I see it as they were a lifestyle at that time in my life. Making the choice to move to a traditional residential area was a lifestyle change.*

Resident 2: One thing I would change in my area are better public transportation and an update on older areas of the city. I feel tending to the older areas by updating building infrastructure and adding more upkept greenery as well as improving transportation would make it more modern overall, with greater appeal visually and functionally. The issue in regard to high-density built that currently plays an inconvenience in my life is that some areas are not as mixed-use in setting as others (and therefore I have to be a bit clearer and more selective in my lifestyle when prioritizing which areas will serve me the most convenient) as well as having more options for efficient transportation. Currently, there is not much I can do about these issues and, to be quite honest, I don't feel bothered by them enough to take action as of yet.

Resident 3: Quite a lot of green space in the area, Paths parks and trails are quite easily walking distance. Since the competition of the area, traffic has increased significantly and very noticeable. Regarding privacy, enjoying the simple joys of sunlight is easily compromised with everyone seeing inside your place as well as what you are wearing and doing. Clarity depends on time of day and lighting. Unfortunately, not much I can do to overcome these issues. Only solutions are to be more aware while the blinds are up and choose certain times to run errands that are not in close proximity.

Resident 4: Prior to the changes that were made in my area due to construction and new infrastructure being built, the area was filled and surrounded by a lot of land, bright colours and nice scenery views. Right now there isn't anything affecting my view from where I live. The new building that is supposed to be going up in front of my view has not finished its development. It looked like it had fell through and I currently have a massive dirt hole if I look down my balcony. Being able to notice the traffic and flow from my window in my house is key to when I need to leave my home and begin my day on the road. More green spaces will be nice but it is sad to see that the area is being more developed year by year.

Resident participants were asked about the most concerning issues regarding mixed-use high density housing from their respective perspective. The answers reflect a cautious view on mixed-use high density housing with emphasis on environmental protection, affordability, and overcrowding. Another interesting concern that was raised in the interviews was the monotonous look of buildings and the overall urban fabric.

Resident 1: They all look the same after a while. And the high prices for the small square footage, not ideal for bigger families.

Resident 2: I would say the most concerning issues with regards to mixed-use high density housing is overpopulation in the area and, as a result, that of supply-and-demand. While I understand a contributing factor to overpopulation would be a result of favoring mixed-use high

density housing, there is a concern that there will (eventually) not be enough land or materials to support the demand for this setting and therefore increasing of housing and its associated costs will continue to grow dramatically. There is also a concern for the health of our environment as land continues to become scarce in favour of mixed-use high density housing. Stripping the land for construction will increase issues of animals' survival as it is forced out of its current natural habitat. While animal extinction is the extreme effect of deprioritizing our efforts to protect the environment, it has long begun in areas that have evidently placed real estate as top priority.

Resident 3: *Having been in the hospitality industry, traveling and commute becomes a huge part of my future as I am not sure where I will end up. Traffic would be my number one concern. Another small concern would be the increase of youth and crime. Denser areas result in more people being out. Depending on the demographic of the area could be very positive or very negative.*

Resident 4: *My main concerns are that with us building these homes and buildings seems great and more functional overtime, I worry about the lack of space and having these buildings just pop up, losing green lands, nature of animals having to relocate. Pricing for rent when these new fancy high built are up. Many factors*

When residents were asked about their feelings about mixed housing, such as the combination of single-family homes, condominiums, and rental accommodation in one neighborhood, the results indicated various feelings towards mixed housing. One resident believes that the amenities and businesses will not be able to accommodate the array of demographics in a single area. One resident sees the positives and the negatives of mixed housing. At the same time, others have a neutral stance on the matter.

Resident 1: *I do like having the idea of having the same type of demographic around the same area because those people are going to get along better, and the environment will be built for that kind of demographic in that area. So if it's a younger group like single parents or something, establishments and businesses will accommodate that type of demographic. On the other side, I do like the idea of having a mixture of everything, because instead of having the same type of businesses around the area, you are going to have a little bit more variety, and variety is good. You get different people.*

Resident 2: *So, I use to live with my mom who lives in downtown Markham and the main type of housing is townhouses, but we also have condos integrated into that same area. It never really bothers me to be honest with you. I didn't see any conflict or anything. I think Markham is a high populated area, it terms of traffic, it didn't surprise me. In a high dense area, you need housing that support that population and it needs and demands so to me it made sense, it didn't affect my*

lifestyle too much. To be honest with you, I feel neutral about it. I understand it in terms of the population, and it needs. I just think about it as how the community is growing and adapting to the population and its need.

Resident 3: *I would deem it more convenient, but the traffic would be horrendous in my opinion. I would disagree with that. When you have a community full of young people you don't want family there. Just like old people neighborhood, if you are young couple or young family growing up, you don't want to move to a neighborhood with a bunch of old people. If I was a young family, I would want to move to a neighborhood with other young families so its more in common, because nothing is going to happen in that area. Store front and other amenities for young people are not going to be open there because the demographic is old. So you are a small family trying to go there, it doesn't match up because you are looking something more young but the area you are moving to is too mixed so its not going to have a specific niche for people.*

Resident 4: *I am okay with it honestly, I mean it doesn't affect me, it hasn't, so I don't think it matters to me at the moment.*

Regarding mixed housing, I followed up the question with how residents feel about social mixing in terms of socioeconomic backgrounds and income levels in a single neighborhood. Interestingly, all respondents have negative views toward social and income mixing, citing security and safety as their primary concerns.

Resident 1: *Yes, I feel like it may devalue your property. With social mixing and income mixing, I feel like there would be a lot of social issues.*

Resident 2: *When I grew up in downtown Markham, it was with luxury condo and townhouses. In some aspect, I didn't feel any way about it, we both live in townhouses and condo and we are both on the same social dynamic. If I am honestly speaking, if I were to live in a place of lots of social mixing, I don't think I would feel as comfortable only because of the social difference. Yes, I understand that land are scarce, and so you need to have access to all the area that you can, I understand that, but would I feel completely comfortable? No. I am not trying to stigmatize and all that, but it does attract certain type of people. But that's not speaking for every person, there is a chance that it does. You buy a condo or a house or whatever it may be, you are buying into the area. If I am starting a family and I am looking at area and I say "Ooo" I like this townhouse but I know there's a lot of social mixing, I might not feel safe for me and my family. I feel horrible saying it, but for my needs which is safety and being comfortable in my area, it would be a little selfish of me to say that I would not prefer it.*

Resident 3: *If I were to have kids, I would feel unsafe about that. I just feel like it won't be a children friendly area, I would not feel comfortable about my kids running around. Like security and safety for sure. Since there's a lot of social mixing and mix income.*

Resident 4: *If I was trying to raise a family I don't think I would want to be in a situation where I would be in a mixed place. But also, I grew up in a place with a lot of social mixing, so I am used to that living, so you learn more hard skills in those type of area. Obviously its not ideal to live in a place like that, but I don't mind it.*

Interviewees were asked about their opinion on the practice of mixed-use intensification with contexts regarding the goals and principles of the concepts and whether or not they think it is a good idea. The responses provided by the interviewees suggest a supportive view of mixed-use intensification stemming from the positive impact on the environment and the convenience of being close to amenities.

Resident 1: *Yes, I do think it's a good idea. You can't do it half way. You can't commit to something and not have enough people or community. If you are going to put in a subway system, and it cost a lot money, you have to make sure you back it up with the population who need it and utilize it. In the contrast, you are not going to be bringing the carbon footprint people down. People who drive will continue to drive because its more convenient. So you have to justify putting in those accommodations to where people would actually use it.*

Resident 2: *Do I think it's a good option? I absolutely do, I think it's a growing trend for people care more about the environment and to bring awareness. I think that people are now more aware now about the environment and how we can be more friendlier towards it. So I think its going to be welcome, but how you do it is another thing. It depends on how it's done. As much as people love to say we are protecting the environment and we want to help the environment. It is easy to say and not easy to do because people choose comfort over everything. So if you are pushing somebody who says "oh we want to care about the environment, we want to protect it, and make it better". Okay, so now you have to take public transportation, I don't know if they are ready to give up that comfort level. I think it's a good idea, and its going to be welcome, and its always good to have that as an option.*

Resident 3: *Me at the age of 33 -34, I would like it to be more dense so there's things to do. So that I would up for, what I wouldn't say I would be up for with all that density, it means that traffic is going to increase significantly because everyone is not going to be going to a bunch of different places, its now a hub that everyone is going to go. So for me for example, I love going to the grocery store across my condo, but I am trading the convenience for everyone going to that grocery store from my condo. I like the density because it is more convenience for me, but at the same time I lose a little bit in timing.*

Resident 4: *Honestly, I like it, I like it in a way that its more convenient. Where I am, its so convenient and everything is so central. I don't mind them, I like the way that it looks and how these buildings are keeping up with the trend that are happening in the world. Coming from a small town, from having just suburbia life like detached home and just having no really big industrial buildings where I am not being central to certain things is kind of different. It's been 10 years since I been living in Toronto, so I kind of like that, it makes life look more fast paced. But I also do miss all that other stuff.*

Lastly, residents were asked about their aspirations in life regarding housing and whether they envisioned a mixed-use intensified environment as the end goal for their family. The respondents exemplify similar aspirations regarding their future housing options. All participants expressed their interest in obtaining or having already obtained single-detached housing. The common reason for their interest is family formation. However, some interviewees acknowledged that a mixed-use intensified environment suits a certain lifestyle (bachelors).

Resident 1: *I live in a traditional residential area at the moment. I enjoyed both areas, but I strongly believe it is based on your lifestyle and where you are in life. As well, employment could play a factor with how long and comfortable you are with commuting each and every day.*

Resident 2: *Less than five years ago I moved from a condominium to a single-detached house. I have lived in a condominium twice throughout my life, once when I was growing up at the age of 16 for a couple of years and then later on when I was 29 for a couple more years. I admit, if I did not have plans to start a family, I would wish to continue living in a high-density mixed-use development. Having said this, I do plan to continue to live in a single-detached home for the majority of the rest of my life especially in consideration of the fact that I hope to expand my family soon, which will require more space. While my enjoyment living in a condominium was largely due to it being the most convenient way for me to live my lifestyle at the time, my lifestyle—despite my shift in priorities—continues to value convenience. I continue to prioritize convenience as I look for mixed-use environments in my decision-making on current and future dwellings.*

Resident 3: *Most definitely seeing myself in a detach. The space is perfect for a bachelor like myself or even with a significant other is plenty. Once thoughts of family are considered the space and access to schools become a deeper thought rather than a more simplistic one. Yard space, outdoor activities etc all become a factor that does not play into condo living and almost feel limiting in these dense areas. I myself would consider detach once I start to have kids.*

Resident 4: *Right now currently I do enjoy my life residing in medium to high density area. When starting a family is in the picture, the plan is to being in a signal detached home in a medium density where school and extracurricular activities are easily accessible and affordable to hinder the development of my children and family.*

6. Discussion

6.1 Quantitative Result Discussion

The quantitative analysis of driving, walking, cycling, and GoRail transit as a mode of transportation in the York Region area using a linear regression modelling provided insightful perspectives on the relationship between density and different modes of transportation. The findings suggest that level of density influences certain modes of mobility and the way people interact with different modes of transportation. The quantitative analysis supports the theory that higher density can influence people's behavior, encouraging them to utilize more active transportation and become less reliant on automobiles as a way of navigating around the urban environment. The result demonstrates a positive correlation between density and the mode of driving and walking. For driving as a mode of transportation, the finding suggests that as density increase, the percentage of people driving tends to decrease. The lowest density municipalities (Georgina, King, East Gwillimbury) represent the highest percentage of automobile usage, while some of the highest density municipalities (Markham and Richmond Hill) represent the lowest percentage of auto drivers. In densely populated areas, destinations such as workplaces, shops, schools, and recreational facilities are typically closer together, reducing the need for long car journeys. This proximity encourages other form of sustainable transportation. Public transit systems also tend to be more developed and efficient in higher-density areas due to the greater demand. Frequent and reliable bus or train services provide a practical solution to car travel, making it easier for residents to navigate the city without needing a vehicle. In addition, the design of higher-density neighborhoods often prioritizes pedestrian-friendly infrastructure, such as sidewalks, bike lanes, and public spaces, which further encourages residents to walk rather

than drive. The combination of all these factors creates an environment where reliance on automobile decreases as density increases, encouraging more sustainable and active transportation. For the mode of walking and density, the finding suggests that there are correlations between density and walking. As density gets higher, the percentage of people walking increases. With higher density living, services and amenities tend to be in closer proximity with places of residence, which gives more opportunities and options for residents to utilize walking as their mode of transportation.

On the other hand, the result demonstrates no correlation between density and the mode of GoRail and cycling. For cycling and density, the average percentage of people who cycle in York Region represents the lowest percentage mode of transportation with only 0.52%. Cycling infrastructure may play a significant role in a user's decision to choose cycling as their mode of transportation. Many people may feel uncomfortable and unsafe when riding along motor vehicle traffic without adequate cycling lanes and proper separations. For GoRail and density, the result of the linear regression analysis indicated no relationship. Although Newmarket has the highest density, the percentage of people utilizing the GoRail transit is less than the average across all municipalities within York Region. The level of service provision of GoRail Transit may induce a possible explanation for the result. Users may be discouraged from taking public transit due to difficulty accessing the service, while other modes of transportation may suit their need and lifestyle and provide the most convenience when it comes to urban mobility.

The findings from the quantitative analysis demonstrate positive and negative correlations between density and different mode of transportation, highlighting the complex interaction between urban form and mobility choices. The connection between density and the mode of

walking and driving greatly supports the goals of mixed-use intensification to create a more sustainable urban form. By concentrating development and integrating residential, commercial, and recreational spaces, mixed-use intensification fosters environments where people can live, work, and play within close proximity. This reduces the need for automobile usage and increases the attractiveness of walking. However, the lack of significant correlation between density and the mode of cycling or GoRail underscores the importance of supporting infrastructure and service accessibility to encourage these modes of transportation. These insights from the quantitative analysis points towards the benefits of mixed-use intensification, as well as area of improvements.

6.2 Qualitative Result Discussion

The interview result provided valuable comprehensions and insights of residents living in mixed-use intensified environment. The responses helped answer crucial research questions regarding how residents interact with their environment and whether mixed-use principles and designs have significantly altered residents' transportation behavior. Questions that the qualitative analysis aimed to answer includes (1) How are residents interacting with mixed-use intensified urban environments? (2) Does mixed-use intensification influence residents' choices in choosing a different mode of transportation? (3) What are the some of the barriers and challenges in promoting sustainable transportation?

The interview analysis identified a recurring theme from the residents' responses. Firstly, all participants emphasized that their favorite aspect of living in a mixed-use environment is the convenience it provides. Close proximity to amenities such as stores, restaurants, and

entertainment greatly enhances residents' quality of life. This proximity reduces the need for extensive travel and allows for more efficient use of time. For example, *Resident 2* spoke about how mixed-use environments support a healthier work-life balance by consolidating errands and household needs into a location accessible within the same area. The response from residents indicated that mixed-use environments are suited for demographics who value efficiency and accessibility. *Resident 1* mentioned that the convenience of having stores and amenities around them is a special bonus, especially for people around 25-40. Residents appreciate the ability to run their errands within their everyday travel routines with minimal disruption. *Resident 3* illustrated this by mentioning that essential services are within a five-minute distance, and most important things can be obtained "on the way home" without planning. Living in mixed-use intensified environments greatly simplifies daily planning and reduces travel stress for many residents.

When it comes to answering the question of, "Does mixed-use intensification influence residents' choices of different modes of transportation"? The answers from resident respondents indicated the continuation of a suburban car culture in the GTA. Despite the advantages of mixed-use environment, the reliance on private automobiles remains prevalent among interviewees. From the analysis of qualitative interviews, although public transportation is available for most residents, many still deem it inconvenient and inefficient compared to driving. For instance, *Resident 1* spoke about the unavailability of public transportation system in their area, limiting their option regarding urban mobility. *Resident 2* shares a common experience with *Resident 1* with regard to dealing with public transportation. However, the choice to rely on private automobiles for *Resident 2* is based on the inconvenience of indirect bus routes. Although

all residents use their vehicles as the main mode of transportation, it is interesting to see some of the ways people are trying to become economically and environmentally sustainable regarding driving. For example, *Resident 2* mentioned that a family member has switched to an electric vehicle, and they often carpool on the weekend. Similarly, *Resident 4* chose to drive a hybrid vehicle to reduce gasoline consumption from the long work commute. On a more positive note, three out of four residents expressed that they had been given more public transportation options. Even though all residents utilize automobile as their main mode of transportation, having public transportation option is a good indication that mixed-use developments are adequately serviced. *Resident 1*, *Resident 3*, and *Resident 4* revealed that public transportation is much easier to access when living in a mixed-use development. *Resident 2* was the only person who felt they had yet to be given more options. However, they utilize public transportation when commuting to Downtown Toronto as it is the most convenient method. Overall, when examining mixed-use residents' mode of transportation, the result indicated no changes in travel behavior. Most residents are still relying on private automobiles as their main mode of transportation due to convenience factors. However, it is particularly important to recognize that most residents feel they have been given more transportation options. If they ever choose to utilize public transportation, it is available to them.

In addition, the interviews from residents of mixed-use development illuminate particular concerns and aspects they wished they could change in their area. Some of the common changes residents wished for during the discussion was decreased traffic congestion. *Resident 1* and *Resident 3* noted that traffic congestion has been more noticeable as the area has become more developed and causes major inconvenience for all type of trips. Traffic congestion has significant

impacts on the quality of life of residents as well as economic consequences, as examined by Pritchard (2022). It is unsurprising that traffic congestion made it to the most common inconvenience in most mixed-use residents' lives, as increased density entails more people per square footage. Other changes residents wish to see in their area include better public transportation in older parts of town, more privacy from being near other dwelling units, and free from obstruction of high density construction project. One surprising thing was that most residents were happy with the amount of green spaces in their area. For instance, *Residents 1* and *3* noted sufficient green spaces in their mixed-use development. Interestingly, when asked how they overcame these challenges, most residents responded that they accepted it as a lifestyle choice and that there is not much they can do to overcome these challenges. *Resident 2* went as far as to say that these problems do not bother them enough to do anything about. In addition, residents were asked what are some of the most concerning issues with regard to mixed-use high-density housing. Environmental degradation is one of the more common concerns that residents have with high-density housing. *Resident 2* and *Resident 4* emphasize the negative impact of continuous construction and urban development, which will majorly impact natural habitats and green spaces. It was interesting to note that environmental protection was one of the more common concerns from residents, since the goals and principles of mixed-use intensification was to build a more sustainable urban form. The interview material reveals certain benefits and challenges of living in mixed-use development. Although residents appreciate the convenience and green spaces their area offers, issues such as traffic congestion, public transportation, and environmental sustainability are still prevalent in the perspective of residents. It is crucial to understand and address residents' concerns since they are the people interacting

with the environment, and their lived experience can shed light on areas of improvement in mixed-use developments.

The interview responses reflect a variety of perspectives on the mixing of housing (single-detach, condominium, rental accommodation) in a single neighborhood. *Resident 1* and *Resident 3* spoke about their preference for living in an area with a common demographic and type of housing, citing that the same demographic promotes better social cohesion and urban environment and amenities that are tailored to that specific community. For example, *Resident 3* mentioned that young couples and young families would not be suited to live in the same neighborhood as older families because the businesses and amenities surrounding the neighborhood would only fit some demographics. However, *Resident 1* showed appreciation for mixed housing and the variety of businesses it would promote in the area. The answers from residents regarding mixed housing align with Brewer and Grant's (2015) and Perrin and Grant's (2014) research. The research outlined challenges of mixing housing within the same neighborhood. Developers are more inclined to group certain types of housing with one another due to aesthetic and consumer preferences. In addition, social interaction proved to be a challenge in mix-use and mix-housing developments. *Resident 2* and *Resident 4* demonstrate a more neutral stance concerning mixed housing, saying that it does not affect them or their lifestyle. When residents were asked about their perspective on social and socioeconomic mixing, interview responses reflected a concern regarding social and income mixing within a neighborhood. Many residents associate social mixing with a decrease in safety and comfort. All residents raised concerns about social mixing for the safety of their families and felt uncomfortable raising their children in an area with significant social mixing. Resident's

negative views towards socioeconomic mixing demonstrate challenges of producing diversity in mixed-use intensified projects, which corresponds with Winstanley et al. (2010) and Grant (2006). The responses from residents and literature reviews of social and housing mixing point towards a significant barrier of mixed-use intensification's goals to creating social and housing diversity. Although creating an urban space with a diverse population and built environment is righteous, implementing the practice may be challenging due to consumer's negative perspectives on social and housing mixing.

On a positive note, the interviewee's response indicated support for mixed-use intensification as means of fighting climate change. Residents were provided with the context of the goals and principles of mixed-use intensification. They were asked if they think this is a good idea in terms of creating a more sustainable and environmentally friendly space. All residents expressed their support for mixed-use intensification. However, *Resident 1* and *Resident 2* did express caution when executing sustainability goals of reducing automobility usage, highlighting their concerns with the societal behavioral change that needs to occur (private transportation to sustainable transportation). This behavioral change may pose one of the most significant challenges when trying to achieve the goal of reducing automobility through mixed-use intensification. As Sheller (2004), Carrabine and Longhurst (2002), Buys and Miller (2011), and Buys et al. (2012) have examined the persistence of suburban car culture; automobility signifies more than just a mere tool for urban mobility. It offers a range of sensation and emotion, while providing more comfort and convenience for users. Although public transportation may be available and services may be adequate, changing residents' behavior to utilize other forms of sustainable transportation proved difficult, especially in low-density environments where crucial amenities are scattered across urban areas.

Lastly, residents were asked about their aspirations in life regarding housing and what type of dwelling they see themselves and their families living in. The analysis from the interview indicated that all residents wished to live in traditional single-detached suburban housing. *Resident 1* and *Resident 3* mentioned that mixed-use intensified housing is more suitable for bachelors and bachelorettes for whom smaller living spaces are adequate. They still aspire to live in a more traditional single detached housing once they start forming a family. One of the significant reasons for residents' aspiration to obtain traditional suburban housing is mainly due to the lot size of dwellings. Understandably, a single-detached home can offer families more living spaces and privacy compared to high-density dwellings. In a way, many residents perceived mixed-use intensified housing as a stepping-stone before they start a family. This transitional view highlights the flexibility and convenience of high-density living for young professionals but underscores the traditional suburban home as the ultimate goal for family life. Understanding future home aspirations is extremely important since people will purchase a home that will suit their family's needs. The evolving preferences may pose challenges to meeting the goals of urban intensification and moving away from lower-density living to create a more sustainable urban form. Clearly, many residents still wish to live in traditional suburban housing at later stages of their lives.

7. Conclusion

The urban built environment of the GTA has undergone significant changes over the past few decades using the principles of mixed-use intensification to create a more sustainable living environment that is less reliant on private automobiles while promoting other forms of mobility that fits into the new paradigm. The research reveals how the built environment affects different modes of mobility in the GTA. From the quantitative analysis of examining density with mode of transportations, the result demonstrates both positive and negative correlations between density and travel modes. For positive correlations, as density increases, people tend to drive less and walk more. The findings support the hypothesis of how density induce sustainable transportation while reducing automobile usage. This may suggest that the goals of mixed-use intensification in promoting a more environmentally friendly form of development are indeed being realized. With this being said, the result from the linear regression model, when analyzing density and mode cycling and GoRail, indicated certain deficiencies in the mixed-use development model. Density seems to have no impact on the rate of people utilizing cycling and GoRail Transit. In addition, the qualitative analysis of interviewing mixed-use residents demonstrates similar findings to the quantitative research. All respondents mentioned how mixed-use environments have provided a more convenient lifestyle from being in close proximity to amenities and services, allowing for less extensive travel and more efficient use of time. Being close to restaurants, grocery stores, and other crucial amenities may significantly influence the rate of people using walking and driving as their mode of transportation. With this being said, residents living in mixed-use environments still heavily reliant on using private automobiles. Most residents cited the inconvenience and inefficiency of public transportation as the main reasons why they still rely on automobiles, even though public transportation is accessible for most residents. Residents also

voice their concerns with regard to living in a mixed-use environment. The most common concern when it comes to high-density living is increased traffic, which is a major inconvenience for most residents and significantly affects their quality of life. However, all residents have concluded and accepted the lifestyle of living in higher-density areas. Interestingly, many residents expressed negative view towards mixed housing with concerns over surrounding amenities not being able to support all demographics. Furthermore, all residents have negative view towards socio-economic mixing in the same area, citing safety and comfortability as their main concern. Nevertheless, all respondent support mixed-use intensification as a development path to create a more sustainable environment and a way of combating climate change. Lastly, when looking at the future prospects of homeownership and aspirations of residents, all respondents disclosed that they wish to reside in the traditional single-detached suburban housing in the GTA at later stages of life. The main reason for this aspiration stems from the larger dwelling sizes, which provide families with more comfort in terms of space.

The research provides valuable insights into how urban density influences various modes of transportation in the GTA and how residents interact with higher-density development. Understanding urban mobility and resident's lived experience is essential for developing comprehensive strategies to reduce automobile dependency and foster an inclusive urban environment. The positive relationship between density and the mode of walking and driving suggests that mixed-use developments successfully encourage a more sustainable urban form. This can lead to healthier lifestyles and reduced environmental impact, making it a key goal in urban design. Additionally, understanding residents' perception and attitude towards social and housing mixing will provide greater harmonious community. Effective communication and

community engagement plays an essential role in mitigating fears and fostering a sense of inclusivity. The resident's future aspirations can also play a significant role in the success or failure to meet the goals of mixed-use intensification. The aspiration for many residents to eventually move to a single detached suburban housing may pose challenges for long-term sustainability goals. The development industries need to consider how to balance preference with sustainable goals in order to create a community that is complete and suited for people at all stages of life. Future research could expand the participant pool to offer a more comprehensive view of residents' behaviors and perceptions regarding mixed-use intensification. It could also include a larger and more diverse group of participants, which will enhance the breadth of the findings by provide a fuller picture of how different demographics interact with and respond to mixed-use environments. A wider sample can capture a wider range of perspectives, particularly on issues related to social and income mixing, offering a richer understanding of how various groups perceive and experience mixed-use developments.

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