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Empirical Research Article

Comparing Urban and Non-Urban Residents' Sustainable Tourism Mobility

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Abstract

Promoting public and active transport among tourists is key to lowering emissions, although this is challenging in areas with scarce public transport, such as non-urban areas. This study explores differences in sustainable tourism mobility between urban and non-urban residents, factoring in air quality, climate change mitigation, well-being, and smart apps. Two surveys were conducted targeting users of different transport modes: one survey of public transport users (n=500) and one survey of active transport (walking/cycling) users (n=660). The surveys measured attitudes, behaviors and other factors related to the respondents' use of these sustainable transport modes. The research employs mixed methods of PLS-SEM, MGA, and fsQCA to assess intent towards sustainable transport. Findings indicate significant impacts of sustainability factors and smart apps on public transport intentions. However, for active transport, only air quality, climate change mitigation, and well-being are significant. Notably, MGA shows minimal differences between urban and non-urban transport preferences, unlike fsQCA. The study presents a range of strategies to promote sustainable tourism mobility, particularly emphasizing the use of smart apps and the importance of environmental improvement policies. It suggests the need for technological infrastructure enhancements, air quality improvements, climate change mitigation, and well-being promotion programs. It highlights the importance of collaboration between cities and non-urban areas to create complementary sustainable transportation policies. This study plays an important role in exploring how environmental protection and tourism demand can be achieved simultaneously in non-urban areas.

Keywords

Sustainable tourist transport; public transport; active transport; urban tourism; non-urban tourism; mixed methods

1. Introduction

Public transport is unevenly distributed in time and space, but the implications of this for tourism-related mobility has only received limited attention. Non-urban areas have long faced issues of limited public transport access. Tourists often value the amenity and environmental qualities of less urbanized destinations, but often have to rely on private transport, particularly automobiles, because of lack of public transport (Dickinson & Robbins, 2008; Le-Klähn & Hall, 2015; Smith et al., 2019; Tomej & Liburd, 2020). As a result, public transportation provision is often a central element of non-urban development with, in some cases, tourism providing the economic justification for public transport services that would not otherwise be available to the permanent population (Hall et al., 2017; Kim et al., 2024a, 2024d). Although walking and cycling has limitations for tourists, the combination of active and public transport may provide more sustainable mobility (i.e., sustainable transport) solutions in many non-urban areas and reduce automobile dependence (Gao et al., 2022; Kim & Hall, 2023a, b; Kim et al., 2023b, 2023c; Li et al., 2021; McAndrews et al., 2018). Such measures are regarded as extremely important given that tourist transport emissions increased by 65% between 1995 and 2019 with tourism very unlikely to achieve its sectoral interim target of reducing emissions by 50% by 2030 (Tourism Panel on Climate Change (TPCC). 2023).

Sustainable transport mobility strategies typically aim to be environmentally friendly, economically viable, and achieve social equity goals (Bao et al., 2023) and are increasingly being encouraged for tourism, especially short-distance domestic trips (Hall et al., 2017). However, the nature of active and public transportation demand for tourism can vary substantially between different locations. Given differences in transport infrastructure, methods used to encourage public transport use in urban destinations, may potentially not be appropriate in non-urban areas (Wang & Zhong, 2023). Therefore, to better understand the sustainable mobility related motivations and behaviors of tourists, it is appropriate to compare active and public transport use for tourism purposes in urban and non-urban

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areas (Rastegar & Ruhanen, 2023). Two online surveys are used to compare metropolitan and non-metropolitan resident sustainable tourism transport adoption in South Korea (hereafter Korea) to identify potential differences between urban and non-urban residents' behavioral intention to use public transport or engage in active transport use.

Non-urban tourism is popular in Korea although non-urban visits as a share of all tourism declined during COVID-19, from 41.1% in 2018 to 30.2% in 2020 (Rural Development Administration, 2020). However, most South Korean tourists want improved transport conveniences in non-urban destinations with 95% of them using private cars to travel to non-urban destinations (Lee, 2022). In many non-urban, peri-urban, and remote areas, tourism plays an important economic role (Shibayama & Emberger, 2023). However, insufficient transport infrastructure in non-urban areas hinders economic and social development, necessitating the development of new public mobility strategies that improve accessibility (Dalkmann et al., 2008). Thus, strategies that improve spatial and temporal mobility patterns are crucial for sustainable non-urban transportation, with accessible information and cooperation between tourism and transport stakeholders being key success factors (Poltimäe et al., 2022).

Non-urban areas face several challenges in providing adequate public transportation, such as lower population density, dispersed destinations, seasonal fluctuations in tourism demand, and limited financial resources (Dickinson & Robbins, 2008; Hall et al., 2017; Shibayama & Emberger, 2023; Tomej & Liburd, 2020). These challenges highlight the practical constraints that must be considered when developing sustainable transportation solutions tailored to the unique contexts of non-urban areas, rather than a lack of commitment from these communities (Wang & Zhong, 2023).

There are a range of factors affecting transport use. Consumers' sustainability efforts, particularly perceived air quality (Kim & Hall, 2023a) and commitment to climate change mitigation (Kim & Hall, 2019), significantly influence sustainable consumption behavior and active transport use but have been shown to differ among leisure and tourism activity groups (Kim & Hall, 2022c; Olya et al., 2023). Cultural differences impact trip subjective well-being, with factors like innovation diffusion, technology readiness, and sustainable development goals play a role in shaping these experiences across different groups (Kim et al., 2020b, 2021; Saayman et al., 2018). Smart apps, or intelligent mobile applications, utilize advanced technologies such as artificial intelligence and data analytics to provide personalized, context-aware services to users (Kim & Hall, 2022b). In the context of sustainable transport, smart apps can offer features such as real-time public transit information, route optimization, and multimodal journey planning (Di Dio et al., 2018). The knowledge and perceived usefulness of these apps have been found to influence tourist active transport behavior, with variations observed between frequent and infrequent users (Kim & Hall, 2022c, 2023b). However, in a wider market context active transport is associated with the high travel satisfaction and positive emotions, while public transport users experience the lowesatisfaction, mainly due to long travel times and poor service quality (Mouratidis et al., 2023).

Although sustainability (air quality and climate change mitigation), subjective well-being, and smart apps (knowledge and usefulness) are significant for tourism related public and active transport, research on where people live is scarce with respect to their transport behavior, e.g., urban versus non-urban residents. To fill this gap, this study aims to build and test an integrated research framework with sustainability (air quality and climate change mitigation), subjective well-being, and smart apps (knowledge and usefulness), comparing urban and non-urban residents. To fulfill the research aims, the authors pose three research questions (RQ): RQ1: Are there significant differences between urban and non-urban residents in the effect of sustainability (perception of air quality and climate change mitigation) on sustainable transport use? RQ2: Are there significant differences between urban and non-urban residents in the effect of subjective well-being on sustainable transport use? RQ3: Are there significant differences between urban and non-urban residents in the effect of smart apps (Knowledge and usefulness) on sustainable transport use? To answer these questions, a digital survey gathering 500 tourism related public transport users and 660 tourism related active transport users was undertaken, applying mixed methods (i.e., quantitative and qualitative approaches) of multi-group analysis (MGA), fuzzy-set Qualitative Comparative Analysis (fsQCA), and partial least squares-structural equation modeling (PLS-SEM).

2. Literature Review

2.1 Sustainable Tourist Transport

Sustainable transport mobility can be defined as a variety of environmentally-friendly transport modes that minimize negative impacts and promote accessibility, equity, and public health, while meeting mobility needs, primary among which is public and active transport (Kim & Hall, 2022; Le-Klähn & Hall, 2015; O'Brien et al., 2014). One-dimensional cause-and-effect problem solving is inappropriate for improving transport sustainability as transport use is influenced by a complex interplay of physical, psychological, and social factors (Richardson, 2005). For example, research on tourists' behavior regarding car travel's impact in a non-urban UK tourism destination found that perceptions of the problem are context-dependent, socially constructed, and vary between locals and car-based visitors, which has implications for destination management (Dickinson & Robbins, 2008). There is therefore a potentially strong relationship as to where people live with respect to their mobility behavior.

Visitor use of public transport can improve the economic basis for transport provision in non-urban areas (Smith et al., 2019), with accessibility to multimode transport facilities creating significant spatial differences in accessibility (Li et al., 2021). This has been identified in studies of the New Forest in the UK (Smith et al., 2019), ferry services in Scotland and Norway (Hall et al., 2017), and West Balaton Region, Hungary, where public transport has helped promote environmentally friendly and socially inclusive tourism (Tomej & Liburd, 2020). Based on this literature, this study regards active and public transport as sustainable transport for tourism destination particularly in non-urban areas.

Sustainable tourist transport refers to transportation methods used in the travel industry that minimize environmental impact, promote energy efficiency, and support local communities, while ensuring accessibility and convenience for tourists (Collins, 2021). Sustainable tourism transportation includes the use of green vehicles, walking, transit, ride-sharing, and cycling as well as using public transportation systems like trams, buses, and trains for intra-city travel as steps towards a greener future (Schauble, 2020). Tourist traveling patterns are influenced by the transport infrastructure at tourism destinations (Liu et al., 2023), with access being critical for public transport use (McCullough et al., 2023). However, while the public transport challenges for urban and non-urban regions are recognized as different (Hall et al., 2017), no previous study has sought to attempt to directly compare the sustainable tourist mobility of urban and non/urban residents.

2.2 Well-Being

Subjective well-being is a person's self-evaluation of their life satisfaction, happiness, and emotional experiences, comprising both affective and cognitive components, and can vary significantly among people due to its reliance on personal perspectives (Kim et al., 2020, 2021; Kim & Hall, 2023a). Active transport can enhance physical and psychological health, suggesting that promoting active travel could yield significant population-level health benefits, increasing mental well-being (Sun et al., 2015). A sustainable, resource-saving transport system promotes mobility and wellbeing within environmental boundaries, although this requires changes in values, infrastructure, preferences, governance, personal costs, and technology (Kammerlander et al., 2015). Studies of the influence of tourism experiences on tourist satisfaction and well-being has shown that higher well-being impacts loyalty, culture affects experiences, and group travelers have more positive experiences than solo travelers (Saayman et al., 2018).

Multidimensional measures of travel-related subjective well-being demonstrate that walking and bicycling are associated with better physical and psychological health, overall well-being, and confidence (Singleton, 2019). Liu et al. (2021) have explored the association between traveling experiences as well as both hedonic and eudaimonic well-being, finding strong positive correlations between them and suggesting that promoting sustainable transport and active travel can improve overall well-being. In light of prior literature, subjective well-being can be considered as a key variable for sustainable transport use behaviors.

2.3 Smart Apps

Intelligent applications (i.e., smart apps) are software and mobile apps that utilize cutting-edge technology like artificial intelligence (AI) to intelligently interact with users, learn from interactions, adapt to preferences, and provide personalized experiences, ultimately enhancing user convenience and productivity (Kim & Hall, 2022a, 2022b, 2023b; Kim et al., 2024a). Mobile apps can be effective in encouraging environmentally sustainable mobility habits (Di Dio et al., 2018). Schwanen (2015) also regards mobile apps as integral to sustainable urban mobility although he suggests that the nature and effects of apps on urban transportation and mobility requires further research. Health applications and behavior change support systems (BCSS) for sustainable travel were similarly identified as important areas for sustainable transport policy research (Sunio & Schmöcker, 2017).

In active transport perceived smart app usefulness meaningfully regulates the associations among community green area, behavioral intention, attitude, and motivation (Kim & Hall, 2022a). Users who heavily rely on smart apps for knowledge and usefulness have notably different approaches to tourist walking/cycling activities compared to light users (Kim & Hall, 2022b). Frequent use of smart apps for biking amplifies the connection between public health and attitude, and between perceived ability to act and intent, while low usage strengthens the attitude-behavioral intention relationship (Kim & Hall, 2023b). In line with this literature review, this study takes knowledge and usefulness of smart apps as important factors for sustainable transport use.

2.4 Non-Urban Areas

Non-urban areas, also often described as rural, peri-urban, and peripheral areas, are geographical regions with low population density, limited transport infrastructure and services, and a predominantly agricultural, forest, or natural landscape, often featuring small towns and settlements (Dickinson & Robbins, 2008; Juschten & Hössinger, 2021; Le-Klähn & Hall, 2015; Tomej & Liburd, 2020). The capacity for tourists to navigate within destination regions is essential for the tourism industry; however, the provision of transport access to tourists is problematic, especially in non-urban destinations and towns where the infrastructure is frequently inadequate for handling the substantial influx of seasonal visitors (Dickinson & Robbins, 2008; Sæþórsdóttir et al., 2020). Public transport is generally less appealing in non-urban areas, often because of perceived access, while it holds more potential in urban settings; however, there is no evidence to suggest that urban visitors are more conscious of their environmental footprint or demonstrate a specific inclination towards public transport (Le-Klähn & Hall, 2015). Offering free public transportation for tourists in destination areas is a response to growing transport demands and sustainability in German holiday destinations, although it has varied stakeholder support and requires better marketing and collaboration between the tourism and transport sectors (Gronau, 2017). Similarly, a proactive policy strategy has been implemented to tackle high traffic levels in the New Forest in southern England to promote a shift among visitors from automobiles to "greener" transportation alternatives in non-urban tourism (Smith et al., 2019).

Tourist sites are often dispersed in non-urban and peri-urban areas and inadequate public transportation infrastructure results in reduced accessibility for visitors without personal vehicles; however, there are often limited resources available for non-urban public transport, even within non-urban towns (Tomej & Liburd, 2020). Masiero and Hrankai (2022) address the challenge urban destinations face in diverting tourists from central urban areas to less-visited peripheral areas: Visiting peripheral area attractions often involves extended journeys and the use of multiple transportation modes. Many individuals base their transport decisions on socially accepted norms, notably favoring cars, even when familiar with alternatives. As car travel characterizes non-urban tourism in many destinations, gaining deeper insights into the factors influencing tourist transport choice is essential to attract visitors and encourage use of alternative and more environmentally methods of transportation (for instance, public and active transit) (Juschten & Hössinger, 2021). Assessing sustainable transport accessibility of non-urban tourism facilities is crucial for informed decision-making regarding quality of transportation infrastructure in non-urban regions and settlements (Zolotarev et al., 2013). Accordingly, we aim to examine variances between urban and non-urban areas sustainable transport for tourist behavior relevant to sustainability (air quality as well as climate change mitigation), personal well-being, and knowledge and usefulness of smart applications.

2.5 Research Questions

The way consumers view air quality and their commitment to mitigating climate change are essential elements in encouraging the intent to consume in a more sustainable manner (Kim & Hall, 2019), as well as affecting their affinity for walking (Kim & Hall, 2023a). In active transport use, citizens' perceived sustainability (air quality and pursuing climate change alleviation) have significant impacts on behavior for increasing personal and public health, indicating similarities and differences from leisure and tourism groups (Kim & Hall, 2022c).

Various cultures have demonstrated diverse outcomes related to travel encounters (contentment) and the influence of these experiences regarding their personal sense of well-being (Saayman et al., 2017). The multifaceted characteristics of travel-related subjective well-being shed light on numerous pertinent distinctions across different modes (Singleton, 2019). Users' subjective well-being was significantly influenced by innovation diffusion and uses and gratifications, revealing differences depending on technology readiness groups (Kim et al., 2020b). The subjective well-being of digital investors has also been found to have differed with respect to three sustainable development goals (SDGs) group (Kim et al., 2021).

In terms of smart apps, utilizing intelligent system services in mobile applications can enhance the biking experience, such as by offering better route choices (Di Dio et al., 2018). Individuals who perceive themselves as frequent users of smart biking applications show stronger correlations between various factors compared to infrequent users, with both groups exhibiting distinct differences in their cycling behaviour (Kim & Hall, 2023b). Significantly, heavy as well as non-heavy users of mobile applications exhibit notably different solutions regarding usefulness and knowledge when it comes to tourist walking and cycling behaviour (Kim & Hall, 2022c). Accordingly, the authors raise three research questions (RQs) as follows:

• ***RQ1:*** *Are there significant differences between urban and non-urban residents in the effect of sustainability (perception of air quality and climate change mitigation) on sustainable transport use?*

• ***RQ2:*** *Are there significant differences between urban and non-urban residents in the effect of subjective well-being on sustainable transport use?*

• ***RQ3:*** *Are there significant differences between urban and non-urban residents in the effect of smart apps (Knowledge and usefulness) on sustainable transport use?*

Building on the aforementioned points, we propose a comprehensive model that encompasses sustainability (air quality and efforts towards climate change weaken), personal well-being, understanding of mobile applications, their utility, and the intent to use sustainable transportation (refer to Figure 1).

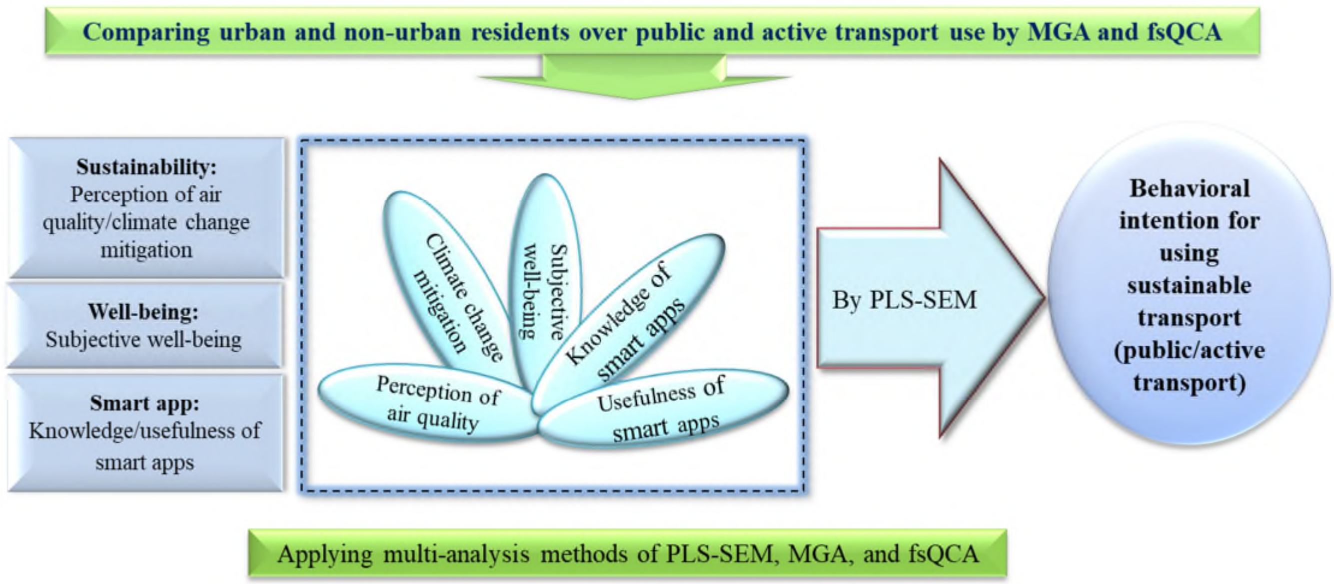

Fig. 1. Research conceptual framework.

3. Methods

3.1 Measurements

Earlier confirmed multiple metrics were incorporated into the survey form because of errors that arise when applying one question (Churchill, 1979). The two surveys employed identical constructs and questions adapted only for the different transport mode. The public transport survey questionnaire consists of six variables with 24 questions: sustainability (air quality and climate change mitigation), personal well-being, knowledge of smart apps, usefulness of mobile applications, and behavioral intention. Specifically, perception of sustainability (four questions on air quality and four questions on seeking climate change mitigation) came from Kim and Hall (2023a). Four items for subjective well-being were resulting from Kim et al. (2020b, 2021; Kim et al., 2024b) and Saayman et al. (2018). Questions relevant to knowledge and usefulness of smart apps came from Kim and Hall (2022a, b) and Xu et al. (2019). Four elements related to behavioral intent were adapted from Kim et al. (2020b, 2021) and Kim et al. (2023a, b).

The active transport survey questionnaire consisted of the same six variables with 26 questions. Six questions on sustainability (atmospheric purity and efforts to counteract climate alterations) came from Kim and Hall (2023a). The items for subjective well-being, knowledge and usefulness of mobile applications, and behavioral intention were derived from the same sources as the public transport survey. Owing to its enhanced reliability and distinct validity as noted by Kim et al. (2020a), items employed a seven-point Likert scale ranging from (1) strongly disagree to (7) strongly agree. Overall information questions and socio-demographic questions were included.

3.2 Content Validity

The questionnaire was initially formulated in English. Subsequently, bilingual Korean experts in English translated the questionnaire into Korean. The translation was subsequently reverse-translated into English to resolve any discrepancies in phrasing as well as planned interpretation due to the distinct cultural and social backgrounds of Korean and English (Brislin, 1970).

A preliminary review of the questionnaires' content validity was conducted by three academic specialists. During this phase, a question about the perception of air quality was removed to prevent redundancy in the construct's meaning. Three online survey experts from a consulting company assessed the survey tool, subsequently modifying it to align with the guidelines of the online platform. As a result, changes were made to the questionnaire's format, style, general questions, and overall phrasing. The tool was then tested on five Ph.D. candidates specializing in hospitality as well as travel, leading to the rephrasing of terms related to use of public transportation and local travel for clearer understanding. A subsequent pre-test involved 50 individuals from Korea who had utilized public transportation for local journeys within the last year. Based on this, several adjustments were made to enhance response quality, reduce response time, and ensure truthful answers, as detailed in Supplementary A (public transport), B (walking), and C (biking).

3.3 Data Collection

Owing to their expense and time-efficient nature, online panel studies are becoming more prevalent for studying consumer behavior in Korea (Kim et al., 2020b, 2022). To gather samples, we engaged Embrain, the leading online questionnaire firm in Asia (https://embrain.com/eng/). The data collection period spanned from September 1 to 10, 2022. We employed socio-demographic quota sampling, reflecting the age, residential region, and gender distribution of the Korean populace. In Korea, metropolitan regions are categorized as urban, while non-metropolitan areas are labeled non-urban, as per the Ministry of the Interior and Safety (2022). We invited inhabitants of Korea aged 18 and above, who had utilized public transportation for local travel within the preceding year, to partake in the survey. Email invites were dispatched to 4,541 individuals, chosen at random from the 1.6 million participants associated with the survey company's panel. Out of these, 1,477 engaged with the invitation, with 1,115 qualifying past the initial screening queries. However, only 570 participants fully completed the survey. After excluding those who took under 4 minutes to respond, a final count of 500 responses were earmarked for analysis. Ethical clearance was not required for the project as XXXX University only requires clearance for human medical and experimental research and for research with children, the disabled, and patients. Approval is not required for use of panel survey data as participants have previously given consent for their responses to be used.

Data related to active transport was gathered during July 2021. The sampling was derived from socio-demographic quotas reflecting the age distribution of the Korean populace, location of residence, and sex. Korean persons 18 years old and older who utilized active transport modes, such as walking or biking, for local journeys within the previous year were approached for the survey. Emails were dispatched to 4,993 individuals regarding walking and 6,191 about biking, selected randomly from Embrain's database of 1,451,319 customers. From this, 2,403 walking and 3,003 biking recipients viewed the email, with 1,528 of those interested in walking and 1,941 in biking proceeding to open the participation link.

Participants were prompted to confirm if they were engaged in active transportation modes like walking or cycling for recreational and tourism purposes by responding to the query: "Have you walked (biked) for leisure and tourism-related activities?" Definitions and categorizations of actions were clarified before these screening queries. For the survey, 'active transportation' encompasses walking and cycling. 'Leisure and tourism activity' are defined as a pursuit selected for enjoyment, relaxation, or emotional fulfillment, usually outside working hours, inclusive of day trips. 'Tourism' is described as individuals journeying to places other than their residence for a duration ranging from 24 hours to one full year.

Only those 1,406 walking and 1,575 biking respondents who affirmed their participation via the filtering queries were allowed to proceed with the questionnaire. From them, 770 participants (370 walkers and 400 bikers) submitted valid responses. After removing outliers, like those who completed the questionnaire in less than 3.5 minutes (referenced from Hair et al., 2020), a total of 660 entries (330 walking and 330 biking) were earmarked for further analysis. The research techniques used included PLS-SEM (Hair et al., 2017), multi-group analysis (MGA) (Ringle et al., 2022), and fuzzy-set Qualitative Comparative Analysis (fsQCA) (Kim & Hall, 2023b).

We determined that a minimum of 500 respondents for the public transport survey and 600 respondents for the active transport survey (300 each for walking and biking) would provide sufficient statistical power for our planned analyses using PLS-SEM, MGA, and fsQCA, as these sample sizes well exceed the commonly recommended minimum of 10 times the largest number of structural paths directed at a particular construct in the model (Hair et al., 2017). Demographic quotas based on age, gender, and residential location (urban vs non-urban) were employed to ensure the sample was representative of the general South Korean population, using data from the Korean Ministry of the Interior and Safety. The combination of sufficiently large sample sizes based on analytical best practices and demographically representative sampling provides a robust basis for the study methodology and enhances the validity and generalizability of the findings

3.4 Data Analysis

The authors employed symmetrical as well as asymmetrical methods to predict sustainable transport actions among local travelers in South Korea, applying mixed methods of quantitative (PL-SEM and MGA) and qualitative manners (fsQCA). Symmetrical approaches, like SEM and regression, evaluate the adequacy of an input factor (X) in predicting an output factor (Y) (Olya, 2023). On the other hand, in asymmetrical techniques, a higher score for X (solution) doesn't necessarily mean a corresponding higher score for Y (outcome factor), setting it apart from symmetrical methods like fsQCA (Ragin, 2017). Among the symmetrical techniques, PLS-SEM was predominantly utilized to assess the study model in conjunction with MGA (Hair et al., 2017). PLS-SEM is often favored over classic SEM methods, like those based on covariance techniques, especially when dealing with intricate models combined with MGA (Hair et al., 2020). For the validation of measurement as well as structural models, this study employed SmartPLS 4 (Ringle et al., 2022).

Using a non-symmetrical approach, fsQCA is utilized to comparatively validate different conFigureurations (Kim & Hall, 2023b). To derive more comprehensive outcomes, comprising adequate conFigureuration resolutions, causal recipes, and the analysis of a necessary condition (ANC), the influences of sustainability (perceptions related to air quality as well as efforts towards counteracting climate alteration), well-being, and smart app insights (familiarity and utility) on the intent to use sustainable transportation were examined. This was done across four groups: urban and non-urban dwellers who use both public and active transport (Kim & Hall, 2023b). To identify the optimal causal combinations of constructs, solutions, and ANC prerequisites, the authors utilized the fsQCA 3.0 software (Ragin, 2017).

It allows researchers to identify the combinations of factors that are necessary and/or sufficient to produce a particular outcome. fsQCA is a social science method that combines case-oriented and variable-oriented quantitative analysis. ConFigureurational modeling was executed in three distinct phases (Olya, 2023). Within the set, the number seven is designated as a full member, carrying a value of 1. Four is deemed the crossover point with a value of 0.5, while one is labeled as a complete non-member, associated with all variables set to a value of 0 (Ragin, 2017). To assess potential issues with common method bias, both the single factor method test (Podsakoff et al., 2003) and the comparison of simple and intricate models (Korsgaard & Roberson, 1995) were carried out. The outcomes suggest that common method bias is not an issue, as detailed in Supplementary D (public transport) and E (active transport).

The mixed methods approach combining PLS-SEM, MGA, and fsQCA was chosen to provide a comprehensive understanding of the factors influencing sustainable transport behavior among urban and non-urban residents. PLS-SEM analyzes complex relationships between variables, particularly with non-normal data and smaller sample sizes (Hair et al., 2017), addressing our first research question. MGA extends PLS-SEM by comparing model parameters between groups (Ringle et al., 2022), aligning with our second research question. FsQCA identifies necessary and sufficient conditions for an outcome (Ragin, 2017), offering a complementary perspective to PLS-SEM and enriching our understanding of differences between urban and non-urban residents. Together, these methods provide a triangulated approach, with PLS-SEM establishing model fit, MGA uncovering group differences, and fsQCA revealing configural patterns driving sustainable transport behavior, offering a nuanced understanding of the phenomenon.

4. Results

4.1 Profile of Samples

In the context of public transport (n=500), the urban group (n=246) is more likely to consist of older, educated males who take longer to answer questions, engage in biking/walking, express concern about climate change, frequently visit Busan (Korea's second most populous city), and utilize active transport (Supplementary F). Conversely, the non-urban group (n=254) is more likely to be females who spend less time answering questions, engage in domestic tourism via public transport, rely on private cars, and show concern for both climate change and public health/well-being.

Regarding active transport (n=660), the urban group (n=359) is more likely to be made up of educated, single females with high incomes, working as professionals or office workers. They tend to use active transport for health and well-being purposes, utilize smart apps, and walk or bike alone. In contrast, the non-urban group (n=301) is more likely to consist of married males with diverse occupations who use active transport for leisure travel as well aa self-satisfaction. These individuals often walk and/or bike with family and relatives (Supplementary G).

4.2 Measurement Model

For the measurements related to public transport, factor analysis revealed that 23 indicators displayed factor weights above 0.7 (Hair et al., 2020), as detailed in Supplementary H. As depicted in Supplementary I, both the composite reliability and Rho_A for variables exceed 0.7, underscoring the inner reliability of the measures. The six concepts possess an average variance extracted (AVE) exceeding 0.5, and all item factor weights surpass 0.7, thereby establishing convergent validity. Also, Discriminant validity is confirmed using the Heterotrait-Monotrait Ratio (HTMT) method (Hair et al., 2017). Specifically, the highest value between climate change mitigation and subjective well-being is 0.671, falling below the threshold of 0.85, thus affirming discriminant validity. Moreover, the Q^2 value indicates a satisfactory degree of predictive significance greater than zero for the dependent variable, registering at 0.465, as per Geisser (1974) and Stone (1974). Furthermore, with a standard root mean residual (SRMR) of 0.044, the model fit is verified, as it is below the set benchmark of 0.9 (Hair et al., 2017).

Factor analysis was conducted for active transport, and it was found that all 27 indicators exhibited factor loadings exceeding 0.7 (Hair et al. 2020), as detailed in Supplementary J. The constructs' Cronbach's α, Rho_A, reliability coefficient, and composite reliability all surpassed 0.7, reinforcing the validity of internal consistency, as noted by Kline 2011 and Stevens 2009 (refer to Supplementary K). Constructs had an average variance extracted (AVE) over 0.5, and item factor weights were beyond 0.7, validating convergent accuracy (Hair et al. 2017). The Heterotrait–Monotrait (HTMT) rate method was employed to verify discriminant validity (Henseler et al., 2014). An HTMT rate below 0.90 is considered precise and is more stringent than the commonly accepted Fornell–Larcker criterion (Fornell & Larcker,1981) for assessing this validity (Hair et al. 2012; Henseler et al., 2014). The obtained HTMT rates were less than 0.85 threshold, affirming discriminant validity. With Q^2 values over zero, satisfactory predictive relevance levels were recognized for the endogenous structure, measured at 0.644 (Geisser 1974; Stone 1974). The standard root mean residual (SRMR) for the model fit stood at 0.049, falling beneath the established benchmark of 0.9 (Hair et al., 2017).

4.3 Structural Model

As illustrated in Figure 2 pertaining to public transport, PLS-SEM evaluates the five relationships using 5,000 bootstrap resamplings (Hair et al., 2017). The R^2 value, which denotes the accounted variance of endogenous latent variables within the structural model, displays a behavioral intention of 48.0% (Hair et al., 2020) (see Figure 2). For relationships, perception of air quality for using public transport ($\gamma = 0.106$, $p < 0.01$), climate change mitigation ($\gamma = 0.402$, $p < 0.001$), subjective well-being ($\gamma = 0.097$, $p < 0.05$), knowledge of smart apps ($\gamma = 0.101$, $p < 0.01$), and usefulness of mobile applications ($\gamma = 0.253$, $p < 0.001$) positively influence behavioral intention.

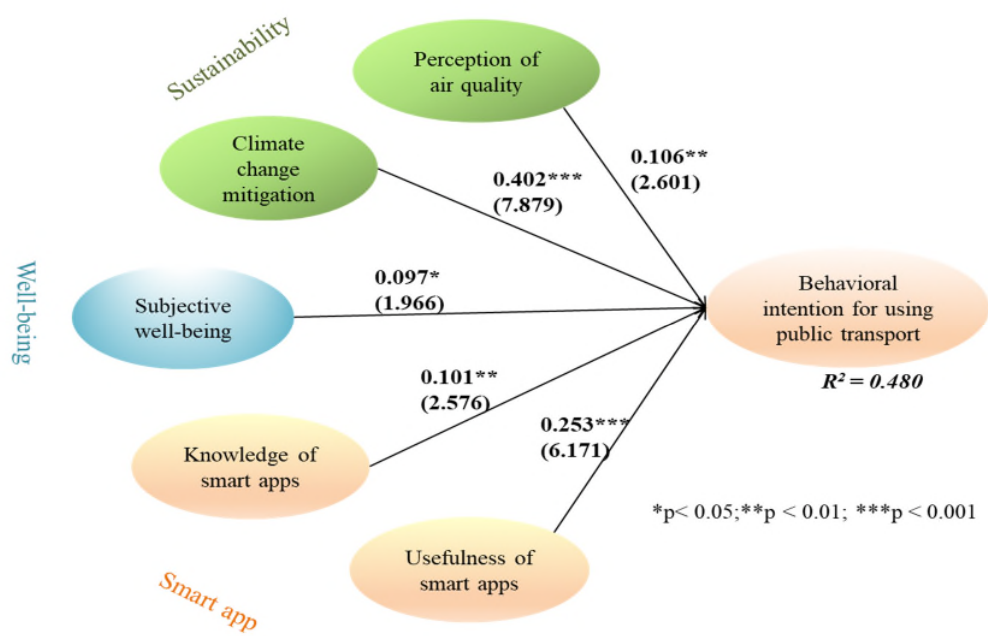

Fig 2. Results of path analysis: Public transport

Concerning active transport, due to the non-normal distributions observed by kurtosis in the data, PLS-SEM was utilized to examine the five relationships. The R^2 value indicates a behavioral intention for adopting active transport at 65.2% (see Figure. 3). To analyze the non-normally distributed sample, PLS-SEM bootstraps with 5,000 resamplings were utilized to access the path coefficients as well as the computed t-statistics for the relationships (Hair et al. 2017). Factors such as perception of air quality (γ = 0.196, p < 0.001), efforts towards climate change lessening (γ = 0.407, p < 0.001), and subjective well-being (γ = 0.360, p < 0.001) have a substantial impact on behavioral intention. However, knowledge of smart apps (γ = -0.006, p > 0.05) and usefulness of smart apps (γ = 0.060, p > 0.05) have insignificant impacts on behavioral intention.

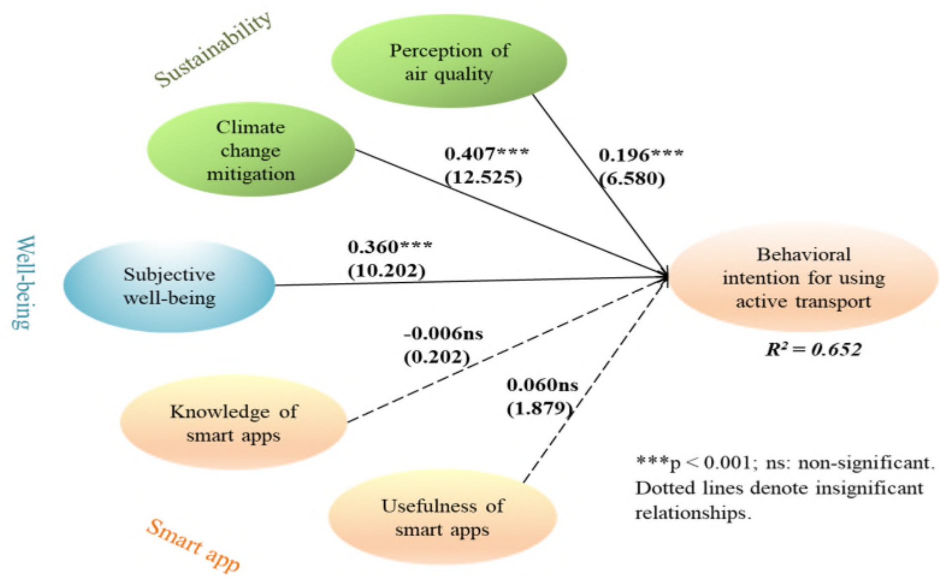

Fig. 3. Results of path analysis: Active transport

4.4 Multi-Group Analysis

Utilizing the MGA approach (Ringle et al., 2022), the researchers contrasted the five relationships between urban and non-urban residents concerning public transport (Figure 4). The study's model reveals that the urban group possesses a higher predictive capacity (R^2) at 51.0%, compared to 46.3% for the non-urban group. The relationships—ranging from the perception of air quality to behavioral intention, efforts towards climate change mitigation to behavioral intention, subjective well-being to behavioral intention, familiarity with smart apps to behavioral intention, and the utility of mobile applications to behavioral intent—are not meaningfully varied, as detailed in Supplementary L.

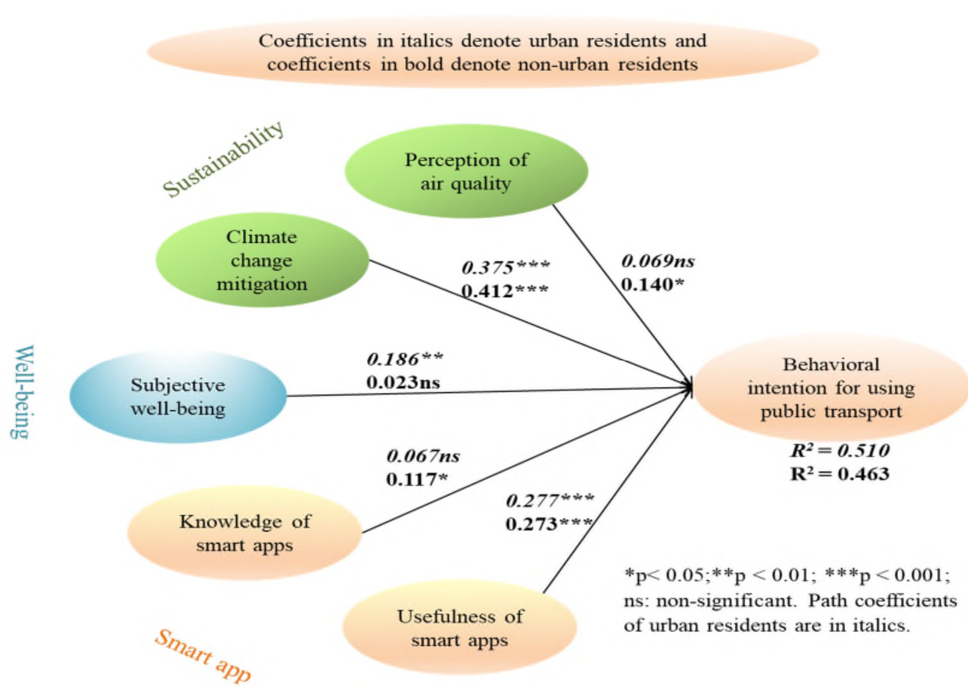

Fig. 4. Comparing urban and non-urban residents: Public transport

For the five relationships related to active transport, the influence of city and non-urban groups as moderators is explored in Supplementary M and Figure 5. Variances in variance between city and non-urban participants are evaluated using explained variance (R^2) as outlined by Hair et al. (2020). The non-urban group, with an R2 of 65.9%, slightly outperformed the urban group's R2 of 65.4%. The relationships, which span from perception of air quality to behavioral intention, efforts towards climate change mitigation to behavioral intention, subjective well-being to behavioral intention, familiarity with smart apps to behavioral intention, and the utility of smart apps to behavioral intention, do not show significant variations.

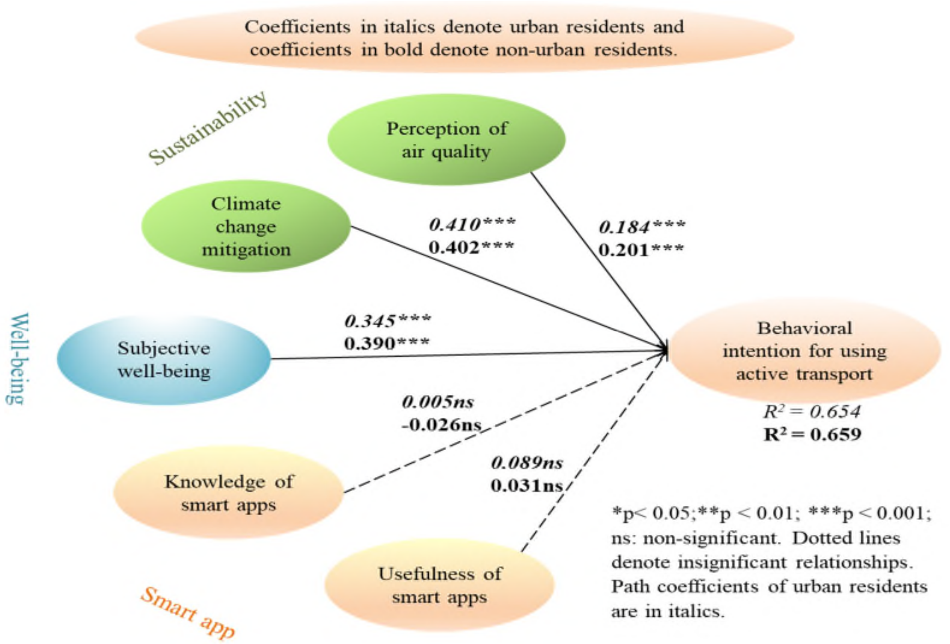

Fig. 5. Comparing urban and non-urban residents: Active transport

4.5 Fuzzy-Set Qualitative Comparative Analysis

For public transportation, perceived air quality as well as mobile application usefulness are necessary for urban as well as non-urban group (Supplementary N). A solution for both urban and non-urban groups is perceived air quality*usefulness of smart apps to produce high level of behavioral intent for using public transportation. For urban residents, five solutions are air quality*pursuing climate change alleviation; air quality*~subjective well-being; pursuing climate change alleviation *personal well-being*usefulness of smart apps; pursuing climate change mitigation*~knowledge of smart apps*usefulness of smart apps; *and* ~pursuing climate change mitigation*~subjective well-being*knowledge of smart apps*usefulness of smart apps to produce high level of behavioral intention. On the other hand, for non-urban residents, four solutions are perception of air quality*~knowledge of smart apps; subjective well-being*~knowledge of smart apps*usefulness of smart apps; air quality*~pursuing climate change*~personal well-being; *and* ~subjective well-being*knowledge of smart apps*usefulness of smart apps to induce high level of behavioral intention (Supplementary O).

For active transport, perceived air quality is necessary for urban as well as non-urban group (Supplementary P). Solutions for urban as well as non-urban groups are perceived air quality*usefulness of mobile applications *and* subjective well-being*knowledge of smart apps*usefulness of mobile applications in order to stimulate high level of behavioral intention for active transport use. With the urban residents, solutions are air quality*pursuing climate change alleviation *personal well-being *and* ~subjective well-being*~knowledge of smart apps*usefulness of smart apps in order to induce high level of behavioral intent to use active transportation. With the non-urban residents, solutions are perception of air quality*subjective well-being; perceptions of air quality*~knowledge of smart apps; ~pursuing climate change mitigation*subjective well-being; *and* ~subjective well-being*~knowledge of smart apps*usefulness of smart apps to bring high level of behavioral intent of using active transportation. Pursuing climate change mitigation seems important to urban residents, and subjective well-being seems vital for non-urban residents with active transport use (Supplementary Q).

MGA and fsQCA are based on different assumptions and methods, which may lead to detecting different patterns. FsQCA considers combinatorial effects and is more sensitive to subgroup differences compared to MGA. The fsQCA results reveal nuances in how factors like climate change mitigation and well-being influence transport intentions differently for urban and non-urban residents. The implications are that sustainable transport strategies should be tailored to urban and non-urban contexts based on the configurations identified. Using multiple analytical approaches provides a more comprehensive understanding of complex phenomena like sustainable transport behavior.

The fsQCA results suggest that both cultural and infrastructural factors likely contribute to the differences observed between urban and non-urban residents' sustainable transport intentions. For urban residents, pursuing climate change mitigation is a key driver, possibly reflecting greater exposure to climate messaging and initiatives, as well as more visible air quality impacts and supportive infrastructure in cities. In contrast, for non-urban residents, subjective well-being is a more significant factor, potentially indicating the importance of individual well-being considerations in the context of limited transport options and longer travel distances. Cultural differences in lifestyles, social norms, and the role of tourism may also shape motivations, with non-urban residents focused more on leisure and personal satisfaction, while urban residents prioritize fitness and smart app use. Although further research is needed to fully unpack these contextual influences, the findings highlight the need for sustainable transport strategies that consider the cross-cutting effects of culture and infrastructure in promoting mode shifts across diverse geographic contexts.

5. Conclusion and Implications

5.1 Discussion

This study investigated the factors influencing behavioral intention for using sustainable tourism mobility (i.e., sustainable tourism transport). The study found that sustainability, well-being, and smart app influence behavioral intention, and that urban and non-urban residents differ over public and active transport use. The results of this research offer valuable perspectives for promoting as well as encouraging sustainable tourism transport and mobility use in non-urban areas, especially for daytrips. Based on the PLS-SEM, behavioral intention for using public transport was most influenced by climate change mitigation, followed by usefulness of smart apps, perception of air quality, knowledge of smart apps, and subjective well-being. The results largely align with previous research on sustainability, well-being, and smart apps (Di Dio et al., 2018; Kim et al., 2020b; Olya et al., 2023). In terms of R square value, the urban residents exhibit a stronger predictive capability in this study's model compared to the non-urban residents. However, the relationships between sustainability (air quality and climate change alleviation), personal well-being, knowledge and usefulness of smart apps with behavioral intention are insignificantly different over urban and non-urban residents. The results are only partially consistent with literature on public transport for tourism in urban and non-urban areas (Dickinson & Robbins, 2008; Juschten & Hössinger, 2021; Le-Klähn & Hall, 2015) and the study's research question.

By the ANC, public transport users' perception of air quality as well as usefulness of mobile applications are necessary for urban as well as non-urban areas. For both urban as well as non-urban groups, a combination of perceived air quality and the usefulness of mobile applications can lead to increased behavioral intent to use travel public transportation. For urban residents, numerous factors contribute to increased intent to utilize public transportation for travel purposes, including combinations of sustainability (air quality perception as well as climate change alleviation) efforts; air quality perception and inverse subjective well-being; climate change mitigation, subjective well-being, and smart app usefulness; climate change mitigation, inverse smart app knowledge, and smart app usefulness; and inverse relationships with climate change mitigation, subjective well-being, smart app knowledge, and usefulness. Conversely, for non-urban residents, increased behavioral intention is influenced by factors such as the perception of air quality and inverse smart app knowledge; subjective well-being, inverse smart app knowledge, and smart app usefulness; air quality perception, inverse climate change pursuit, and inverse subjective well-being; and inverse subjective well-being, smart app knowledge, and smart app usefulness.

With regard to the demographic analysis, urban active transport users are often educated, single, high-income females using it for health and well-being and employing smart apps, while non-urban users are typically married males engaging in active transport for leisure, tourism, and personal satisfaction, often accompanied by family. Regarding PLS-SEM, climate change mitigation influences the most behavioral intention for using active transport, followed by subjective well-being and perception of air quality, while knowledge of and usefulness of smart apps have insignificant impacts on active transport user behavior. The results of this study largely align with existing research on sustainability, well-being and smart apps (Di Dio et al., 2018; Kim & Hall, 2022c; Singleton, 2019). Concerning MGA, the non-urban residents had slightly greater R square than the urban residents to predict active transport user behavior. However, the relationships between behavioral intention and elements like air quality and efforts towards climate change alleviation, personal well-being, smart app knowledge, and usefulness are all insignificantly different for urban and non-urban residents. These findings somewhat deviate from previous literature (Gronau, 2017; Smith et al., 2019; Tomej & Liburd, 2020).

Grounded upon the ANC, perception of air quality is necessary for urban and non-urban group related to active transport. Solutions for urban and non-urban groups include perceived air quality and smart app usefulness, as well as the combination of subjective well-being, smart app knowledge, and usefulness, to encourage a strong inclination towards behavioral intention for active transport use. For urban residents, the combination of sustainability (air quality perception and climate change alleviation efforts), personal well-being, and inverse relationships with subjective well-being, smart app knowledge, and usefulness can lead to increased behavioral intention to use active transport. For non-urban residents, solutions include combining air quality perception with subjective well-being, air quality perception with the absence of smart app knowledge, the inverse of climate change mitigation efforts with subjective well-being, and the inverse of subjective well-being with the absence of smart app knowledge and app usefulness, to promote a strong inclination towards behavioral intention for using active transport. Also, of interest with respect to market segmentation, according to demographic analysis, urban public transport users tend to be older educated males with active transportation habits and climate change concerns, while non-urban users are often females who prefer domestic tourism, private cars, and express concerns for both climate change and public health/well-being.

This study contributes to a more comprehensive and contextualized understanding of sustainable transport adoption in urban and non-urban settings. The findings also underscore the importance of tailoring theoretical frameworks and intervention strategies to the specific geographic, cultural, and infrastructural realities of different communities to effectively promote sustainable mobility transitions.

5.2 Theoretical Contributions

The research applies fsQCA to investigate differences between the tourism transport behaviors of urban and non-urban residents and has several theoretical contributions. First, the study provides insights into the variations between urban and non-urban areas residents' behavioral intentions to sustainable mobility for tourism, expanding the understanding of how various factors influence sustainable tourism transport usage depending on residential location, whereas most prior studies primarily concentrate on the context of the destination. Second, by applying PLS-SEM and fsQCA methodologies, the research demonstrates the applicability of these methods to examine complex connections among different elements and their influence on sustainable transport use by Korean tourists. Third, the study underscores the significance of considering active as well as public transport in developing sustainable transport solutions, particularly for non-urban areas, which are under-researched and have limited public transport. Fourth, the study contributes to the understanding of how sustainability (air quality and climate change alleviation), personal well-being, smart apps, and sustainable transport interact and influence domestic tourists' mobility choices, particularly in less urbanized areas. Fifth, by providing practical implications for stakeholders, the research emphasizes the need for sustainable public transport development and innovative solutions to address the challenges faced by tourists in less urbanized destinations for tourism proposes.

5.3 Practical Contributions

In order to enhance sustainable mobility solutions in non-urban areas, the practical and/or managerial contributions of the research are as follows: First, this research highlights the need for sustainable public transport development in less urbanized areas, which can help stakeholders such as tourism authorities, local governments, local residents, and transport providers prioritize investments in infrastructure and services to improve accessibility and sustainability. Second, by identifying the differences in behavioral intention to use sustainable transport between urban and non-urban residents, the study helps transport planners, destination marketing organizations (DMOs), and policymakers tailor their strategies to better meet the needs as well as preferences of varied clusters of tourists, including leisure and travel excursionists, resulting in more effective and targeted interventions for non-urban tourism destinations. Third, the authors emphasize the significance of taking into account both active as well as public transport solutions for leisure travelers, informing stakeholders of the potential benefits of integrating these modes of transport for more sustainable and appealing tourism experiences. Fourth, the study emphasizes the importance of smart apps in encouraging sustainable transport use among tourists, suggesting that tourism authorities and public transport providers should invest in user-friendly and informative applications to facilitate route planning, booking, and ticketing for public transport options. Fifth, the findings on the associations between sustainability (air quality and climate change mitigation), subjective well-being, knowledge and usefulness of smart apps, and public/active transport use can help stakeholders develop better targeted campaigns and communication strategies to encourage sustainable transport use among tourists visiting less urbanized tourist destinations. Finally, a better understanding of market segments and their sustainable transport perceptions and behaviors may greatly improve marketing of pubic and active transport and encourage new sustainable transport initiatives, especially in non-urban areas.

In sum, to translate the study findings into practice, tourism authorities and transport providers should invest in user-friendly smart apps with personalized features, tailored marketing campaigns for different segments, and partnerships with local stakeholders to co-design integrated sustainable mobility solutions. Securing dedicated funding streams, supportive policies, and robust impact monitoring systems is also critical for long-term success. Specific initiatives could include promoting cycling routes connecting tourist sites with public transport hubs, implementing congestion charges or parking restrictions in sensitive areas, and regularly engaging diverse stakeholders to refine strategies based on evidence. By providing concrete examples grounded in the research insights and addressing potential implementation challenges, policymakers and industry practitioners can better translate the findings into tangible actions to enhance sustainable transport adoption in different tourism contexts.

5.4 Limitations and Future Research Directions

Regarding the limitations of this work, first, the authors focus on Korean tourists, which might restrict the applicability of the results to other populations and/or regions. Cultural, social, and infrastructural differences may lead to different results in other contexts. Secondly, the research employed a cross-sectional approach, which may not capture the potential changes in transport behavior over time or the impact of interventions to promote sustainable transport use. Accordingly, longitudinal studies or experimental would help in understanding the dynamics of sustainable transport adoption. Third, the study may not consider all factors that could influence the sustainable tourism mobility behavior of urban and non-urban residents, such as income, education, and accessibility to different modes of transport. Including additional factors that might provide a more comprehensive understanding of the determinants of sustainable transport behavior, particularly for non-urban areas. Lastly, fsQCA involves some degree of subjectivity in the calibration of fuzzy-set membership scores. This may influence the results and limit reproducibility.

With regard to future research directions, similar research should be conducted in different nations to ascertain the broader applicability of the findings and identify situation -specific factors that influence eco-friendly transportation use in non-urban tourism destinations. Second, a longitudinal approach could provide insights into the factors driving changes in mobility behavior, as well as the effectiveness of interventions to promote sustainable transport use. Third, future research could explore additional factors that might influence sustainable transport behavior, such as the length of travel. This would help develop a more comprehensive understanding of the determinants of sustainable transport behavior. Fourth, employing other analytical techniques, such as multi-level modeling or structural equation modeling, could provide additional insights into the relationships between the factors influencing sustainable transport behavior and help validate the findings. Fifth, evaluating interventions aimed at promoting sustainable transport use would provide evidence-based recommendations for policymakers and practitioners. Moreover, research on the role of smart apps, especially those applicable to both public and active transportation, and other technologies in promoting sustainable transport use could provide insights into how technology can help overcome barriers to sustainable transport adoption, especially in non-urban areas. Furthermore, future research may need to include possible moderating, mediating, and/or intervening variables to better understand residents' sustainable transport behavior in non-urban destinations. Finally, due to the methodological limitations of potential biases in online survey responses, future research may consider undertaking expert interviews, especially from public transport providers, to gain their perspectives on sustainable tourism mobility.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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