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ASSOCIATION BETWEEN GENDER AND OPINION ABOUT SMART CITY

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Purpose: The paper aims to provide new insights into the opinions of women and men about selected smart city areas.
Design/methodology/approach: The study was conducted using CATI and CAWI methods, involving respondents from two Polish cities — Szczecin and Koszalin. The survey assessed participants' opinions of various aspects of smart cities through the analysis of four chosen areas. The analysis is based on quantitative data, where Chi-square test for independence was utilised.
Findings: In Szczecin, the first hypothesis yielded significant relationships, indicating that the opinions of specific smart city areas are indeed influenced by residents' gender. In contrast, the data from Koszalin revealed two significant relationships, indicating that opinions may be more susceptible to gender-based variations.
Research limitations/implications: A limitation of the study is that it is based solely on respondents from two cities, which may restrict its generalizability to other regions. The study is a pilot study. Future research could consider diverse locations, additional demographic factors, and an in-depth analysis of the relationship between gender and subjective opinions on various areas of smart cities.
Practical implications: The findings of the study may be utilized by city managers in designing urban spaces that more effectively meet the diverse needs of women and men. Such an approach can contribute to increased acceptance of initiatives and greater resident satisfaction.
Social implications: Incorporating a gender perspective into urban planning promotes more inclusive and informed decision-making, contributing to the development of spaces that meet the needs of all residents, thereby strengthening social cohesion and supporting sustainable development.
Originality/value: The study provides an innovative perspective on the diverse perceptions of urban innovations by women and men, contributing to the literature on urban space management from a gender perspective and residents' quality of life.
Keywords: smart city, citizens, gender.
Category of the paper: research paper.

1. Introduction

It is projected that in the coming decades, global cities will become the primary place of residence for the majority of the world's population, which has traditionally inhabited rural areas (Beyer, 2020; Tumwesigye et al., 2021; Wen et al., 2020). According to the UN report *World Urbanization Prospects: The 2018 Highlights*, by 2050 approximately 70% of the global population will reside in urban areas, indicating an increase in migration from rural to urban regions (World…, 2019). Such transformations necessitate rethinking how contemporary cities can meet the diverse needs of their residents. Jacobs noted as early as 1958 that a city must be designed with people in mind, not just buildings. Her approach emphasized the importance of accounting for differences in the experience of urban space by its users, including from a gender perspective (Jacobs, 1992).

The concept of a smart city, though lacking a unified definition, has gained recognition as a modern approach to addressing the challenges of contemporary urban areas. In literature, this concept is the subject of extensive discussion, influenced by geopolitical context and researchers' specific areas of interest. A smart city can be understood as a space that leverages modern technologies and data analytics to sustainably meet residents' needs, respond to social challenges, and support urban development (Albino et al., 2015; Mora et al., 2017; Nam, Pardo, 2011; Schaffers et al., 2012). Currently, this concept is widely applied worldwide, including in Polish cities that are actively implementing smart solutions to improve the quality of life for their citizens (Alaverdyan et al., 2018; Alshamaila et al., 2024; Bitkowska, Łabędzki, 2021; Boichuk, 2021; Caprotti, 2019; Caragliu et al., 2009; Krasowska et al., 2023; Mikucki, 2021; *Smart City Observatory,* 2024; Winkowska, 2021). Three key phases of smart city development are distinguished, starting from Smart City 1.0 and progressing through subsequent stages up to Smart City 4.0 (Cohen, 2015; University of Opole, Kauf, 2020).

The creation and development of smart cities pursues various objectives. However, a contemporary priority is to ensure equal conditions for all residents to participate in decision-making processes. This is particularly crucial in cities marked by spatial segregation and inequalities (Bastos et al., 2022; Leclercq, Rijshouwer, 2022; Tran Thi Hoang et al., 2019).

While technology-related goals are an essential component of smart city development, the primary focus today is on creating human-centered environments that meet residents' needs. A successful smart city requires not only technological contributions from officials and companies but also active engagement from the community (Leclercq, Rijshouwer, 2022; Tran Thi Hoang et al., 2019).

For city administrators, citizen participation provides valuable support, driving economic growth in a way that respects residents' needs while promoting sustainable urban development. The opportunity for residents to express their views enhances their awareness of co-creation (Capdevila, Zarlenga, 2015; Sikora-Fernandez et al., 2012; Wiścicka-Fernando, 2024).

Urban spaces are inhabited by diverse communities with varying social and demographic characteristics, such as age, education, social status, physical attributes, and gender. Analyzing residents in terms of gender is particularly valuable, as it serves as a key factor differentiating urban populations. Examining the city from a gender perspective reveals significant differences between men and women, particularly in how they perceive and evaluate the functionality of smart cities. Researchers focusing on gender differences indicate that these distinctions may manifest, for example, in cognitive abilities and life preferences (Fine, 2010; Meyers-Levy, Loken, 2014).

An analysis of women's and men's preferences in utilizing urban space reveals that, despite similarities in economic activities, their differences in space usage can and should inform urban planning decisions made by city authorities (Jo et al., 2020).

Diverse expectations of women and men regarding urban space can shape their perceptions of their living environment, engagement in decision-making processes, and opinions on the implementation of modern urban technologies. This, in turn, influences residents' evaluations of these solutions' effectiveness. In introducing innovative technologies aimed at improving residents' quality of life, city managers should consider the varied needs and preferences of both genders. Possessing such data enables the adaptation of public space enhancements to be equally effective and satisfactory for both women and men. Therefore, it seems essential to undertake research that provides insights into the similarities and differences in opinions held by women and men, which is the primary objective of this paper.

2. Methods

A pilot survey was conducted in 2021 by the authors, who employed CATI and CAWI interview methods to gather data from a random sample of 427 residents of Szczecin and Koszalin, the largest cities in Poland's West Pomeranian region. The data were analyzed using the Chi-square test for independence, which was employed to assess the relationships between variables. The primary data were collected through a structured questionnaire designed to capture various aspects of the participants' opinions about selected smart city areas.

Participants were invited to indicate their level of agreement or disagreement with the statements presented to them on a five-point Likert scale. The scale ranged from 1 (strongly disagree) to 5 (strongly agree), with 2 (disagree), 3 (neutral), and 4 (agree) representing intermediate positions. This format allowed respondents to express varying degrees of agreement or disagreement with specific statements.

The survey assessed participants' opinions of various aspects of smart cities through the analysis of four specific areas. Firstly, the integration of modern technologies within the intelligent city (m1) was evaluated, with a particular focus on the contribution these

advancements make to urban life. Secondly, respondents were invited to share their opinions on the capacity of intelligent cities to enhance the quality of life for residents in response to their evolving needs (m2). Thirdly, the utilization of data technologies (m3) to address social challenges within the intelligent city framework was explored, with a particular focus on the proactive role of technology in problem-solving. Finally, the survey addressed the smart city's commitment to working for the benefit of future generations (m4), emphasizing the importance of sustainable practices in urban planning.

To guide the study, a conceptual framework was created (Figure 1).

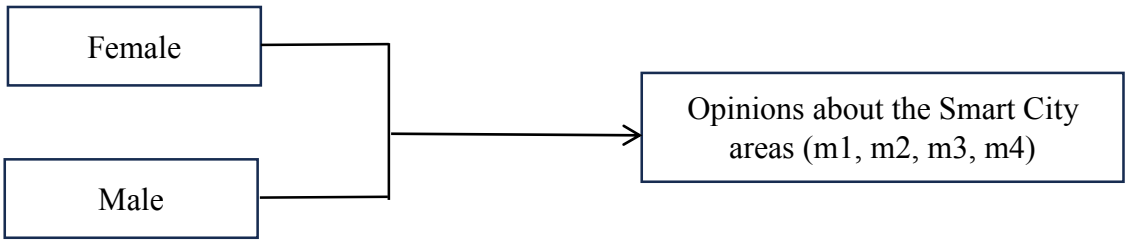

Figure 1. Conceptual framework of the study.

Source: own study.

The Chi-square test was used to assess the relationship between gender and the four areas of a smart city, where H_{0x} represents the null hypothesis, and H_{ax} is the alternative hypothesis. Hypotheses 1 to 4 pertain to the city of Szczecin, while hypotheses 5 to 8 relate to the city of Koszalin. The formulated statistical hypotheses are as follows:

H_{01}: There is no association between the gender of the residents of Szczecin and their opinion about the area 'the smart city uses modern technologies'.

H_{a1}: there is an association between the gender of residents of Szczecin and their opinion about the area 'the smart city uses modern technologies'.

H_{02}: There is no association between the gender of the residents of Szczecin and their opinion about the area 'the smart city improves the quality of life of the residents according to their changing needs'.

H_{a2}: There is an association between the gender of the residents of Szczecin and their opinion about the area 'the smart city improves the quality of life of the residents according to their changing needs'.

H_{03}: There is no association between the gender of the residents of Szczecin and their opinion about the area 'the smart city's capacity for analyzing, monitoring and utilizing data'.

H_{a3}: There is an association between the gender of the residents of Szczecin and their opinion about the area 'the smart city's capacity for analyzing, monitoring and utilizing data'.

H_{04}: There is no association between the gender of the residents of Szczecin and their opinion about the area 'the smart city's commitment to working for the benefit of future generations'.

H_{a4}: There is an association between the gender of the residents of Szczecin and their opinion about the area 'the smart city's commitment to working for the benefit of future generations'.

H_{05}: There is no association between the gender of the residents of Koszalin and their opinion about the area 'the smart city uses modern technologies'.

H_{a5}: there is an association between the gender of residents of Koszalin and their opinion about the area 'the smart city uses modern technologies'.

H_{06}: There is no association between the gender of the residents of Koszalin and their opinion about the area 'the smart city improves the quality of life of the residents according to their changing needs'.

H_{a6}: There is an association between the gender of the residents of Koszalin and their opinion about the area 'the smart city improves the quality of life of the residents according to their changing needs'.

H_{07}: There is no association between the gender of the residents of Koszalin and their opinion about the area 'the smart city's capacity for analyzing, monitoring and utilizing data'.

H_{a7}: There is an association between the gender of the residents of Koszalin and their opinion about the area 'the smart city's capacity for analyzing, monitoring and utilizing data'.

H_{08}: There is no association between the gender of the residents of Koszalin and their opinion about the area 'the smart city's commitment to working for the benefit of future generations'.

H_{a8}: there is an association between the gender of residents of Koszalin and their opinion about the area 'the smart city's commitment to working for the benefit of future generations'.

3. Results

The pilot study comprised a sample of 427 participants, with 225 individuals from Szczecin and 202 from Koszalin. In Szczecin, the gender distribution was 118 females and 107 males, while in Koszalin, there were 129 females and 73 males. This demographic breakdown enabled an analysis of opinions on smart city areas across various gender and regional contexts. The approach taken in the regional survey was designed to ensure that the sample accurately reflected the demographics of the West Pomeranian population. By employing rigorous sampling techniques, the study aimed to enhance the validity of its findings and ensure that the results are generalizable to the wider community. This methodological framework is critical for understanding the opinions of residents in this particular region (Bazarnik et al., 1992).

The Chi-square test is a statistical method used to determine whether there is a significant association between categorical variables. In this study, Chi-square tests were used to assess the relationships between the responses of residents in Szczecin and Koszalin regarding different smart city areas. The researchers wanted to understand how gender and location might influence opinions about smart city areas. The results are presented in Table 1 (Szczecin) and Table 2 (Koszalin).

Table 1.
Chi-Square test summary - Szczecin

Sample	Hypotheses	Chi-square test statistic	df	α	p-value	Observation	Decision
Szczecin (n = 225)	H_{01}	11.04	4	0.05	0.026	p-value < α	Reject the null hypothesis
	H_{a1}						
	H_{02}	5.12	4	0.05	0.275	p-value > α	Fail to reject the null hypothesis
	H_{a2}						
	H_{03}	6.92	4	0.05	0.140	p-value > α	Fail to reject the null hypothesis
	H_{a3}						
	H_{04}	1.86	4	0.05	0.762	p-value > α	Fail to reject the null hypothesis
	H_{a4}						

Source: Field survey 2021.

A Chi-square test of independence showed that there was no association between the gender of the residents of Szczecin and their opinion about the area 'the intelligent city improves the quality of life of the residents according to their changing needs' (m2), $\chi 2$ (4, N = 225) = 5.12, p > .05. There was no association between the gender of the residents of Szczecin and their opinion about the area 'the intelligent city uses data technologies to solve social problems' (m3), $\chi 2$ (4, N = 225) = 6.92, p > .05. There was no an association between the gender of the residents of Szczecin and their opinion about the area 'the intelligent city works for future generations' (m4), $\chi 2$ (4, N = 225) = 1.86, p > .05. However, there is an association between the gender of residents of Szczecin and their opinion about the area 'the intelligent city use of modern technologies' (m1), $\chi 2$ (4, N = 225) = 11.04, p < .05.

The next step was to analyze the results of the study for the city of Koszalin.

Table 2.
Chi-Square test summary - Koszalin

Sample	Hypotheses	Chi-square test statistic	df	α	p-value	Observation	Decision
Koszalin (n = 202)	H_{05}	4.87	4	0.05	0.301	p-value > α	Fail to reject the null hypothesis
	H_{a5}						
	H_{06}	8.51	4	0.05	0.075	p-value > α	Fail to reject the null hypothesis
	H_{a6}						
	H_{07}	14.54	4	0.05	0.006	p-value < α	Reject the null hypothesis
	H_{a7}						
	H_{08}	18.81	4	0.05	0.001	p-value < α	Reject the null hypothesis
	H_{a8}						

Source: Field survey 2021.

There is no association between the gender of residents of Koszalin and their opinion about the area ‘the intelligent city use of modern technologies’ (m1), $\chi 2$ (4, N = 202) = 4.87, p > .05. There was no association between the gender of the residents of Koszalin and their opinion about the area ‘the intelligent city improves the quality of life of the residents according to their changing needs’ (m2), $\chi 2$ (4, N = 202) = 8.51, p > .05. Nevertheless, there was an association between the gender of the residents of Koszalin and their opinion about the area ‘the intelligent city uses data technologies to solve social problems’ (m3), $\chi 2$ (4, N = 202) = 14.54, p < .05. Finally, there was an association between the gender of residents of Koszalin and their opinion about the area ‘the intelligent city works for future generations’ (m4), $\chi 2$ (4, N = 202) = 18.81, p < .05.

4. Discussion

The survey examined participants' opinions of smart cities by analyzing four key areas. Firstly, the integration of modern technologies (m1) was evaluated, with a particular focus on the extent to which these innovations contribute to the enhancement of urban living. The analysis reveals a statistically significant association in Szczecin between residents' gender and their opinions on the use of modern technologies within the intelligent city framework. This suggests that gender plays a crucial role in shaping residents' opinions on technological advancements. In contrast, no such association was found in Koszalin, where the Chi-square test result indicates that gender does not significantly impact residents' views on this aspect of the intelligent city. Thus, while gender influences opinions on technological integration in Szczecin, it appears to be a neutral factor in Koszalin. This discrepancy between the two cities may reflect varying socio-cultural contexts or levels of technological engagement among residents. Research by Aguirre-Urreta and Marakas supports the notion that gender differences in technology use may diminish over time, particularly as younger generations grow up in increasingly technology-pervasive environments (Aguirre-Urreta, Marakas, 2010). This indicates that while gender may influence technology perceptions in some contexts, it may not hold the same weight universally, as seen in the case of Koszalin. No relationship between gender and attitudes towards modern technology was also confirmed by research on mobile usage. No relationship between gender and attitudes towards modern technology was also confirmed by research on mobile usage (Fernando, Misiak-Kwit, 2023).

For the area assessing whether the smart city improves residents' quality of life according to their changing needs (m2), the Chi-square test of independence indicated no association between residents' gender and their opinions in both cities. These findings resonate with existing literature that emphasizes the multifaceted nature of smart city initiatives and their varying impacts on different demographic groups. Moreover, Lytras and Visvizi argue for

an interdisciplinary approach to smart city research, suggesting that understanding the diverse needs of residents is crucial for effective policy-making (Visvizi, Lytras, 2018). This perspective reinforces the notion that while individual characteristics, such as gender, may play a role in technology adoption, they do not necessarily dictate perceptions of quality-of-life improvements in the context of smart cities.

For the area assessing the smart city's capacity for analyzing, monitoring, and utilizing data to address social issues (m3), results differed between Szczecin and Koszalin regarding the association with residents' gender. In Szczecin, the Chi-square test showed no significant association between gender and residents' opinions on the smart city's use of data technologies for social problem-solving, indicating that gender does not impact these views. However, in Koszalin, there was a significant association between gender and opinions on this topic, suggesting that in Koszalin, gender plays a role in shaping perspectives on the smart city's application of data technologies to address social challenges. These findings are consistent with the literature on smart cities and public perceptions of technology. Rijshouwer et al. emphasize the importance of understanding public views on smart cities, noting that perceptions can be influenced by local socioeconomic contexts and how technology is integrated into governance (Rijshouwer et al., 2022). This aligns with the results from Koszalin, where gender differences may reflect deeper societal attitudes toward technology and governance. Furthermore, Istambul and Abinowi highlight the necessity of effective information technology governance in smart city applications, suggesting that the success of such initiatives depends not only on technology but also on how well they are perceived and accepted by the community (Istambul, Abinowi, 2019). This is particularly relevant in Koszalin, where gender appears to influence opinions on the smart city's data utilization, suggesting that governance structures may need to be more inclusive to address diverse perspectives.

In examining the smart city's commitment to benefiting future generations through sustainable urban planning (m4), the results varied between Szczecin and Koszalin in terms of gender influence on residents' opinions. In Szczecin, no association was found between gender and opinions on the smart city's use of data technologies for sustainable planning, indicating that gender does not impact residents' views in this area. This finding aligns with the notion that effective urban planning can create inclusive environments where both men and women feel equally represented and engaged in the planning process (Buyana, Shuaib, 2014). The participatory approach in urban planning, as highlighted by Buyana and Shuaib, emphasizes the importance of involving both genders as partners in shaping urban agendas, which can enhance community ownership and livability (Buyana, Shuaib, 2014). Conversely, in Koszalin, there was a significant association between gender and opinions on this topic, suggesting that in Koszalin, gender influences how residents perceive the smart city's dedication to sustainable practices for future generations. This aligns with the findings of Basbas et al., who argue that gender differences in mobility and urban experiences can influence how individuals perceive urban policies and initiatives (Basbas et al., 2023). In Koszalin,

the differing views may stem from local social dynamics that affect how men and women engage with urban planning processes. Rivera's research on grassroots movements in Medellín illustrates how women's perspectives can be marginalized in urban renewal projects, reinforcing the need for gender-sensitive approaches in urban planning (Rivera, 2020). Moreover, the importance of gender-sensitive planning is further supported by the work of Mela, who emphasizes that addressing safety and inclusivity in public spaces from a gender perspective is vital for enhancing the quality of urban life (Mela, Tousi, 2023). This suggests that in Koszalin, the differing opinions may reflect broader societal issues related to gender equity in urban environments. The findings underscore the necessity for urban planners to consider gender dynamics in their strategies to ensure that sustainable urban development benefits all residents equitably. In summary, the contrasting results from Szczecin and Koszalin highlight the complex interplay between gender and perceptions of sustainable urban planning.

5. Summary

The aim of the paper was to provide new insights into the opinions of women and men about selected smart city areas.

A comparison of the results from Szczecin and Koszalin reveals the presence of distinct patterns. The results from Szczecin showed a single significant association between the hypotheses, while those from Koszalin demonstrated two significant associations. This indicates that the perceptions of the smart city areas may diverge considerably between the two urban populations, reflecting the varying impacts of the implemented innovations and urban policies. The results underscore the necessity for bespoke strategies to address the distinctive requirements of residents in each city.

A limitation of this study is its reliance solely on respondents from these two cities Szczecin and Koszalin, which may restrict the generalizability of the findings to other regions. Due to its pilot nature, this study serves as an initial exploration of the issue. Future research could benefit from incorporating a broader range of locations, additional demographic variables, and a more comprehensive analysis of the relationship between gender and subjective perceptions of various aspects of smart cities.

The findings of this study provide valuable insights into how smart city areas are perceived by residents of both genders, offering practical guidance for city administrators in designing urban spaces that better account for the diverse needs of women and men. Such an approach can enhance the acceptance of innovative urban initiatives and overall satisfaction among residents of both genders. Incorporating a gender perspective into urban planning supports more inclusive and informed decision-making, contributing to the development of spaces that meet the needs of all residents, thereby strengthening social cohesion and promoting sustainable

development. This study offers an innovative perspective on the differentiated perceptions of smart cities by women and men, making a valuable contribution to the literature on urban space management from a gender-sensitive perspective and enhancing our understanding of the quality of life in urban settings.

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