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EXPLORING GENDERED WALKING BEHAVIOR AND ENVIRONMENT PERCEPTION IN HERITAGE CITY: THE CASE OF GULANGYU, CHINA

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Abstract

Gender differences in walking may manifest as disparities in walking behaviour and perception. However, there is a lack of a comprehensive study on walking behaviour between gender and their differences in the environment perception in Chinese heritage cities. Some Chinese heritage cities, like Gulangyu, China are car-free destinations where walking is an essential transportation mode. However, many previous studies suggest that women may be more inclined to fatigue due to intense walking or perceive a greater threat while walking. The inequality of gender in walking has led to the need for gender studies to receive more attention in Chinese heritage cities with car-free destinations. This study explores gender differences in walking behaviour and perception of Chinese heritage cities, intending to create a healthier and more comfortable walking environment for both males and females. Therefore, the data for this study were analyzed using SPSS software, employing ordered regression models and independent sample t-tests. The findings indicate that males are more likely to engage in walking behaviour than females, and they also rate the walking environment higher than females in Gulangyu, China. Moreover, males rated comfort higher than females. These results suggest disparities in walking behaviour and environmental perceptions between male and female walkers in Gulangyu, emphasizing increased attention to healthy walking behaviour and perceptions of females in Chinese heritage cities.

Keywords: Female; Gender; Walking behaviour; Environment perception; Chinese heritage city

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INTRODUCTION

Walking activity is widely recognized as beneficial for physical and mental health (Vich et al., 2019). Growing research focuses on pedestrian walking behaviour and the perception of the walking environment, aiming to promote healthier walking habits. Gender research has emerged as a crucial aspect in previous studies exploring walking perception and behaviour (Pollard & Wagnild, 2017). In this context, 'gender' pertains to masculinity and femininity in the biological sense (Tcymbal et al., 2020). Research findings indicate that gender differences in walking activities manifest in behaviour and environmental perception. For instance, variations exist in daily walking distances, overall environment satisfaction, and perceptions of safety, comfort, and other factors between males and females (Pirra et al., 2023). The design and construction of urban environments can influence the walking activities and experiences of both males and females (Park & Garcia, 2020). Therefore, it is crucial to identify which environmental factors may impact males and females differently.

Walking is often considered a suitable physical activity for females due to its minimal requirement for muscular strength (Kavanagh & Bentley, 2008). Repeated exposure of females to the environment can increase their engagement in walking activities and foster a sense of belonging to the area (Ivory et al., 2015). Female-friendly urban environments serve as catalysts for females' healthy walking behaviours. However, studies indicate that females in 159 out of 168 countries have lower physical activity levels than males (Ding et al., 2016; Talmizi et al., 2022). This disparity in physical activity between genders may stem from various factors, such as differences in physical fitness and social norms (Kavanagh & Bentley, 2008). Compared to males, females require more attention and consideration in walking.

Walking is a significant mode of heritage appreciation, yet research focusing on walking in heritage cities is still lacking (Wang & Wong, 2020). Heritage cities are characterized by their rich history. They are protected under the Tangible Cultural Heritage Convention and regional heritage policies. Heritage cities in China are also subject to the constraints of the Heritage Convention and heritage protection policies at the provincial and municipal levels where the heritage sites are located. Many cities feature narrow historic pathways with distinctive surroundings and interiors (Nayan et al., 2022). In China, the siting of heritage cities is influenced by concepts such as Feng Shui and Taoism, with a keen emphasis on environmental beauty and the distinct characteristics of historical cities (Zheng et al., 2018). During the era when these cities were established, motorization had not occurred, resulting in the construction of narrow, winding roads and a dense network of thoroughfares. China contains 56 World Heritage Sites, including 38 World Cultural Heritage Sites, 4 Dual World Cultural and Natural Heritage Sites, and 14 World Natural Heritage Sites. Nine cities and villages fall under the designation of heritage cities and villages,

including Beijing, Pingyao, Lijiang, the southern Anhui villages of Hongcun and Xidi, Macau, Kaiping, Gulangyu, Liangzhu, and Quanzhou. Many Chinese heritage cities, especially the delineated core and buffer zones, are car-free destinations like Lijiang and Gulangyu.

Research on gender differences in walking is relatively few in China (Shen, 2019). Existing studies on gender and walking in China primarily focus on major cities such as Beijing and Shanghai. Research on gender and walking in heritage cities remains largely unexplored. Zhang's (2008) study on gender travel behaviour in Beijing revealed that males primarily commute for work and rely more on cars, and females do more shopping and leisure walking (Zhang, 2008). Furthermore, Lei's master thesis (2015) analyzed gender differences in walking behaviours within the urban block of Chongqing. It concluded that street diversity influenced male travel patterns, while safety considerations impacted female walking behaviours (Lei, 2015).

Based on the theoretical background presented above, limited conclusions regarding behavioural and perceptual differences among pedestrians of different genders in car-free heritage cities in China. Chinese heritage cities serve as residential communities and tourist destinations where walking behaviour and environmental perception research provide the basis for improving psychological feelings and promoting healthy walking among pedestrians. Gender study has concluded for male and female walking needs, offering guidance for walking among genders in Chinese heritage cities and providing recommendations for the sustainable development of the historic environment.

LITERATURE REVIEW

Walking in Heritage Cities

The literature and urban development show the importance of pedestrian paths for cities (de Freitas Miranda & da Silva, 2012). Lack of walking in cities will cause numerous issues, including traffic safety, personal health, and environmental pollution (Ewing et al., 2003). Although many studies have confirmed the relevance of walking to the environment, it is still a subject worthy of study for cities and communities, especially heritage cities. "World Heritage City" was defined as an urban settlement where one or more World Heritage properties would be located (Roders, 2010). The legacy city is a unique sort of city with values that other cities cannot replace. Historical locales, environments, and structures with conventional and regional features are valuable in history, culture, and the arts. There is little research on the pedestrian environment and the walking experience in heritage areas in China, with most existing walking research focusing on neighbourhood and community scales and little attention paid to the inner heritage areas (Li et al., 2020).

Walking Research in Gender Difference

The topic of females' perceptions of public amenities and environments has garnered more interest in scholarly research on walking behaviour (Hidayati et al., 2020). According to Rodríguez and Joo (2004), there is a perception that females are more susceptible to vulnerability in outdoor activities, resulting in a 72 to 83% lower likelihood of utilising non-motorized ways compared to males. According to a study conducted by Agrawal and Schimek (2007), it has been observed that males tend to cover greater distances while walking in comparison to females. Nevertheless, several research have indicated that there is a higher level of engagement in leisure walking among females compared to males (Ball et al., 2001). According to Bengoechea et al. (2005), the provision of affordable or no-cost recreational amenities inside the community can also promote autonomous walking among females, separate from their male counterparts. In addition to the study of walking activity, numerous academics have focused their investigations on the relationship between gender and the perception of walking. Several studies have identified disparities in the walking requirements between males and females (Salvo et al., 2018). According to Humpel et al. (2004), there is a belief among researchers that there exist distinct walking requirements for males and females. The study aims to examine the various aspects that influence walking behaviours in both genders. The impact of various walking settings on individuals differs according on their gender, with females exhibiting greater concerns regarding aesthetics, safety, and accessibility compared to males (Ball et al., 2001; Humpel et al., 2004; Pirra et al., 2023).

Females also exhibit greater concern for walking at night and traffic safety (Bengoechea et al., 2005; Lalonde et al., 2019). Females are often more sensitive to environmental safety risks and are more likely to alter their walking behaviour due to feelings of unease (Clifton & Livi, 2005; Herrmann-Lunecke et al., 2021). Without company, females may walk less recreationally because of safety concerns (Ball et al., 2001). Females are less likely than males to be satisfied with walking path facilities (Pirra et al., 2023). In addition, females may also bear a greater responsibility for household and childcare, which adds difficulty to their walking trips (Eyer & Ferreira, 2015). While safety factors may not significantly influence males' walking behaviour, nearby park facilities in the community may encourage more males walking (Foster et al., 2004).

Walking Behaviour and Perception of Environment Factor

It is widely recognized that social and physical environments can influence physical activity levels (Frank et al., 2010). Published research has demonstrated that the physical environment can enhance physical activity and promote healthier walking behaviour (Herrmann-Lunecke et al., 2021). In many studies, participants' daily walking duration and distance are assessed as indicators of their physical activity levels (Tan et al., 2020).

Environmental perception is subjective feelings and psychological judgments about the surrounding environment and its changes (Peng & Zhou, 2001). In many studies, findings on environmental perceptions are derived by investigating respondents' satisfaction with environmental factors. The environment in this study refers to the artificial and natural environment in a heritage city that pedestrians can feel, touch, and see. Many gender-based studies on walking have concluded that there are differences in the perception of safety between different genders. However, other walking research factors, like function and comfort, may influence pedestrians' satisfaction with the environment (Arellana et al., 2020). In this study, to explore which factors may contribute to gender differences in pedestrian perceptions in Chinese heritage cities, we reviewed 35 articles published after 2000, focusing on identifying the factors that impact walking most. Based on the most frequently mentioned items in the literature, the researcher categorized these items-- function, safety, comfort, aesthetic, and pleasure (Table 1).

Table 1: The Frequency of Environmental Factors Associated with Walking

Factors	Items	Frequency	Main Authors
Function	Accessibility	10	(Arellana et al., 2020; Erna & Amin, 2016; Lee et al., 2016)
	Sidewalk quality	8	
	Sidewalk presence	7	
	Sidewalk width	6	
	Obstructive	4	
	Slop	3	
	Barrier-free facilities	3	
Safety	Walking safety	12	(Southworth, 2005; Zakaria & Ujang, 2015)
	Lighting	6	
Comfort	Walking facility	7	(Alfonzo, 2005; Erna & Amin, 2016; Tan et al., 2020)
	Walking comfort	6	
	Street furniture	5	
	Shade	4	
	Cleanliness	3	
Aesthetic	Green/Tree	13	(Cain et al., 2014; Gorrini & Bertini, 2018; Humpel et al., 2004)
	Building frontage	6	
	Building feature	6	
	Attractive	4	
	View	4	
Pleasure	Public space	9	(Ozbil et al., 2019; Yang et al., 2019; Zang et al., 2020)
	Walking pleasurable	4	

Source: Literature

Function, safety, comfort, aesthetics, and pleasure that may influence environmental perception were selected based on the summarization and screening of the above literature. The definition and range of factors included in these five factors are summarized from the literature. Function: The sidewalk's

accessibility, condition, and walking quality (Ozbil et al., 2019). Safety: A person feels safe from the threat of crime, traffic, or disorder (Southworth, 2005). Comfort: Walking comfort comes mainly from the perception of nature, like climate, and men-made comforts, such as shade, cleanliness, etc. (Alfonzo, 2005). Aesthetic: Aesthetics include environmental appeal (natural beauty, public art, etc.) and architectural elements (colour, height, age, etc.) (Cain et al., 2014). Pleasurable: Pleasantness is among the factors influencing walking, with public recreational facilities, squares, green spaces, etc. (Ozbil et al., 2019).

RESEARCH METHODOLOGY

Research Area

The research is in Gulangyu, Fujian Province, China (Figure 1). It is an island with an area of 1.91 km2 and a population of 12.59 million. In July 2017, Gulangyu entered the World Heritage List under the 'Historical International Community' theme. Gulangyu is an island across the sea from Xiamen and is connected to Xiamen by ferry, with no bridges or roads for vehicles. Gulangyu is famous for being a pedestrian island, and walking is the only mode of transport. A study of gender differences in the walking behaviour and perceptions of Gulangyu's walkers will help to understand the perceptions of male and female walkers of their environment and activity behaviour in this pedestrian area. This study provides evidence for promoting healthy walking among male and female pedestrians in Chinese heritage cities and offers recommendations for creating a human-friendly environment in Gulangyu.

Figure 4: Research Area
Source: Google Maps,2022

Participants and Data Collection

This study administered a questionnaire to walkers in Gulangyu to investigate the relationship between walking behaviour and environmental perceptions. The

questionnaire consisted of three parts. The first part was to collect basic information about the respondents, gender, age, and education. The second part evaluated the walkers' perceptions of the environment, divided into an overall evaluation and an evaluation of five environmental factors. The overall evaluation of indicators was evaluated using a 5-point Likert scale. The environmental factors were evaluated on a two-level scale, with respondents choosing 'yes' if they felt the factor affected their walking experience. The third section surveyed respondents' walking behaviour, focusing on their average distance and daily walking time.

The survey was conducted in January and June 2022, using a random sampling method for the questionnaire. The survey locations were chosen randomly in different areas of Gulangyu, such as the pier, the centre square, the stores, and the streets. Since residents and tourists are primary walkers on Gulangyu, both groups are considered respondents for this study. Sample sizes are calculated based on the number of residents and tourists in Gulangyu—determination of sample size by the Krejcie and Morgan method (Krejcie & Morgan, 1970). According to the 2022 statistics, Gulangyu's inhabitants are approximately 12,590. Therefore, for N = 10,000, S = 370 (N is the population size, and S is the sample size). The number of visitors to Gulangyu in 2022 is about 2.21 million per year (>1 million), so the minimum sample size is 384. The Confidence Level and Margin of error were considered 95% and + or - 5%, respectively. The researcher are 341 distributed 781 questionnaires and recovered 753 valid questionnaires during the survey period. Of the valid questionnaires, 372 were residents, and 381 were tourists. The gender of the respondents was randomly selected in the survey. Finally, there male and 412 female respondents.

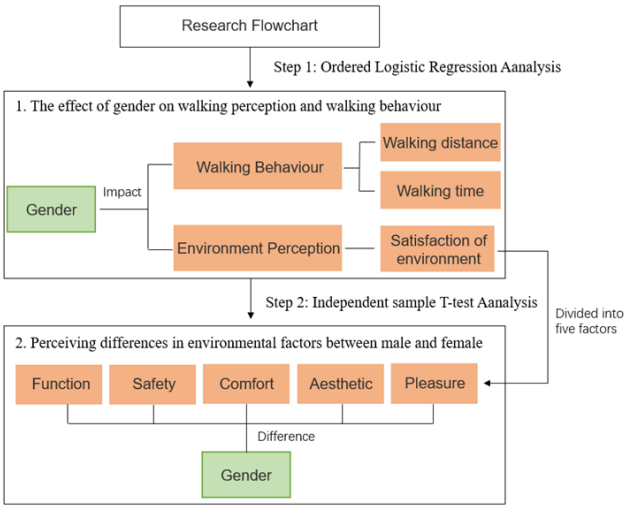

Figure 2: Research Flowchart

Statistical Analyses

The data analysis for this study was divided into two main steps, both of which were completed using SPSS 26 (2019) (Figure 2). The first step began by using ordered logistic regression analysis to derive the effect of respondents' gender on walking behaviour and perceptions. The first logistic regression step shows the level of gender influences walking behaviour and perceptions. The second step explores the differences in perceptions of environmental factors between males and females. This step uses an independent samples t-test, showing which environmental factors differ in gender.

RESULT

The Participants' Demographics

In this survey, there were 341 male and 412 female respondents. Most respondents in this survey were in the 21-30 age group, while fewer people were over 61 years old. The proportion of males and females in the other age groups was similar. Secondly, most of the respondents in this survey were educated above high school, with the largest number of people with bachelor's degrees. The education level indicates that most respondents can understand and perceive this survey. The ratio of males and females regarding age and education is consistent with the overall distribution pattern.

Table 2: The Participants' Demographics

		Overall=753		**Male=341**		**Female=412**	
		n	**%**	**n**	**%**	**n**	**%**
Age	11-20	84	11.16	38	11.14	46	11.17
	21-30	364	48.34	179	52.49	185	44.90
	31-40	182	24.17	76	22.29	106	25.73
	41-50	73	9.69	27	7.92	46	11.17
	51-60	29	3.85	11	3.23	18	4.37
	61+	21	2.79	10	2.93	11	2.67
Education	Primary School	14	1.86	8	2.35	6	1.46
	Junior Middle School	66	8.76	30	8.80	36	8.74
	Senior Middle School	132	17.53	60	17.59	72	17.47
	Diploma	148	19.65	60	17.59	88	21.36
	Bachelor Degree	297	39.44	135	39.59	162	39.32
	Master's Degree and above	96	12.75	48	14.08	48	11.65

Source: Author's Calculation

The Descriptive Analysis of Walking Behavior

Respondents in Gulangyu were surveyed on their daily walking time and distance, and their walking behavioural status was stated using descriptive analysis (Figure 3). Most respondents in Gulangyu walked 1-2 hours daily, and more walked 3-6 km. It is a relatively healthy time and distance of physical activity (Lee & Buchner, 2008). There is a difference in walking behaviour

between respondents of different genders. The proportion of females is higher than males for walking distances of 0-6km and walking time of 0-2 hours. The proportion of males is higher than females walking over 6km and 2 hours. In summary, women were likelier to walk fewer hours and distances, while more men than women walked longer hours and distances daily.

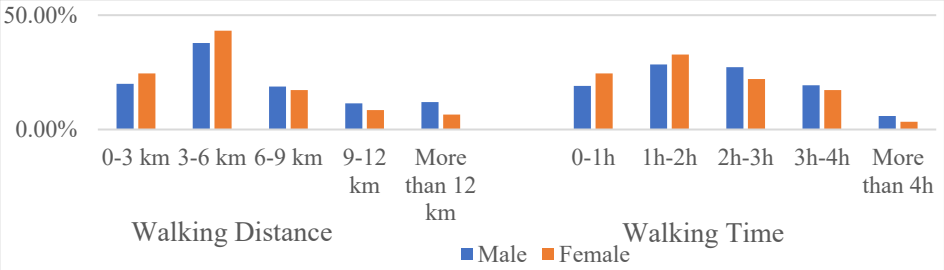

Figure 3: The Walking Distance and Time for Males and Females in Gulangyu
Source: Author's Calculation

The Ordered Logistic Regression Analysis

Ordered logistic regression models verify the causal relationship between the independent and dependent variables. The independent variable X denotes the factors that may have an effect, and the dependent variable Y denotes the levels of a measurement scale (Harrell & Harrell, 2015). The regression coefficients from the ordered logistic regression analysis predict the relationship between the categorical variables and one or more variables (Bender & Grouven, 1997). In the other gender walking research, logistic regression analysis was also used to compare male and female walking behaviour and perception (Foster et al., 2004).

This study assumes that walkable distance, walking time, and perception of the environment are all influenced by gender. The perception of the environment is rated from 1-5, indicating very unsatisfactory, unsatisfactory, general, satisfactory, and very satisfactory. Walking distance is also divided into five categories, from 1-5, indicating the average daily walking distance of 0-3km, 3-6km, 6-9km, 9-12km, and above 12km. A walking time scale of 1-5 reflects respondents walking for less than 1 hour, 1-2 hours, 2-3 hours, 3-4 hours to more than 4 hours per day. As the three dependent variables, walking distance, walking time, and overall evaluation of the environment, are all categorical variables, the ordered logistic regression model was applied to regression models where the dependent variable was categorical.

In the result of Ordered Logistic Regression, B (β - Coefficient) represents the coefficients in the model, also known as regression coefficients. OR (Odds Ratio) means quantifying each independent variable's impact and is the exponential function of the "B" value. The OR represents the odds ratio of two different levels or categories of a single independent variable. CI (Confidence

Interval) stands for Confidence Interval and measures the uncertainty associated with parameter estimates. According to the results in Table 3, the OR for the effects of gender on perception of the environment, walking distance, and walking time is 1.510, 1.493, and 1.400 for males, indicating that males are longer than females in terms of walking distance and time and are more satisfied with their environment than females. The likelihood of walking distance, time, and satisfaction increasing by one level is 1.400-1.510 times greater for males than females. The data means that males are more likely to increase the distance and length of their walks and are more likely to be satisfied with their environment.

Table 3: Ordered Logistic Regression for Perception, Walking Behaviour, and Gender

		B	OR	OR value of 95% of CI	p-value
Threshold (Environment perception)	[EP = 1]	-4.841	0.008	0.003-0.019	0.000
	[EP= 2]	-4.248	0.014	0.007-0.028	0.000
	[EP= 3]	-1.504	0.222	0.177-0.279	0.000
	[EP = 4]	1.156	3.177	2.572-3.924	0.000
Gender	Male	0.412	1.510	1.140-2.000	0.004
	Female	0	1.000	---	--
Threshold (Walking distance)	[WD = 1]	-1.072	0.342	0.279-0.419	0.000
	[WD = 2]	0.723	2.061	1.698-2.500	0.000
	[WD = 3]	1.649	5.201	4.156-6.509	0.000
	[WD = 4]	2.505	12.247	9.231-16.249	0.000
Gender	Male	0.401	1.493	1.149-1.939	0.003
	Female	0	1.000	--	--
Threshold (Walking time)	[WT = 1]	-1.115	0.328	0.267-0.402	0.000
	[WT = 2]	0.272	1.313	1.091-1.581	0.004
	[WT = 3]	1.390	4.015	3.249-4.961	0.000
	[WT = 4]	3.221	25.052	17.340-36.194	0.000
Gender	Male	0.346	1.400	1.093-1.829	0.008
	Female	0	1.000	--	--

Source: Author's Calculation

Perceiving Differences in Environmental Factors in Male and Female

Next, the analysis is conducted to determine if there are differences in people's perceptions by gender on the five factors of function, safety, comfort, aesthetics, and pleasure, and the results can guide the process of specific environmental enhancement. The analysis is carried out through independent sample t-tests. The t-test has also been used in other studies investigating gender differences in physical activity. (Tester & Baker, 2009).

The test results in Table 4 show a significance level of 0.009 for the comfort factor to test for differences between male and female perceptions of the environment in Gulangyu. Therefore, there is a statistically significant difference between males and females for the mean of the comfort factor (t= -2.606, p= 0.009). Furthermore, based on the negative t-value, it can be concluded that females perceive comfort factors to be more important than males. On the other

hand, function, safety, aesthetics, and pleasure are not gender-specific. However, as can be seen from the results in the table, males generally consider road function more important than females. In other research findings, it has been suggested that males are more concerned about road width than females (Sapawi & Said, 2012). In contrast, more females consider the three factors of safety, comfort, and aesthetics to influence their perception of the environment and the pleasurable factor to be approximately equal in the ratings of males and females.

Table 4: The Independent Samples T-test for the Environment Perception and Behaviour According to Gender

Environment perception	T-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Function	0.996	751	0.320	0.036	-0.035	0.108
Safety	-1.572	751	0.116	-0.057	-0.128	0.014
Comfort	-2.606	691.885	0.009	-0.084	-0.147	-0.021
Atheistic	-0.484	751	0.629	-0.015	-0.074	0.045
Pleasure	-0.015	751	0.988	-0.001	-0.072	0.071

Source: Author's Calculation

DISCUSSION AND FINDINGS

According to the results of this study's description analysis on walking behaviour and ordered logistic regression model, it is also proven that males in Gulangyu are more likely than females to walk in terms of walking behaviour. According to the regression model results, males were about 1.40 to 1.49 times more likely than females to increase walking distance and time by one level (e.g., from 3-6 hours to 6-9 hours). However, according to a review of studies on gendered walking (Pollard & Wagnild, 2017), females under 60 do more leisure walking than males (Beenackers et al., 2013). And a phenomenon attributed to the fact that females may have more childcare and family responsibilities (Pollard & Wagnild, 2017). Without categorizing the purpose of walking (recreational and purposeful walking), there are no obvious conclusions regarding the relationship between walking activity and gender (Pollard & Wagnild, 2017). However, some of these findings are similar to the present study, with males walking more than females (Eyler et al., 2003), partly because they tend to work closer to home than males (Pollard & Wagnild, 2017). As Gulangyu is a car-free destination, work and leisure activities rely on walking. Males may be more likely to be responsible for household financial income and therefore have more walking activities.

Furthermore, according to the logistic regression model results, males are more likely to rate the perceived environment of Gulangyu higher than females, with an OR of 1.51. It means that males in Gulangyu are more likely to feel satisfied with the environment, while females are less satisfied than males. In other findings, it was also concluded that females were harder to be satisfied

with the walking facilities (Pirra et al., 2023). Therefore, it is important to pay attention to the psychological needs of pedestrians, particularly females, in developing the walking environment and facilities in car-free heritage cities.

Next, five environmental factors are tested for gender differences, and the results are that comfort differed significantly by gender. Some researchers have also mentioned that females have a higher need for comfort. For instance, it has been found that males tend to feel more comfortable in hot weather conditions during walking compared to females (Jin et al., 2019). In addition to gender differences, comfort factors seem to be highly important in Gulangyu. In the study conducted by Li (2020), it was discovered that comfort significantly influenced the walking perception of residents in Gulangyu (Li et al., 2020). The findings of this study also reveal the unique importance of comfort for walkers in Gulangyu, particularly for females. Enhancing the perception of comfort requires the provision of more shading, resting areas, and signage systems, which can help alleviate physical and weather-related concerns for females during walking.

Both previous research and the results of this study highlight the importance of aesthetics and safety for females (Garrard et al., 2008; Humpel et al., 2004; Ortoleva & Brenman, 2004). According to the results of this study, there is no significant gender difference between safety and aesthetics in the independent sample t-test, but a greater number of females feel that safety and aesthetics are more influential in their perception of the environment when walking. The aesthetics of Gulangyu are generally good, with the island surrounded by the sea, covered by a high density of vegetation, and the majority of its historic buildings well-maintained and harmonious overall. As a World Heritage Site, more attention is paid to the city's natural and artificial aesthetics. The security of Gulangyu comes from the full CCTV coverage and the mandatory security checks before visitors enter the island by ferry. Therefore, Gulangyu's aesthetic and safety advantages lead to different results on these two factors regarding gender than previously concluded. But comfort is a factor that needs to be taken into account, and in particular, the factors affecting the comfort experience of females need to be further researched to provide a better walking experience for walkers in Gulangyu.

CONCLUSION

This study examines people's walking behaviour and perceptions of the walking environment in the absence of car travel in Chinese heritage cities. It explores gender differences in walking behaviour and environmental perceptions. This study enriches the findings of heritage city walking studies and provides a reference for enhancing heritage environments to develop Chinese heritage cities into more walkable communities and tourist destinations. Our findings allow us also to draw some practical conclusions (Figure 4):

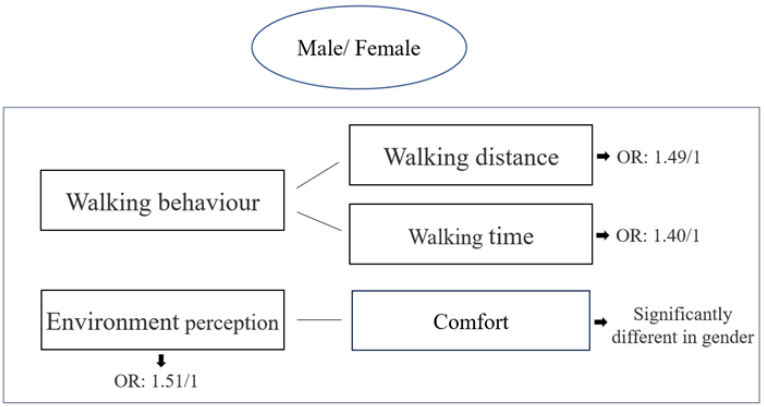

Figure 4: The Gender Differences in Walking Behaviour and Perception

Most respondents walked within a healthy time and distance range of 1-2 hours and around 3-6 km daily. The proportion of females walking for short periods and short distances is higher than males, with longer walking times and distances being more common for males in Gulangyu (Foster et al., 2004). Males are more likely than females to walk for longer periods and distances, with a likelihood ratio of 1.49:1 and 1.40:1. Overall, the findings of this study are consistent with previous research, which indicates that males tend to have better physical fitness compared to female, resulting in higher levels of walking activity (Agrawal & Schimek, 2007). Males are 1.51 times more likely than females to be satisfied with their perception of the environment.

Only the comfort factor shows a significant difference in perception by gender. The perception scores for the three factors of safety, comfort, and aesthetics are lower for females than for males. The result means that when walking in heritage cities, females are more likely to show dissatisfaction with safety, comfort, and aesthetics, especially regarding the comfort factor. Improvements in safety, comfort, and aesthetics for female pedestrians in heritage cities can be achieved through various measures, including adequate lighting for nighttime visibility, the provision of shade and resting facilities for enhanced comfort, and the integration of plants and historic architecture to enhance the visual appeal of the environment.

The attention and maintenance of walking conditions for females are crucial for the sustainable development of urban systems (Pirra et al., 2021). Promoting walking activities in heritage cities should consider the specific needs and preferences of both males and females, providing a basis for future environmental improvements and sustainable development in heritage cities. Based on this study, promoting healthy walking and environmental enhancements in Chinese heritage cities should prioritize considering females' requirements for environmental comfort, aiming to encourage more females to engage in healthy

physical activities. There are also certain limitations to this study. The current study did not specify the types of walkers for residents and tourists, purposeful walking, leisure walking, etc. Also, environmental perception factors were not broken down into detailed factors in this study, and exactly which comfort factors differed by gender will need to be discussed further in future studies.

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