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Systematic Review

A Systematic Review of Government Measures to Improve Age-Friendly Transportation in the U.S., U.K., Japan, and China

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Abstract: The global population is aging, and many countries face the daunting challenge of improving their social service systems to accommodate the shift. As global aging increases, the travel needs of older persons are becoming more pronounced. Given this, there is now an urgent need to create and enforce efficient actions to reconcile the incompatibility of the current transportation networks with the growing demand for travel by the elderly. In light of this context, the United States, the United Kingdom, Japan, and China are used as examples in this study. It adopts a literature review analysis method based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines to systematically review and analyze the efforts of the four countries to address the challenges of aging mobility in five dimensions, namely, laws and regulations, planning and design, policy measures, transportation infrastructure and services, and technology development. This review illustrates the similarities, distinctions, and difficulties that each nation faces in advancing the development of an age-friendly transportation environment by contrasting and evaluating the real-world experiences of the four nations. Accordingly, countermeasures and recommendations, such as stepped fare concessions and attention to the psychological adaptation of older persons in technological innovations, are proposed.

Keywords: population aging; policy; age-friendly transportation; mobility

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1. Introduction

The global population is undergoing a massive demographic transition, with increasing longevity and declining fertility rates leading to a world with a smaller labor force and more older people [1]. According to the United Nations' official definition, a nation is considered to have entered an "aging society" when the proportion of elderly individuals 65 (or 60) and older exceeds 7% (or 10%) of the total population. Concerning the international standards, this paper refers to the aging society when the proportion of the percentage aged 65 and above exceeds 7%, representing the stage of mild aging; when the proportion of the population aged 65 and above is greater than 14%, it is called the aged society, representing the stage of medium aging; when the proportion of the population aged 65 and above exceeds 20%, it is called the super-aged society, representing the stage of super-aging. According to the United Nations, the global population aged 65 and over is expected to rise from 10% to 16% between 2022 and 2050 [2]. From 2000 to 2023, the global population aged 65 and over increased by more than 830 million [3].

The aging situation in different countries and regions presents various characteristics and development trends. Most developed countries have long entered the aging society. By 2023, for instance, about one-third of the population in Japan was elderly, and roughly one-fifth of the population in the United States (U.S.) and the United Kingdom (U.K.) was 65 and over. With the rapid development of developing countries, some countries are aging faster than developed countries [4]. For example, China's elderly population aged 65 years or older accounted for as much as 14.3% at the end of 2023, officially entering the stage of a moderately aging society. The demographic change involves several challenges for human society, including social isolation, mobility, mental health, transportation, and many other aspects, so there is an urgent need to explore solutions to support healthy aging [5].

As the global population ages, the mobility needs of older persons are becoming more pronounced. The transportation needs of older persons are not homogenous but diverse and are influenced by a variety of factors. Many older people want to be able to travel independently. On the one hand, older people need to go out for unavoidable daily activities such as shopping and medical appointments in their independent lives; on the other hand, due to loneliness older people desire social participation activities such as recreation and visiting relatives as a way to avoid social isolation [6]. However, many older people face difficulties in traveling due to inadequate transportation facilities and public services. For example, older people who do not have a small car can only choose to travel on foot or by public transportation. This is especially true for older people with chronic mobility problems, who are affected by the unique circumstances at the intersection of aging and disability, and for whom neither walking nor public transportation is friendly [7]. The development of age-friendly transportation (e.g., shared mobility) as a sustainable transportation system has the potential to alleviate this situation.

In 2020, the United Nations General Assembly declared the decade 2021–2030 as the Decade of Healthy Ageing, emphasizing that policymakers around the world should focus their policies on improving the lives of older populations. In addition, the social isolation faced by older persons, which is an objective state of affairs in which individuals have less contact and interaction with friends, family, or the community, and lack fulfilling and quality social relationships, involves the impact of multiple and complex factors that cannot be fundamentally addressed at the individual level. Therefore, the development of appropriate government measures is a strong and fundamental guarantee to provide travel convenience for the elderly. Thus, the research perspective of this paper is a systematic review of governmental measures.

There are some successful cases of initiatives in developed countries in Europe and the U.S. For example, in 2007, the U.S. Environmental Protection Agency (EPA) and its sponsors implemented the four-year "Building Healthy Communities for Active Aging" (BHCAA) program. They set up a national program for building communities that promote active aging. BHCAA program, a four-year program, has established national achievement and commitment awards for community-building programs that promote active aging [8]. Since 2007, 15 US states' 21 commonality programs have been honored for their outstanding achievements or innovations in one or more age-friendliness-related fields. In contrast, China, the most populous developing nation, is concerned about the slower advancement of transportation systems to deal with the aging population.

A national strategy to aggressively address population aging is being implemented by the Chinese government, and part of this policy calls for a complete design of transportation laws that take into account the new issues that the aging society stage presents. Implementing suitable transportation policies will lessen the social exclusion of older people due to transportation, and promoting aging-friendly public transportation and active aging policies will offer the chance to keep older people socially integrated and avoid

social isolation [6]. Therefore, based on the relevant transportation policies of developed nations and the circumstances in China, the Chinese government should adopt appropriate transportation policies to encourage independent mobility among older persons.

So far, there is some literature examining the effects of population aging on the travel demand of the elderly and transportation policy enhancements [9]. Still, most of the studies come from developed countries. The design of age-friendly public transportation facilities and the protection of senior citizens are the main topics of the research that is currently available on aging and transportation development in China. These studies tend to be individual case studies centered on specific regional policies. Cross-cultural comparative studies are scarce in the literature, and the few that exist typically mainly address the issues that aging civilizations face in terms of national development. This approach overlooks the efforts made and the achievements attained by the authorities in addressing transportation issues amid the global trend of population aging.

Therefore, the contribution of this paper is to systematically review the literature on aging and sustainable transportation in four countries based on the PRISMA guidelines, taking the U.S., the U.K., Japan, and China as examples. Government measures are divided into five categories: laws and regulations, planning and design, policy measures, transportation infrastructures and services, and technological development. Accordingly, this paper evaluates and contrasts the four nations' efforts to cope with the aging and transportation problems. Finally, it offers countermeasure recommendations to provide critical practical references to China and developing countries that are about to enter an aging society.

2. Methodology

2.1. Systematic Literature Review Method

In this systematic review, we strictly followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [10]. Our review article has passed the PRISMA 2020 statement, and the registration number is CRD420251005861. To ensure the completeness and reproducibility of the study, we not only provide a detailed flow diagram (Figure 1) demonstrating the literature screening process, but also present the PRISMA checklist in the Supplementary Materials. Based on the normative requirements of the PRISMA guidelines, this review has developed a systematic research strategy that provides a strong guarantee of research transparency and methodological rigor. Using a structured research methodology, the Systematic Literature Review Method, this paper aims to comprehensively and objectively collect, organize, and conduct an in-depth evaluation of existing research findings in a specific and growing area of interest (mobility issues for older adults). This paper develops a meticulous search strategy based on a precisely articulated research question and scope to guarantee a thorough and impartial literature screening process. Subsequently, the screened high-quality literature was carefully scrutinized, and key information was extracted from it, including but not limited to the main findings, conclusions, and potential implications. To present these results more intuitively, charts and graphical tools were employed to convert intricate data and trends into an easy-to-understand visual presentation. Ultimately, this view concludes by offering a thorough analysis of the transportation policies and specific measures adopted at the national level to address the mobility of the elderly. aiming to offer a solid literature base and insights to promote further research and policy optimization in this area.

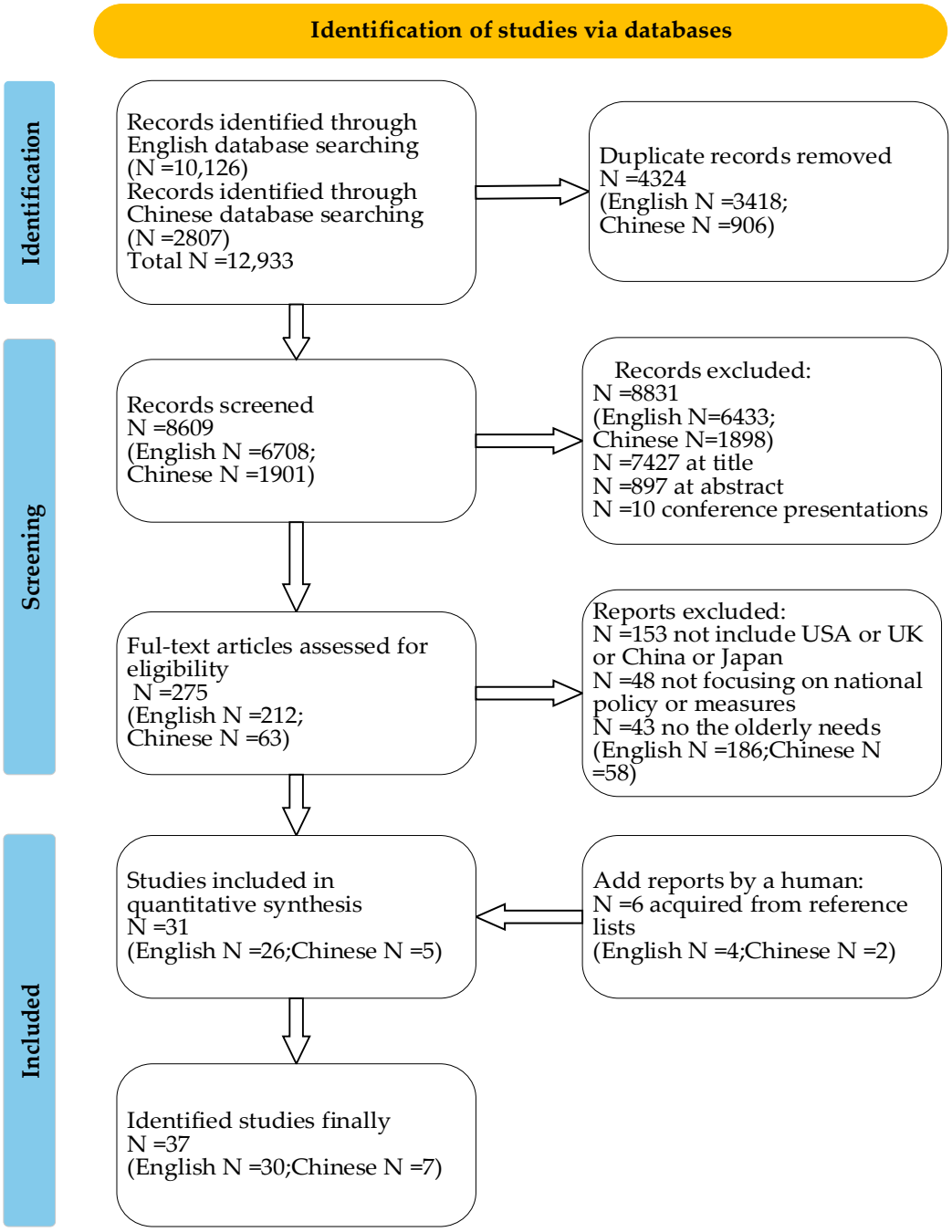

Figure 1. PRISMA flow diagram of the systematic review.

2.2. Search Strategy and Data Extraction

During the initial search process, a literature search was conducted using the Web of Science database, Scopus, ScienceDirect, Google Scholar, and the China Knowledge Infrastructure (CNKI) database; CNKI is a large-scale platform for disseminating and utilizing academic literature in China, which provides a rich service for searching and obtaining academic papers, journal articles, and other research materials. The literature included Chinese and English journal articles published after 2000 (conference papers, books, and other gray literature were excluded). Inclusion criteria focused on transportation policies and travel measures enacted in the U.S., the U.K., Japan, and China for people with disabilities and older adults and travel safety issues for older adults. The search terms used were as follows: [elderly or older people or senior or population aging or aging society or aging] AND [public transportation or transportation or travel or age-friendly

transportation or mobility or transportation policy] AND [U.S. or US or the United States or USA or America] AND [U.K. or UK or the United Kingdom or British or English] AND [Japan or Japanese] AND [China or Chinese]. Even though the database search turned up a lot of publications, many of them were disqualified from the review because they did not meet the inclusion and exclusion criteria specified in Table 1 and the search terms mentioned above. A total of 12,933 results were returned from the database search, including 10,126 English and 2807 Chinese articles, with 4324 duplicate records (comprising 3418 English and 906 Chinese articles) first excluded based on more detailed inclusion and exclusion criteria. Of the remaining 8609 articles, 7427 were screened by title, 897 were excluded based on their abstract, and 10 conference reports were excluded due to lack of depth and breadth; so, 275 articles were chosen to be included for further screening. The remaining 153 articles focusing on international agencies (e.g., WHO) rather than on the four countries selected for this paper were excluded. Additionally, 43 articles that did not focus on older people's mobility or social participation needs were excluded, resulting in the inclusion of 31 articles that could be evaluated. In addition, manual searches were conducted from the references of relevant articles and other sources, yielding four articles in English and two in Chinese. Therefore, we included 37 (30 English and 7 Chinese) articles for categorization in the final analysis. The review protocol and flowchart for literature retrieval are shown in Table 1 and Figure 1, respectively. To broaden the inquiry beyond older persons to include relevant topics like disability, we also carried out a manual search. Data were extracted independently by the authors using a standardized Excel file. We fully ascertained the qualifications and quality of the material we provide in this paper.

Table 1. Review protocol.

Items	Criteria
Research Problem	(1) What policies have been developed to address the mobility of the aging population? (2) What practical efforts have been made to build age-friendly transportation? (3) What are the research directions and key questions that need to be answered in the field of transportation and mobility for the elderly in future studies?
Inclusion Criteria	Research on transportation provision in an aging society from a policy perspective
Exclusion Criteria	Papers that do not discuss transportation policy; literature that does not focus on transportation for the elderly
Search Formula	[elderly or older people or senior or population aging or aging society or aging] AND [public transportation or transportation or travel or age-friendly transportation or mobility or transportation policy] AND [U.S. or US or the United States or USA or America] AND [U.K. or UK or the United Kingdom or British or English] AND [Japan or Japanese] AND [China or Chinese]

2.3. Selection Criteria for Countries

Population aging is not only affecting developed countries but is also gradually spreading to developing countries, posing a global challenge. Among them, Europe is the most advanced fastest aging, while Asia is aging at a faster pace with significant regional differences, especially in Japan. North America is at a moderate stage of aging, and the process is relatively stable. Africa and the Middle East have the lowest levels of aging, but with economic development and improved health care, the pace of aging is likely to accelerate in the future, facing the challenge of "aging before we are rich." Reviewing the history of population aging in countries worldwide, we find that the U.S. and the U.K. are characterized by "early entry and slow development". In contrast, Japan and China's development process of population aging is relatively fast, especially since Japan became an aging country in 1969 and became the world's most aging country in only 34 years.

As shown in Figure 2, GDP per capita has been on an upward trend in the U.S. since 1960; the U.K. and Japan have seen a significant increase in GDP per capita compared to the 20th century but a decline between 2020 and 2023, while China has experienced rapid economic development since 2000 but has ranked low in terms of GDP per capita. The U.K. and U.S. have been able to control the slow rise in aging while maintaining increasing GDP, compared to China's relatively rapid rise in aging as it rapidly develops its economy, and Japan's almost linear rise, which is highly informative.

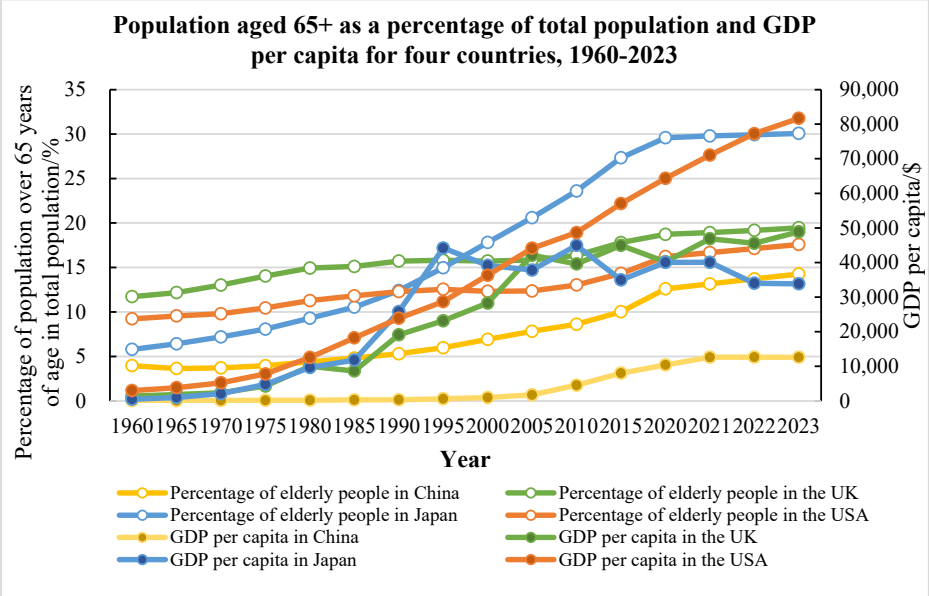

Figure 2. Population aged 65+ as a percentage of total population and GDP per capita for four countries, 1960–2023. Data Source: World Bank Open Data.

Therefore, the development process of the aging society in these four countries is typical [11]. The four countries were selected in this paper to achieve a representative geographical distribution of developed countries in Europe, North America, and Asia, in contrast to developing countries like China. Furthermore, it makes it easier to examine how mildly and severely aging nations respond at various societal phases. China, which has recently entered the stage of moderate aging, can benefit from its revelation and application. For nations that have already reached or will soon reach the stage of a moderately aging society, it also offers a theoretical reference value. It also facilitates the analysis of the responses of moderately and severely aging countries when they are at different social stages. It is not only of considerable revelation and application value to China, which has just entered the stage of moderate aging, it also provides a theoretical reference value for countries that have entered or will soon enter the stage of a mildly aging society.

3. Results

Using the U.S., the U.K., Japan, and China as empirical cases, this review focuses on developing age-friendly transportation in five main dimensions: laws and regulations, planning and design, policy measures, transportation infrastructure and services, and technology development (Table 2). On the one hand, due to overlapping data, age-friendly transportation is intertwined with transportation for people with disabilities. On the other hand, current traditional transportation policies in China that address the mobility needs of the elderly tend to focus on the physically weaker elderly [4]. Thus, the research object of this paper not only includes the elderly but part of it also focuses on the mobility needs of people with disabilities.

Table 2. Measures to build age-friendly transport in the U.S., U.K., Japan, and China.

Country	Author(s), Year	Laws and Regulations	Planning and Design	Policy Measures	Transportation Infrastructure and Services	Technology Development
The U.S.	Chen X, Feng S (2024) [12]	Older Americans Act [b]		Driving licence renewal rules	Door-to-door paratransit services	
		Rehabilitation Act [ab]			Public transport accessibility	
		Transportation Equity Act for the 21st Century [ab]				
		Amendments to the Older Americans Act [b]				
		EO 13330 [ab]				
		FTA 5310 program [ab]				
	Cirella G T, et al. (2019) [13]	Americans with Disabilities Act [ab]				MaaS platform
	Remillard E T, et al. (2024) [7]	Fixing America's Surface Transportation Act [ab]				
	Black K, et al. (2020) [14]		Age-friendly Community Program [b]			
	Li, R. and L. Zhu (2017) [15]					Greyhound Bus
	Choi Y J (2020) [16]		Age-friendly communities			
	Coughlin J F (2009) [17]		Livable community [ab]			Intelligent Transport System
	Shaheen S, Niemeier D A (2001) [18]					Vehicle night vision technology
	Owsley C, et al. (2003) [19]			Driver training		
	Chen X, Feng S (2016) [20]	EO 13217 [a]		Taxi travel subsidy Volunteer driver	Paratransit services	
	Siren A, Haustein S (2015) [21]			Procedure for renewal of car driving license		
	Charness N, et al. (2018) [22]					Autonomous vehicles
The U.S.	Mofolasayo A (2020) [23]		Complete streets strategy [ab]			
	Ibraeva A, et al. (2020) [24]		TOD development mode [ab]			
	Paiva, S., et al. (2021) [25]					Traffic flow optimization

Table 2. *Cont.*

Country	Author(s), Year	Laws and Regulations	Planning and Design	Policy Measures	Transportation Infrastructure and Services	Technology Development
The U.K.	Dou X, et al. (2015) [8]		Sustainable Communities Program [b] Lifelong community [b]			
	Metz, D (2003) [26]		Ten-year transport plan [ab]	Voluntary passenger service		Vehicle auxiliary equipment Low-floor bus
	Wong, R C P, et al. (2018) [27]			Concessionary Ticket Price		
	Laverty A A, Millett C (2015) [28]			Fare subsidy		
	Mackett R (2014) [29]			English National Concessionary Travel Scheme		
	Wright S, et al. (2014) [30]				Flexible Transport System	
The U.K.	Pangbourne K (2010) [31]					Intelligent Transport System Information Communication Technology
	Davison L, et al. (2014) [32]				Demand Responsive Transport	
	Reinhard E, et al. (2019) [33]			free bus pass		
	Shaheen S A, et al. (2001) [18]					Driving assessment center network
	Lin D, Cui J (2021) [4]			Voluntary social vehicle program		
	Wong R C P, et al. (2020) [34]			Taxicard scheme		

Table 2. *Cont.*

Country	Author(s), Year	Laws and Regulations	Planning and Design	Policy Measures	Transportation Infrastructure and Services	Technology Development
Japan	Gu Z, Luo X (2024) [35]	Act on Promoting Accessibility for the Elderly and Persons with Disabilities [ab]				
	Wright S, et al. (2014) [30]		Land site optimization planning [ab]		Flexible Transport System	ICT devices
	Liu M, et al. (2021) [36]	Long-Term Care Services Act [ab]	Land Application Scheme [ab]		Slow-moving traffic system	
		Elderly People's Welfare Act [b]	Regional Public Transportation Network Itinerary Plan [b]			
		Act on Promoting and Improving the Regional Public Transport [ab]				
	Ohta, Hidetaka (2022) [37]		Age-friendly communities			
	Zhang Y, Zou Z (2022) [38]					New transport modes Safe driving assistance functions
Japan	Sakakibara Y (2012) [20]			Driving licence renewal Driving safety education		
	Kamata M, Shino M (2006) [39]					Micro Electric Vehicles
	Shergold I, et al. (2012) [40]					Driverless car

Table 2. *Cont.*

Country	Author(s), Year	Laws and Regulations	Planning and Design	Policy Measures	Transportation Infrastructure and Services	Technology Development
China	Chen X, Feng S (2024) [12]	Law of the People's Republic of China on Protecting the Rights and Interests of the Elderly [b]	13th five-year plan for accessible environment construction [ab]		Auxiliary services for public transport authorities	
		Law of the People's Republic of China on Constructing the Accessible Environment [ab]				
		Regulations on Constructing the Accessible Environment [ab]				
	Cheng L, et al. (2019) [41]				Accessible public facilities	
	Zheng G (2020) [42]		Implementation of the National Strategy on Active Response to Population Ageing [b]			
	Yu J, et al. (2021) [43]		Age-friendly rural communities			
	Cirella G T, et al. (2019) [13]					Intelligent Bus Autonomous vehicles
China	Gu Z, Luo X (2024) [35]		Outline for the Construction of a Powerful Transportation State [ab]			
			Outline of the National Comprehensive Stereo Transport Network Plan [ab]			
	Zhang NJ, et al. (2012) [44]			Old age allowance		
	Wong R C P, et al. (2020) [34]			Accessible taxi fare subsidy scheme		

Note: In the table, a is for persons with disabilities and b is for older persons.

3.1. Summary of Methodology

Based on the detailed assessment of the included literature, we found that 51.4% of the literature studies on this topic are based on case studies, or comparative studies combining the current case form with the current situation in another region or country. Additionally, 18.9% of the studies adopt regression analysis, 18.9% of the studies adopt experimental methods, and the rest (16.2%) mostly adopt descriptive analysis. The studies adopting regression analysis mainly focus on the design optimization of transportation systems and the evaluation of intelligent transportation. Among the collected literature, 32.4% of the studies adopt primary data analysis, of which 58.3% come from questionnaires, 33.3% from interviews, and only 8.3% from experiments; 67.6% of the studies adopt secondary data. In terms of research scope, 16.2% of the studies adopt case studies, 5.4% are cross-sectional studies, and the remaining 78.4% are mostly longitudinal studies of a single node. These 37 pieces of literature are listed in Table 3. In this table, we specify the research methodology used in each article.

Table 3. Retrieved literature and the methodology.

Reference	Methodology
Shaheen S A, Niemeier D A (2001) [18]	Literature study/qualitative analysis
Metz, D (2003) [26]	Literature study
Owsley C, et al. (2003) [19]	Intervention trial/randomized controlled design/questionnaire
Kamata M, Shino M (2006) [39]	Randomized visits/field test experiments
Coughlin J F (2009) [17]	Descriptive analysis/case study/literature study
Pangbourne K, et al. (2010) [31]	Focus group interview method/questionnaire
Sakakibara Y (2012) [20]	Case study/descriptive analysis
Shergold I, et al. (2012) [40]	Scenario planning/expert advice
Davison L, et al. (2014) [32]	Questionnaire and interviews/regression analysis/comparative study
Mackett R (2014) [29]	Literature study/descriptive analysis
Wright S, et al. (2014) [30]	Case study/comparative study/literature study
Dou X, et al. (2015) [8]	Literature study/comparative study
Laverty A A, Millett C (2015) [28]	Literature study/qualitative analysis
Siren A, Haustein S (2015) [21]	Literature study/descriptive analysis
Chen X, Feng S (2016) [45]	Case study/comparative study
Li R, Zhu L (2017) [15]	Questionnaire/field observation/literature study
Charness N, et al. (2018) [22]	Experimental design/questionnaire/statistical analysis (principal component analysis/factor analysis/ANOVA/regression analysis)
Wong, R C P, et al. (2018) [27]	Questionnaire/experimental design/regression analysis
Cirella G T, et al. (2019) [13]	Literature study/qualitative analysis
Cheng L, et al. (2019) [41]	Spatially extended modeling /multiple regression analysis
Reinhard E, et al. (2019) [33]	Quasi-experimental design/fixed effects regression analysis
Black K, Jester D J (2020) [14]	Questionnaire/cluster analysis/statistical analysis (ANOVA/chi-square test/linear regression analysis)
Choi Y J (2020) [16]	Descriptive analysis/statistical analysis (multilevel linear and logistic regression)
Ibraeva A, et al. (2020) [24]	Literature study
Mofolasayo A (2020) [23]	Literature study/case study/descriptive analysis
Wong R C P, et al. (2020) [34]	Questionnaire /experimental design/statistical analysis
Zheng G (2020) [42]	Literature study/descriptive analysis
Lin D, Cui J (2021) [4]	Literature study/comparative study
Liu M, et al. (2021) [36]	Case study/comparative study
Paiva, S., et al. (2021) [25]	Literature study/descriptive analysis
Yu J, et al. (2021) [43]	Questionnaire/statistical analysis (chi-square test/*t*-test/reliability test/multiple regression)/comparative analysis
Zhang N J, et al. (2021) [44]	Literature study
Ohta, Hidetaka (2022) [37]	descriptive analysis/qualitative analysis
Zhang Y, Zou Z (2022) [38]	Literature study/descriptive analysis
Chen X, Feng S (2024) [12]	Comparative literature study
Gu Z, Luo X (2024) [35]	Literature study/comparative study
Remillard E T, et al. (2024) [7]	Qualitative interviews/comparative study

3.2. Laws and Regulations

Laws and regulations are the most direct and powerful institutional safeguards to protect the mobility needs of the elderly. In this section, we will analyze the legal frameworks and institutional safeguards of the four countries—U.S., the U.K., Japan, and China—from the perspectives of the elderly and the travel environment, in order to comprehensively demonstrate the legal support and institutional innovations of each country in addressing the challenges of aging transportation.

3.2.1. Targeting the Elderly

Since the 1960s, the U.S. Congress has passed a series of federal laws directly or indirectly related to transportation for older persons or persons with disabilities. To address the mobility needs of older individuals and improve their capacity to engage in social contacts and community activities, the Older Americans Act (OAA) of 1965 placed a strong emphasis on the provision of transportation services. In 1973, Section 504 of the Rehabilitation Act mandated that non-profit providers and public transportation agencies would provide paratransit for individuals with disabilities. In 1990, the Americans with Disabilities Act (ADA) required accessible design modifications to transportation to meet the travel needs of people with disabilities. Considering that some older adults cannot use fixed-route bus services due to their disabilities, the ADA requires public transportation agencies that provide fixed-route services to provide "supplemental paratransit" services to this disability group [13]. Chen and Feng (2024) argue that the Rehabilitation Act and the ADA are groundbreaking as policy and legal frameworks for securing the rights of people with disabilities in all federal programs because they not only extend protection from discrimination to all public entities that provide transportation services, but also expand the scope of transportation accessibility requirements [12].The Older Americans Act Amendments of 1992 and 2006 require states to devote a proportionate share of funding to senior transportation services. On 18 June 2001, President Bush issued Executive Order 13217 (Community-Based Programs for Individuals with Disabilities), which requires that individuals with disabilities be provided with a variety of opportunities to participate in the community, including a variety of modes of transportation to facilitate their travel. On 24 February 2004, Presidential Executive Order 13330 (Population Services Transportation) called for increased cooperation among federal departments to provide federal funding for transportation services to those who do not have access to private transportation, who have disabilities, who are low-income, and who use community-based transportation systems. Accordingly, the federal government established the Interdepartmental Coordinating Agency for Accessible and Mobility Transportation. The Federal Transit Administration (FTA) issued the 5310 program to leverage the private sector by providing formula funding to states to help private non-profit organizations meet the transportation needs of seniors and people with disabilities when the transportation services they provide are unavailable, insufficient, or unsuitable to meet those needs.

Japan, as one of the developed countries with one of the world's most seriously aging populations and rapid urbanization, has made many efforts to address the difficulties of the elderly in urban transportation. In 1963, Japan enacted the Elderly Welfare Law, which clearly stipulated the operation of welfare facilities for the elderly, etc., marking the beginning of Japan's efforts to devote special attention to the elderly group in its social security system, followed by the Elderly Welfare Law of 1980, which elaborated on specific service measures for the elderly's mobility. To improve the travel environment for the aged, the Act on the Promotion of Accessibility for the Aged Persons with Disabilities was released in 2006 and subsequently updated in 2012 and 2018. It lays out requirements for

age-appropriate design and accessibility of transportation facilities. The Long-Term Care Services Act of 2015 further optimizes and enhances accessible transportation services.

In the 1990s, China successively introduced laws to protect the rights and interests of the elderly in traveling. The Law of the People's Republic of China on Protecting the Rights and Interests of the Elderly, enacted in 1996, was amended several times, in 2009, 2012, 2015, and 2018. For example, Article 64 calls for constructing and providing barrier-free transportation facilities [13].

3.2.2. Travel Environment

In 1998, the Transportation Equity Act for the 21st Century was first approved in the U.S., calling for increased investment in and support of public transportation systems, with significant funding allocated for Intelligent Transportation System (ITS) development and other public transportation facilities. In 2005, the Act renewed the call for local agencies to explore ways to improve transportation coordination, such as combining public transportation and human services to improve accessibility for seniors and people with disabilities. In 2015, the Fixing America's Surface Transportation (FAST) Act provided formula grants to states to assist private non-profit organizations in meeting the transportation needs of seniors and people with disabilities when the transportation services provided are unavailable, insufficient, or unsuitable to meet those needs [7].

According to our literature review, the U.K. government paid attention to the mobility needs of older and disabled people in the 1980s [46]. Since 1989, all new taxis in London have been required by the Metropolitan London legislation to be wheelchair accessible to improve mobility for the elderly and those with disabilities. To provide safe and convenient travel for all passengers, the Accessibility of Public Service Vehicles Regulations 2000 were passed.

The Japanese government has gradually improved the legal system, which guarantees the mobility and accessibility of public transportation facilities for the elderly and persons with disabilities, starting with the Welfare Cities Law in 1973 and ending with the enactment of the Compassionate Building Law and other acts in the 1990s. The Act on Promoting and Improving Regional Public Transport was released in April 2023, requiring policy revisions and implementation that specifically address the needs of the elderly and persons with disabilities to improve the convenience and accessibility of regional public transportation [36].

In the area of accessible mobility for the elderly, China is also constantly exploring new requirements and norms in terms of law. On 1 September 2023, the Standing Committee of the National People's Congress passed the Law of the People's Republic of China on Constructing the Accessible Environment, which proposes to strengthen the construction of barrier-free environments to better meet the mobility needs of the elderly [47]. According to Article 12 of the law, newly built, renovated, and enlarged residential buildings, residential areas, public buildings, public spaces, transportation facilities, and urban and rural highways must all adhere to engineering and construction standards for barrier-free facilities [35]. Additionally, in 2012, the Barrier-Free Design Code and the Regulations on Constructing Barrier-Free Environments clarified the design specifications for barrier-free facilities, emphasizing improving the design requirements for transportation hubs and barrier-free travel [12].

3.3. Planning and Design

Planning and design form an important foundation for constructing age-friendly transportation systems, involving transit-oriented development (TOD)-based urban community planning (including land planning) and accessibility optimization. This section will

start with these two parts and provide an in-depth discussion of the specific practices in age-friendly transportation planning and design in the U.S., the U.K., Japan, and China.

3.3.1. TOD-Based Urban Community Planning

TOD is an urban planning and development model that focuses on public transportation. Most of the following community or urban planning adopts the public TOD development mode. It promotes the close integration of residents' lives and work with the public transportation system [48]. In this model, the government encourages the elderly to use public transportation, improving the age-friendly transportation environment [49].

In 2005, the American Alliance of Retired Persons (AARP) released a comprehensive report on how urban environments should respond to the construction of "livable communities" requirements [17]. Housing, schools, and parks characterize livable communities within walking distance of user-friendly transportation [50]. Between 2007 and 2011, the U.S. EPA and its sponsors implemented the Active Ageing Healthy Communities Program [14,16]. In 2008, the City of New York and the New York Academy of Medicine (NYAM) launched the Age-Friendly New York City Initiative, which promotes active aging and strengthens the social connections of older people by transforming urban environments, thereby improving civic engagement, housing, transportation, and social services [24].

As one of the first developed countries to enter the stage of mild aging, the mobility demands of the elderly are particularly relevant in the U.K. In 2003, the British government proposed the "Sustainable Communities and Building for the Future" program. At the community level, construction and planning standards for age-friendly built environments in the UK focus on the development of accessibility systems, recreational spaces, and community care facilities [51]. Based on this, in February 2008, the U.K. began to implement "sustainable communities" and "Lifelong Communities", for all older people in the general urban residential planning and design requirements. The key lies in constructing public transportation-oriented community services, such as elderly bus support services [52].

Urban planning in Japan focuses on closely integrating public transportation stops with the needs of elderly people's lives, resulting in a community development model with rail transit at its core. Lin (2021) argues that land use patterns and related housing arrangements reflect the daily living patterns of older people [4]. Wang (2017) states that the built environment affects an individual's participation in daily activities and related transportation trips [53]. Therefore, the development of appropriate land planning is vital to address the mobility needs of the elderly [54]. In Japan, many land site optimization plans were carried out in 2014 in cities, with the vision of moving from sprawling to intensive cities [55]. The plan emphasizes the rail transit framework as the central axis of development to form a new spatial structure of compact development characterized by "transit-led contraction". The elderly can travel easily and independently in a compact town to fulfill the various demands of daily life and engage in meaningful social interactions. Ohta (2022) points out that Japan's age-friendly communities are in the process of being promoted in response to the United Nations' "Healthy Ageing" program [37].

In China, the concept of age-friendly transportation has been gradually integrated into urban planning in the practice of the TOD model. For example, Beijing has built a number of "age-friendly communities" around rail transit stations, optimizing the walking and cycling environment, installing barrier-free facilities, and providing community feeder services. In 2024, Shanghai proposed a "15-min community living circle" plan to ensure that older persons can reach public transportation stations, medical institutions, parks, and commercial facilities within a 15 min walk, so as to meet their mobility needs.

3.3.2. Accessibility Optimization

There are transportation network layouts in the U.S. that use complete streets strategies, whereby streets are designed to include sidewalks, special bus lanes, comfortable and accessible bus stops, and accessible pedestrian signals [23,56]. By applying this approach, communities can promote active transportation and improve travel safety for seniors and people with disabilities [57]. In 2008, the California State Assembly approved the Complete Streets Act. The bill requires local administrations to establish a diverse transportation network to meet the transportation needs of all road users, including people with disabilities and the elderly [58].

To enhance public transportation accessibility more rapidly, the Disability Rights Report of 2000 proposed criteria for the amount and pace of investment in the government's ten-year transport strategy. Dou (2015) pointed out that accessibility for older and disabled people was required to use public funds in all new investments in the program [8].

In 2007, the Ten-Year Plan for Long-Term Care was introduced to provide transportation services for persons with disabilities and the elderly similar to the Rehabus. From 2010 to 2014, the Age-Friendly Plan and Evaluation Indicator System was introduced by each city and prefecture to provide comfortable and convenient age-friendly transportation services. In 2013, the Regional Public Transportation Network Itinerary Plan proposed to improve barrier-free facilities to enhance the convenience of the transportation environment and ensure the safety of mobility-impaired people and the elderly. In 2014, the Localization Plan was proposed to ensure that public transport becomes the preferred mode of travel for the elderly through measures such as optimizing the layout of bus routes and promoting intelligent bus systems [36].

Since China entered the aging society in 2001, the aging speed has been even faster than that of Japan, which has attracted significant attention from the government. From the beginning of the 21st century, in order to comprehensively develop an age-friendly transportation system, China's State Council and various ministries and commissions have put forward a series of plans for aging. For example, the 13th Five-Year Plan for constructing an accessible environment and the implementation of the National Strategy for Actively Responding to Population Aging were formulated in 2016 [42]. Several departments jointly released the Implementing Opinions on Strengthening and Improving Travel Services for People with Transportation Difficulties in 2018, citing China's 260 million elderly citizens aged 60 and over and its 35.66 million disabled citizens. The 2019 Outline for the Construction of a Strong Transportation State issued by the CPC Central Committee and the State Council proposed achieving a perfect accessible travel service system by 2035 to accommodate the travel needs of vulnerable groups such as the elderly and the disabled [35]. The 2021 Outline of the National Comprehensive Stereo Transportation Network Plan also called for the complete construction of an age-appropriate ITS through age-appropriate remodeling. Yu (2021) pointed out that, in order to improve the active aging of rural older persons, it was also crucial to positively promote the establishment of age-friendly rural communities [43].

3.4. Policy Measures

The policy measures in this study refer to the specific courses of action that governments have developed to address the challenges of aging transportation. The specific programs involved are public transportation fare concessions, cab travel subsidies, driver's license renewal and training, and social volunteer activities. Given the commonalities and differences in policy measures across countries, and to avoid repetition of content, this section will look at the above four categories of measures and describe the specific practices and innovations in these areas in the U.S., the U.K., Japan, and China. Through a categorical

comparative analysis, this section aims to reveal the similarities and differences in policy measures across countries, thus providing a systematic basis for an in-depth understanding of the diversity and effectiveness of age-friendly transportation policies.

3.4.1. Public Transportation Fare Concessions

Wong noted that to actively encourage the elderly to use public transportation, the government can meet their travel needs by providing subsidies and reducing the cost of public transportation [27]. Governments have provided public transportation fare concessions. In the U.K., various discounts for aged, blind, and disabled individuals have been provided for bus travel since the early 1950s. For example, England provides public transport passes for locally resident older people and people with disabilities to travel on local buses at half price between 9:30 am and 11:00 pm on weekdays [29,33]. In 2005, the concessionary fare scheme in some places was extended from a half-price concession to free travel on local bus services [28]. For example, London's English National Concessionary Travel Scheme (ENCTS), funded by London's local government, allows older people and people with disabilities to travel free on public transport services, such as buses, during off-peak hours [26]. Scotland allows local older people to travel free on buses after 9:30 am on weekdays and all day on weekends [59]. After joining the Global Network of Age-Friendly Cities and Communities, the Japanese city of Akita launched a coin-operated bus service for senior citizens in 2011. The program allows seniors aged 65 and older to ride public buses using a bus I.C. card, paying only 100 yen per ride. Since the 21st century, many cities in China have also gradually begun to provide preferential or free bus rides for the elderly and have introduced bus senior cards accordingly [60]. In 2007, a nationwide preferential policy of free public transportation for citizens over 70 was generally implemented. How and when this policy was implemented varied from region to region.

3.4.2. Taxi Travel Subsidies

Several governments have introduced cab travel subsidy programs in response to the high cost of cab services for older persons. In recent years, in Taipei City, China, the government has assisted cab operators in introducing more accessible cabs. More than 11 operators have joined forces with it to provide an accessible taxi subsidy scheme for qualified individuals over 65 and those with impairments. The basic model of the program is that the government provides a payment card (called EasyCard), and users can efficiently complete the payment process by scanning a pre-installed card-reading device on the cab with their payment card, with a government subsidy of TWD 32 (equivalent to USD 1.04) per payment [34]. In 2017, the U.K. launched a cab card program for the elderly and disabled community, where eligible passengers typically pay a flat fare of only GBP 2.50 (equivalent to USD 3.22) per trip, plus any additional cab fare beyond the subsidy [27].

3.4.3. Driving License Renewal and Training

Generally, driving is considered an ideal way to maintain independent mobility in old age, as it is the safest and often most convenient mode of transportation for older adults [21,61]. Older adults may face many challenges in their driving abilities as they age. Consequently, governments have taken different measures to ensure the safety of older drivers. The National Motor Vehicle Administration (NMVA) of the U.S. has set up regulations for senior drivers to renew their licenses to protect them by conducting routine physicals and evaluations of their driving skills. In Virginia, drivers aged 75 years and older must renew their driver's license in person every five years and undergo a vision test to ensure that their vision meets safe driving standards; however, in California, this age requirement has been moved up to 70 years in light of its heavy traffic and higher driving risks [12]. Moreover, the U.S. has introduced driver training programs for older

adults and developed educational programs to promote driver safety to help them cope with age-related changes in functioning [19]. China increased the safety education and testing component of the senior driver's license application procedure and loosened the age limit for older persons to apply for a driver's license in 2020. For example, people over 70 who apply for a driver's license are required to pass tests of memory, judgment, and other abilities. They are also required to undergo a physical examination once a year and submit proof of the physical examination. In contrast, driving lessons and safety education in Japan have been conducted in private driving schools authorized by police departments, and such topics have never been taught in formal educational institutions. Sakakibara believes that it is best to develop driver safety awareness at an early age by learning prudent driving habits and safety rules when students are still young [20].

3.4.4. Voluntary Social Activities

Volunteer driver programs have been implemented in some parts of the U.S. by recruiting volunteers to provide transportation for older adults. For example, the city of Mesa, Arizona, has implemented a mileage reimbursement program that allows elderly and disabled people over the age of 65 to choose a volunteer driver to take them where they want to go [45]. In areas of the U.K. where bus and rail services are scarce and community access is limited, community transport groups and voluntary organizations are essential in filling the gaps in transport services [4]. These non-profit entities have set up a convenient voluntary passenger service (e.g., "on-call" bus services) for the elderly and disabled people with limited mobility, and run voluntary social car programs that cover medical care, daily shopping, and leisure activities [26]. Furthermore, China offers senior citizen subsidies and priority seats for the elderly on public transportation, while the U.S. has a comparable system of senior citizen priority parking [44].

3.5. Transportation Infrastructure and Services

Transportation infrastructure and services are the core elements of building an age-friendly transportation system, which is directly related to the convenience, safety, and comfort of travel for the elderly. This section will systematically reveal the common strategies and unique practices of countries in addressing the challenges of aging transportation from the three dimensions of accessibility construction, paratransit services, and flexible transportation systems.

3.5.1. Accessible Transportation Environment

According to Chen, building a barrier-free transportation environment is crucial in all aspects of public transportation for the elderly [45]. In 1961, the U.S. formulated the world's first accessibility standard, "U.S. Standards for Accessible and Usable Architectural Facilities for Persons with Physical Disabilities" [62]. Since 2006, China has carried out nationwide activities to create accessible cities and put forward some requirements for the accessible construction and renovation of public transportation facilities [63]. In the UK, London cabs are wheelchair-accessible and many of them offer wheelchair ramps, swivel seats, sensory devices, and intercom systems, and guide dogs are also allowed on board. In 1970, Japan followed the lead of Europe and the U.S. and formally stepped into constructing accessible environments, popularizing auxiliary facilities. To increase walking safety, Japan established a slow-moving system and implemented several strategies, including installing crossing signals for the elderly, creating traffic islands for secondary crossings, and scientifically choosing pedestrian crossing locations [41,64]. In some local transportation construction, Japan promotes an experience-oriented concept, whereby older persons and persons with disabilities are invited to participate in the entire design and construction process and work with the designers to ensure that the barrier-free design is usable by

all groups of people. For example, most of the bodywork is low to the ground, and after stopping at each station, the bodywork is tilted toward the steps by an air suspension system to make it easier for slow-moving seniors and people with disabilities to get on and off the bus.

3.5.2. Paratransit Services

The concept of paratransit first appeared in the 1960s, aiming to maximize the convenience and accessibility of vehicular resources to enhance the efficiency and economy of the transit system [65]. It focuses on special groups (e.g., the elderly and people with disabilities) to ensure that their travel needs are met. In the U.S., the paratransit service has become a standard feature of major bus companies with the deep implementation of the ADA. Following this act, all public transportation providers that receive federal financing must offer qualified passengers individualized door-to-door or curb-to-curb paratransit services no more than three-quarters of a mile from a conventional bus route. Meanwhile, public facility optimization, upgrading, and intelligent transformation projects have been undertaken across China. In Beijing, for instance, the local authorities have focused on addressing the "first kilometer" issue of elderly travel and established taxi warm stations to assist the elderly. In addition, some regions have introduced innovative services such as cab reservations and wheelchair sharing. The UK is focusing on accessibility training for transport sector staff to provide timely and professional assistance to disabled and mobility-impaired older people. All train operators and Network Rail in the UK have joined a project called the Sunflower Project. The aim of the program is to better identify people with invisible mobility problems and provide them with special assistance.

3.5.3. Flexible Transportation System

A flexible transportation system (FTS) is defined as a transportation service in which at least one of the characteristics of the routes, vehicles, schedules, passengers, and payment system is not fixed [32]. Compared to traditional public transportation services, FTS is seen as an intermediate option between fixed-route, fixed-schedule public transportation, and private car use in terms of flexibility, comfort, and cost [30]. Successful practices in FTS in the U.K. and Japan have demonstrated the great potential of such non-fixed-route, non-fixed-schedule transportation services to meet the individualized travel needs of the elderly.

Since the 1970s, flexible transportation services for older and disabled people have been provided in the U.K. as dial-a-ride services. In 2006, the U.K. government formally formalized FTS into two categories: Demand Responsive Transportation (DRT) and special transportation services [52]. Japan has produced over 3000 unique transportation services using a similar approach, according to the Ministry of Land, Infrastructure, Transport and Tourism [66]. Some local governments in Japan are actively integrating FTS into their local public transportation systems, such as the on-demand bus system, which was developed precisely to provide on-demand transportation services to users with reserved seats [67]. Additionally, the micro-circulation public transportation launched in China and the Dial-A-Ride service in the U.S. are both applications of FTS.

3.6. Technology Development

Technology development is an important driving force for the modernization and intelligence of age-friendly transportation systems. This section will systematically present and comparatively analyze the specific initiatives and innovations in technology development of the U.S., the U.K., Japan, and China in the four dimensions of ITS, new transportation modes, Information Communication Technology (ICT), and Mobility-as-a-Service (MaaS) platforms to reveal their technological paths and practical experiences in addressing the

challenges of aging transportation, so as to provide references for the development of aging-friendly transportation technologies on a global scale.

3.6.1. Intelligent Transportation Systems

Shaheen pointed out that the development of new technologies not only improves the safety and convenience of travel for the elderly but also promotes the overall optimization and intelligent development of the transportation system [18]. In China, the application scenarios of ITS are very extensive, covering a wide range of aspects such as traffic management planning, traveler information services, vehicle operation and management, electronic toll collection, and automotive mobile Internet of Things. Through various technological methods, ITS makes up for the potential decline in reflexes and perceptions that older drivers may experience as they age. For example, collision warning systems help determine the distance of oncoming vehicles with blind spot detection, and night vision technology extends the safety of night driving [24]. These technologies significantly reduce the stress and risk of driving by providing real-time information and assistance [68].

User-centered ITS in the U.S. covers a variety of features, such as rear approach warning systems, which prevent vehicles from entering the path of other vehicles in dangerous situations [69]. Moreover, laser and radar systems aim to provide drivers with audible warnings to alert them of potential risks when making hazardous lane changes [70]. Paiva et al. (2021) proposed traffic optimization technology as an emerging ITS that can improve the safety of older people driving minivans by adjusting the speed of the vehicle to minimize its time at traffic lights, detecting and preventing traffic congestion, or recommending alternative routes [25].

The U.K. Driving Assessment Centre network, relying on ITS, provides drivers with accurate assessment and personalized advice to help improve their skills [18]. Based on the assessment results, the centers can recommend suitable driving assistance technologies to the elderly, such as automatic parking systems, blind spot monitoring, and collision warning. In particular, the U.K. has actively introduced power-assisted steering and automatic gearshift technologies to promote transportation accessibility, which opens up new driving possibilities for older drivers with physical limitations [26]. In response to the unique needs of drivers with disabilities, a full range of personalized vehicle modification and accessory services are provided, including electronic acceleration and braking systems.

Faced with the trend of an increasingly large group of elderly drivers, the Japanese government is actively promoting driver assistance safety technology. To reduce the financial burden, the government provides subsidies for elderly drivers over 65. It encourages them to retrofit their old cars with safety support functions, such as emergency braking and over-the-line warnings [38].

3.6.2. New Transportation Modes

Driven by science and technology, new transportation modes are emerging, bringing more possibilities for the elderly to travel. These new transportation modes not only meet the travel needs of the elderly, but also promote the diversified development of urban transportation [71].

(1) *Intelligent Buses*

The U.S. has long been investing in innovative intelligent transportation technologies. Among them, the "Greyhound" bus is a good example, taking into account the needs of the elderly and providing comfortable seats and convenient facilities [15]. With the global popularization of the concept of barrier-free design and the development of technology, the U.K. has gradually introduced low-floor buses into the public transportation system.

This type of bus adopts a low-floor design, which makes it easy for people with mobility problems, such as the elderly and the disabled, to get on and off the bus [72].

Simultaneously, China uses artificial intelligence technology to deeply optimize its bus operation system. Through sophisticated algorithmic analysis, the system can accurately plan routes and anticipate and prevent maintenance needs, such as monitoring the status of vehicle components in real-time to ensure that each vehicle is in optimal operating condition, thereby improving the overall reliability and efficiency of the service [43]. Additionally, China provides more convenient services for the elderly through intelligent technology. Real-time positioning, arrival reminders, and other functions are visually displayed through cell phone APPs or onboard displays so that the elderly can quickly grasp the dynamics of public transportation and reasonably arrange travel time [73]. The addition of an intelligent voice announcement system allows elderly passengers to obtain station information at any time, even during the traveling process.

(2) *Micro Electric Vehicles*

In Japan, new types of vehicles, such as mini-cars and green slow-mobility vehicles, are increasingly being used by local elderly people as complementary modes of existing public transportation. The Micro Electric Vehicles advocated by scholar Kamata are mobility devices designed to meet the specific needs of Japan's elderly population, with features designed to meet the safety, comfort, and convenience of elderly travelers [39]. Cirella contends that since not all senior citizens have access to a passenger car at home or a driver's license, it is critical to look into alternate modes of transportation such as DRT systems (e.g., Dial-a-Ride), motorized mobility scooters, and electric wheelchairs [13].

(3) *Autonomous Vehicles*

A study by the Pew Research Center showed that 75% of respondents anticipate that the advent of autonomous vehicles will help seniors and people with disabilities live more independently [22]. Harper notes that vehicle automation has the potential to improve mobility and accessibility to transportation for people with travel-limiting illnesses and seniors [9]. Various TIS and Advanced Vehicle Control and Safety Systems in the U.S. can provide services and perform tasks to compensate for age-related deficiencies, such as driver status monitoring, navigation guidance, visual enhancement, and obstacle detection [74]. Equally, the U.K. and Japan continue to promote self-driving cars and artificial intelligence, with the Autonomous Vehicles Act coming into the U.K. on 20 May 2024 [72]. In 2020, autonomous vehicles began to be put into trial operation in China. The cars can interact with passengers through voice control, touch control, and eye tracking, making it simple for the elderly to choose their destination quickly and enjoy a comfortable traveling experience [75,76]. Thus, the emerging technology of autonomous vehicles has great potential to improve the mobility of older adults [40,77,78].

3.6.3. Information Communication Technology

The U.K.'s telephone booking facility, a key component of ICT, has played an essential role in developing flexible transport services, particularly in DRT [31]. Much practical experience in DRT dates back to the early days of "on-call" services for the elderly and disabled. In Japan, ICT is widely used in public transportation systems, especially in providing information on bus operations. Many FTS operators have introduced ICT devices and constructed two types of ICT dispatch systems to improve the efficiency and reliability of their services [30].

3.6.4. MaaS Platform

MaaS platforms are an emerging artificial intelligence service model. Kett notes that early MaaS offered users the opportunity to access integrated door-to-door services through service packages paid for online and covering a range of transportation options from autonomous vehicles to cabs, bicycles, and even walking [79]. The U.S. government's efforts in MaaS, such as introducing age-friendly carpooling and car-sharing programs, have further enhanced the travel independence of seniors [80]. In Japan, MaaS provides information and services integrating multiple transportation modes (e.g., buses, subway) to give passengers one-stop travel solutions. Passengers can quickly check real-time transportation information, plan travel routes, and purchase tickets through mobile applications.

4. Discussion

4.1. Issues and Challenges

First, although governments are committed to improving laws and regulations to protect the rights and interests of the elderly in travel, there are differences in implementation and effectiveness. The U.S. has a relatively well-developed legal system. Japan has gradually improved its legal system relating to transportation and mobility for older persons and has improved the travel environment for older persons and persons with disabilities. In China, new laws are constantly being revised and introduced to emphasize the construction of barrier-free facilities. In comparison, the legal system in the U.K. is weaker. However, due to the heterogeneity of regions and individuals, the implementation and effectiveness of different countries may vary, and it is difficult to draw clear conclusions about the effectiveness of specific policies; therefore, further evaluation and improvement are still needed. Moreover, with the development of science and technology and society, the travel needs of the elderly are constantly changing. Considering the lagging and imperfect nature of laws and regulations, determining how to ensure that they can adapt to new needs and challenges is an important issue to be faced in the future.

Second, active actions taken by countries in transportation planning and design include community planning, transportation network layout, public transportation facility design, land planning, and other dimensions. Regarding the concept of a livable community, AARP in the US released a comprehensive report and put forward a clear definition as early as 2005, similar to the sustainable community advocated by the UK in 2008, followed by Portugal, China, and others that began to focus on how to build livable cities. Twenty-first century Japan carried out the optimization of site selection planning for the construction of the city to a certain extent, which is based on the implementation of the TOD model of development for livable cities. Meanwhile, Chinese cities are also vigorously implementing the TOD model. Therefore, determining how to adapt to the current urban development situation in order to implement appropriate policies is crucial to the future form of economic development of a city in the long term. For example, the EPA's BHCAA program has been successful since 2007 and has been awarded to 21 community-based programs in 15 states that have demonstrated outstanding achievements or innovations in age-friendliness, thanks to multiple sources of support and collaboration. The international context of the World Health Organization's promotion of active aging has allowed the project to receive extensive cooperation and support from multiple agencies, including the U.S. EPA's Older Adult Initiative, the President's Council on Physical Fitness and Sports, and the Centers for Disease Control and Prevention, creating a powerful driving force. More importantly, in the early 21st century, as U.S. society ages, the program is able to meet the increasing housing and mobility needs of seniors through innovative community design and service models. In addition, through the establishment of a national accreditation program and an annual honors event, the program has succeeded in inspiring more communities to actively

participate and strive to meet high levels of developmental standards, thus contributing to the continued growth of the program as a whole. Over the past 30 years, there has been some progress in the study of age-friendly cities in Western developed countries. As of now, Japan has relatively few such community or urban action programs, and lacks a range of tools to promote public participation by older residents. Nonetheless, a program may face challenges in terms of funding, technology, and implementation efforts. Hence, effectively overcoming these challenges and ensuring the steady implementation of policy plans to effectively improve the quality of mobility and social participation of older persons is a direction that governments must work towards in the future.

Third, authorities have implemented several policy initiatives to lessen the financial burden and enhance the convenience of travel for the elderly. Cab travel subsidies in the UK and China have played an important role in facilitating the current situation where the majority of cabs are not accessible and are not utilized by older people. To our knowledge, the U.S. and Japan currently lack such large-scale initiatives. Providing preferential public transportation fares for older persons is one of those measures. Although it has played a positive role in promoting the active use of public transportation by older persons, the cost of the preferential fares has, to a certain extent, increased the financial burden on the state. One of the biggest challenges facing the state today is lowering its financial burden while maintaining older people's ease of mobility.

Fourth, grass-roots-oriented transportation infrastructure development and service delivery are equally crucial in national strategic actions on aging. The supply of transportation services is characterized by variety, which may raise the question of transportation equality. This is due to the diverse transportation demands of older people and the varying economic realities of different locations. It is worth noting that the U.S. has made remarkable achievements in building accessible transportation environments, and China and the U.S. are making unremitting efforts to improve paratransit services. In particular, the FTS has shown its potential to meet the needs of the elderly in terms of convenient access to transportation. The hands-on practice of the U.K. and Japan in this area has provided us with valuable experience and inspiration. However, one crucial issue that we must solve immediately in the future is how to guarantee both the diversity of transportation services and the parity of services.

Fifth, technological advancement drives countries to actively explore and effectively apply technological innovations to age-friendly transportation. ITSs based on the Internet of Things have great potential and capability to make transportation systems efficient, safe, smart, and sustainable. With the continuous development of emerging technologies, new types of transportation such as self-driving cars and MMS are increasing. Previous studies on whether intelligent transportation technologies such as safe driver assistance technology and AVCSS are beneficial to elderly travel have yielded positive results. Zhu et al. point out that a variety of intelligent transportation technological tools compensate for the decline in reaction and perception that older drivers may experience as they age [68]. However, the popularity and acceptance of these technological innovations is challenged by the cognitive deficits of older adults. Many studies have concluded that older adults encounter more barriers to using technological products and have more negative attitudes toward technology. Zhang (2023) stated that they prefer to use traditional services than technological older adults, who do not see technology as useful to their lives [81]. Thus, determining how to effectively enhance older people's adaptability and acceptance of new technologies, and to ensure that these innovative technologies can truly benefit the older population, has become a key challenge that needs to be addressed.

Finally, despite the growing body of research exploring transportation mobility for older adults, there are clear shortcomings in the research methodologies employed. Based

on a detailed review of the 37 papers selected for this paper, we found that research in this area consists mainly of qualitative insights consisting of secondary data or inductive summaries after integrating the literature, with fewer cross-sectional studies and a lack of dynamic experimental research. Thus, future research should focus on empirical studies with primary data as the main source to implement exactly the vision of a transportation system that meets the needs of age-friendly mobility. Secondly, in the econometric analysis, more panel data should be used to better observe the development trend and to conduct dynamic analysis. In terms of research content, there is a lack of literature on cross-cultural multi-case studies. In addition, a few intelligent transportation studies focus on the convenience of travel for the elderly, thus ignoring the point that age-friendly transportation should be a sustainable transportation system, and there is a lack of research on sustainable age-friendly transportation. Thus, future research could focus more on this point.

So far, there are various studies discussing the impact on travel demand and the changes needed in transportation policies in developing or developed countries in the face of an aging population. Age-friendly built environments, including safe, affordable, and accessible transportation, have been identified as key factors in improving the quality of life for the growing number of older adults [82]. This paper provides an overview of strategies to improve age-friendly transportation in three developed countries and one developing country and finds that they each excel. Most of the developed countries established relevant laws and regulations at an earlier period to protect the rights and interests of the elderly in traveling, which may be due to the fact that the developed countries have a faster economic development and entered the aging society earlier. Some technologies were introduced earlier in developed countries, for example, the popularization of low-floor vehicles in China originated from the UK. In addition to government promotion, there are also aging-friendly projects implemented by third-party organizations in developed countries to better achieve public participation. Moreover, transportation services for the elderly in developing countries, such as the promotion of assisted transportation, are still not comprehensive enough compared to those in developed countries. Consequently, learning from the age-friendly transportation strategies of developed countries is profoundly important for the development of sustainable transportation for older persons in developing countries.

4.2. Policy Implications

First, in response to the pressure that fare concessions may put on government finances, we propose the introduction of a "senior transportation card" linked to each city's financial system, with mileage reimbursement up to a limited amount. This is similar to the cab payment card implemented in Taipei City, China. The "Senior Transportation Card" can be used on buses, subways, and cabs. No funds will be pre-loaded onto the card, and the card will not be reimbursed for any expenses exceeding a certain amount each year, so as to avoid over-concentration of resources. On the other hand, we believe that the measure of free rides for the elderly during off-peak hours implemented in London, U.K. and Shanghai, China is worthy of reference in other regions, including the U.S. and Japan, as it can alleviate the pressure of peak hours and at the same time increase the utilization rate of public transport resources.

Secondly, we are entering a new phase in which there is an urgent need to explore new technologies to optimize the service process and enhance the operational effectiveness of age-friendly transportation. However, older people often face many obstacles in adopting these new technologies, such as unfamiliarity with the technology, psychological concerns, and physical limitations. Therefore, in promoting technological innovation, the actual needs and abilities of the elderly must be fully considered. We suggest promoting forms of shared transportation, such as low-pedal shared bicycles and electric scooters that are suitable for

use by older people, and setting up dedicated parking spots in communities to facilitate short-distance travel for older people. Training in their use should also be provided to help older people master their operation. Additionally, we suggest developing a travel app for the elderly that is easy to operate and has a friendly interface, supporting voice input, a large-font display, and voice navigation functions, so that it is convenient for elderly people with poor eyesight or hearing to use. The app integrates services such as public transportation, cabs, and shared bikes. It provides functions such as one-click taxi hailing, shared carpooling, and route planning. Considering the rejection of new technologies by the elderly, while strengthening publicity and education to ensure that the elderly have a sufficient understanding of the new technologies and appropriate psychological guidance, test-driving activities for the elderly on new types of transportation can be arranged. For example, test-drive competitions of autonomous vehicles are held in the community, accompanied by safety drivers, to popularize driving technology while allowing seniors to experience the convenience and safety of the new technology in order to increase interest in driving.

Finally, China, as a developing country that has entered the stage of a moderately aging society and is facing the profound social transformation brought about by population aging, should comprehensively examine and actively respond to the challenge and then consider transportation policy as a key lever for promoting the social integration and independent living capacity of older persons. Within the framework of pursuing the sustainable development of the transportation system, China needs to actively learn from the advanced experiences of developed countries. For example, more cities should join the United Nations Global Plan for Age-Friendly Cities and provide more complementary public transport services for older persons in the area of transportation, so as to reduce their difficulties in getting around. Simultaneously, a series of highly targeted and effective policy measures have been formulated and implemented in close conjunction with the actual situation in the country, for example, strengthening the construction of FTS services and safety-assisted driving technology. Also, the government should focus on sustainable transportation development to lay a solid foundation for the sustainable development of China's aging society in order to achieve the goal of building a strong transportation nation.

In summary, the transportation demand response strategy for the elderly in an aging society faces many problems and challenges. In the future, it will be necessary for the government, enterprises, and all sectors of society to work together to strengthen laws and regulations, optimize transportation planning and design, explore sustainable transportation modes, and enhance the adaptability of the elderly to new technologies to build a more friendly, convenient, and safe transportation environment.

4.3. Limitations

There are some limitations in this study. First, this study lacks first-hand survey data and detailed data that can be used for quantitative analysis. We only systematically reviewed the literature on aging and transportation issues in four countries and categorized the efforts made by the four countries in addressing aging and transportation issues. Therefore, this paper mainly provides qualitative analysis based on the literature review. Secondly, we removed gray literature during the search process and may have missed studies, so we cannot guarantee that our review includes an exhaustive list of relevant studies. Nonetheless, this systematic literature review was conducted following a rigorous methodological search and selection process to identify the state of knowledge on policies to improve age-friendly transportation in the context of an aging population, focusing on scholarly sources.

As high-quality research results in this field continue to emerge, updating the literature review and adopting more refined and systematic means of review and analysis (e.g., structured meta-analysis) will play a crucial role in advancing the development and progress of knowledge in this field. In addition, since the extent of aging and related transportation policies are far from the same across regions, it would be valuable in future research to examine the similarities and differences in policy measures across geographic regions. In this regard, the authors are confident that this systematic literature review will contribute to further investigation of this topic and to timely discussions among policymakers.

5. Conclusions

Taking the U.S., U.K., Japan, and China as examples, this paper systematically reviews the literature related to aging and transportation issues in the four countries and classifies and organizes them into five aspects, namely, laws and regulations, planning and design, policy measures, transportation infrastructure and services, and technology development, and then compares and analyzes the efforts made and the challenges faced by the four countries in coping with the problem of aging and transportation. Through our research, we have found that countries are increasingly aware of the impact of population aging on the formulation of transportation policies and have continued to take active measures in various aspects such as laws and regulations, planning and design, policy measures, transportation infrastructure and services, and technological development. Specifically, first, the U.S. and Japan have relatively well-developed legal systems for the protection of the rights and interests of the elderly in transportation, while China and the U.K. have relatively weak legal frameworks. Second, the U.K. and the U.S. have achieved remarkable results in building sustainable communities, and their experiences have been widely utilized by China and other countries. In contrast, Japan's top-level planning in this area is still insufficient. Third, each of the four countries has its own characteristics in terms of government measures and transportation infrastructure services, but they are generally faced with the challenge of preferential fare policies that increase the pressure on national finances. Fourth, while emerging transportation technologies are increasingly being used for the safe mobility of older persons, older persons still face significant barriers to adapting to and adopting these technologies.

Overall, our study highlights that optimizing age-friendly transportation policies is a common theme across these five key areas, which is of great academic value to the global aging society. This paper suggests strategies like stepped fare concessions, consideration of the psychological adaptation of the elderly in technological innovations, and synergistic cooperation among all sectors of society to address the various challenges in implementing these policy measures, and advocates the development of sustainable transportation. These strategies will provide China and future developing countries that will soon enter an aging society with useful practical guidelines and insights. Through these efforts, we look forward to contributing wisdom to developing transportation in the context of global aging and jointly building a more inclusive, convenient, and safe transportation environment.

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