Ageing and Transport

MOBILITY NEEDS AND SAFETY ISSUES

TRANSPORT

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

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Publié en français sous le titre :

VIEILLISSEMENT ET TRANSPORTS
Concilier mobilité et sécurité

FOREWORD

The baby boom generation's maturation to retirement, lower birth rates and increased longevity are creating dramatic demographic shifts in OECD Member countries. By 2030, baby boomers will account for one in every four persons in the developed world, and by 2050, experts predict a tripling of those aged 80 or more. This "greying" of society will affect virtually every facet of life in the 21st century. Proactive and thoughtful planning is needed to ensure senior citizens' safe, lifelong mobility.

Members of this generation will live longer, more active and healthier lives than earlier generations. However, there is a tendency to associate older people with progressive functional loss and disability, and public perception of the safety of older road users may be based on erroneous information, unsupported by actual crash data. It is important to clarify this situation and to distinguish between their personal risk of injury or death in a crash and the risk some may present to the safety of others.

An OECD Working Group comprised of road safety research practitioners, transport planners and engineers, medical professionals and policy makers has produced the present study, which explores the travel patterns, transport and safety needs and mobility implications of tomorrow's elderly. (A list of members of the group and of the editorial board for the present publication is given in Annex.) The study examines mobility in the context of other societal objectives, including safety, infrastructure provision and accessibility. It aims to inform strategists, policy makers, regulators and the general public of the ageing population's safety and mobility needs. Further, it seeks to dispel many myths and misconceptions about older road users and presents the latest research findings in order to assist decision makers to formulate sound policies and programmes for the safe mobility of ageing populations.

The OECD Working Group has collaborated with the Transportation Research Board of the National Academy of Sciences (United States) and the European Conference of Ministers for Transport, two organisations that address related issues in separate reports.

This volume is published on the responsibility of the Secretary-General of the OECD.

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EXECUTIVE SUMMARY

Introduction

In most OECD Member countries, older adults comprise the fastest growing segment of the population, and in many, one in every four persons will be aged 65 or over in 2030. Over the next three decades, the maturation of the "baby boom" generation (those born between 1946 and 1964), combined with increased longevity and declining birth rates, will markedly transform the developed world's demographics. By 2050, the population of those over 80 years of age is expected to have tripled in most OECD Member countries.

Providing for the ongoing, safe mobility of ageing baby boomers will require active planning and a rethinking of strategies, policies and provision of services in order to support their continued health and well-being into and beyond retirement.

Over the next 30 years, the significant increase in the adult population aged 65 or more will place new and growing demands on transport systems in OECD Member countries. On the whole, older people who drive will prefer to continue doing so for as long as possible. They will also expect to have access to alternative transport modes that meet their individual needs, especially as they approach 80 years of age. Future transport systems and services will play an essential role in supporting independent, healthy ageing.

Providing for the ongoing, safe mobility of ageing baby boomers requires a rethinking of policies and strategies to support their continued health and well-being into and beyond retirement. This volume seeks to dispel many myths and misconceptions about older road users and provides the latest research findings to assist planners and decision makers to formulate sound policies, programmes and services that meet the mobility needs of their ageing populations.

The time horizon, 2030, marks the year when the last of the baby boomers will reach 65 years of age. The analyses, projections and policy recommendations are based on the expected status of older road users in OECD Member countries in 30 years.

The study described in this volume had as its aim to identify current and emerging mobility and safety issues arising from the ageing of the baby boom generation and to develop policy and research recommendations to meet older people's transport needs while maintaining acceptable safety standards. On the basis of literature and policy reviews, analysis of demographic and statistical data and study of recent research findings and case studies, the study has sought to:

- Assess the effects on safety and mobility of changes in demographics, economics and older people's functional abilities.
- Determine the ageing population's travel patterns and the implications for transport needs.
- Evaluate the effectiveness of past strategies for reducing older people's exposure to crash risk and their impact on mobility.
- Identify new strategies for addressing the mobility and safety needs of the elderly, including an assessment of infrastructure provision and maintenance, public transport options, new technology, vehicle design and regulation (*e.g.* driver licensing requirements.).

- Evaluate the extent to which road infrastructure design and maintenance has taken into account the needs of older road users.
- Identify the impact of road infrastructure on older people's safety and mobility.
- Develop and make recommendations on key policy issues concerning the mobility and safety needs of an ageing population.
- Identify marketing strategies to disseminate information to educate, advise and promote ways to improve safe mobility for older road users.

This volume identifies four key issue areas, offers eight major policy recommendations and specifies eight areas for further research (Chapter 10). Issues discussed in the report range from reasonably specific measures (for example, altered vehicle design specifications) to overarching recommendations (such as improved land-use planning). The study attempts to identify the main policy issues flowing from the analysis of the mobility needs and safety problems of an ageing society. It considers measures for targeting key decision makers associated with specific issues so that they are informed of the recommended policy options.

Key issues

Safety, mobility, land use and socio-economic factors are the principal areas addressed:

- Older drivers tend to be safer than is commonly believed. They have fewer reported crashes per capita or per number of drivers. The most important safety concern is their frailty and consequent vulnerability to personal injury or death in a crash. Older pedestrians have higher fatality rates than younger ones; they account for nearly half of all pedestrian fatalities in many OECD European countries.
- Older people who suffer from health-related limitations must often cease walking or using public transport before they cease driving.
- In most OECD Member countries, older people tend to age in place. Well-planned communities facilitate ageing in place, and improved land use planning is paramount to facilitating lifelong mobility.
- The ratio of working to retired persons is decreasing and hence generating less funding to support retirement pensions and health care programmes for older adults. Governments therefore need to anticipate the mobility and safety needs of older adults.

Major policy priorities identified

The following eight policy priorities are identified:

- Support and funding to enable lifelong mobility.
- Support for older people to continue driving safely.
- Provision of suitable transport options to the private car.
- Safer vehicles for older people.
- Development of safer roads and infrastructure.
- Appropriate land-use practices.
- Involvement of older people in policy development.
- Educational campaigns to promote maximum mobility and safety for older people.

Support and funding to enable lifelong mobility

Governments face substantial challenges for developing integrated approaches to supporting lifelong, safe mobility and for raising the level of awareness of the coming needs of an ageing population so that this issue has budget parity with other national priorities.

- National governments need to recognise and then demonstrate the cost savings to be achieved through the support of lifelong mobility.
- Mobility provides a link to independence, freedom of movement, social activity and choice.
- The ability to travel is as important to older people as to other age groups.
- Continued mobility and access to services will be best achieved in conjunction with successful strategies for ageing in place. The sooner governments act, the better. By 2030, it is unlikely that there will be sufficient public funds to support the wide range of programmes and services needed. A proactive rather than a reactive approach is vitally important.

Support for older people to continue driving safely

As the number of older people in OECD Member countries increases over the next 30 years, most will have driving licences and access to cars and will prefer driving as their primary means of transport.

- This policy objective will require support from all levels of government, health and social service providers, caregivers, families, transport planners, licensing bureaux, enforcement agencies and businesses.
- Mandatory age-based testing appears to be ineffective. A licence management alternative that targets only those drivers considered at higher risk is recommended. Thus, assessments can be more thorough and individually tailored. This will require a community-based referral system involving doctors and health professionals, police, community workers, friends and families of older drivers and older drivers themselves.
- It is necessary to define more clearly and support driver assessment and rehabilitation approaches for those afflicted with significant functional impairment that can affect safety.
- Media campaigns will need to relay information to the public and raise general awareness, particularly in countering the misconceptions that create a distorted image of older road users.

Provision of suitable transport options to the private car

By 2030, the health of older people may well be much better than at present. Nevertheless, a sizeable proportion of the older population will have some type of disability. What transport options will be most suitable for meeting the diversity of older people's functional abilities? How can older people best be encouraged to use the appropriate mobility options?

- Transport services must be designed to suit older users if they are to serve as viable alternatives to the private car.
- Changes to the physical infrastructure to support ease of use of alternative transport options need to be identified and implemented. Public-private partnerships offer opportunities to leverage public funds to provide improved transit services.
- Mobility management programmes for functionally limited older people need be developed to support their transition to user-friendly transport options over time. Effective introduction of this new approach would benefit substantially from comprehensive demonstration projects and regular information sharing.

Safer vehicles for older people

New technologies can make a significant contribution to improving the safety and use of roads, streets and vehicles by older drivers and passengers, pedestrians, cyclists and public transit riders. Unless there are marked improvements in vehicle safety features, there will be a significant increase in fatalities for older drivers and pedestrians, more than for any other age group.

- Vehicle manufacturers must be mandated or encouraged to increase substantially the protection of vehicle occupants in the case of a crash and to design vehicles with less aggressive external characteristics in order to protect pedestrians.

- Vehicles need to be designed to be easier for older people to drive.
- Particular attention needs to be given to evaluating new technologies to ensure that older people can use it comfortably.

Development of safer roads and infrastructure

Governments are urged to continue to improve roads to make them safer and easier for older people to use. In particular, policies are needed to:

- Provide safer roads and roadside environments for older drivers, pedestrians, cyclists and users of powered wheelchairs and scooters. Improved pedestrian safety for older users will require policy initiatives that address personal security concerns. Improved road environments will facilitate or reduce older drivers' need to make complex decisions and perform time-related tasks and will give them advance notice.
- Make roadways and advisory systems standard and consistent across different jurisdictions
- Keep abreast of technology, which plays an important role in improving the intrinsic safety of the road system.
- Provide user-friendly and convenient public transport, featuring low-floor buses and trams to facilitate kerbside access to these vehicles.

Appropriate land-use practices

There is an urgent need for governments to improve their land-use planning if ageing in place is to be a major strategy for managing the mobility and safety needs of older people.

- In particular, it is vital to develop local services and facilities appropriate to an ageing community and supported by sufficient transport services.
- New practices arising from improved land-use planning include the need for proposed road and pedestrian networks to meet road safety standards while providing efficient public transport routes.
- Where sidewalks and safe road crossings are lacking, consideration should be given to retrofitting these where appropriate.
- Measures that improve the environmental sustainability of communities are similar to those needed to enable older people to maintain independent mobility.
- Where cycle routes are introduced for more sustainable transport, these should provide the infrastructure needed for powered wheelchairs, scooters and other unlicensed low-speed alternatives to the car.
- Provision of an adequate policy framework and practical guidelines for regional and planning authorities to implement such improvements would be beneficial. This action could be very effectively supported by a number of demonstration projects in partnership with the private sector.

Involvement of older people in policy development

Formulating effective policy to address safe mobility for an ageing society must involve older people and their caregivers in a comprehensive and meaningful way. It must be recognised that no single solution will satisfy their diverse needs, expectations, preferences and lifestyles. Flexible policy approaches are needed.

As older people, baby boomers will be better educated and more politically involved than earlier generations, and they are expected actively to seek the means to meet their needs. By their sheer numbers, this group will be a formidable political and social force and will compel decision makers to respond to their demands for services.

Directly involving ageing populations in the development of relevant processes and achieving beneficial outcomes will be a challenge for local, regional and national governments. Families, businesses and professional organisations must also be involved in developing measures that meet the mobility and safety needs of older people. Failure to respond to this challenge in an integrated way across all levels of government is likely to result in misguided and therefore rejected programmes and policies.

A key policy issue relates to the acceptable balance between mobility and safety. Research indicates that the greatest safety risk to older road users is the possibility that they will be injured or die in a crash because of their fragility. As the principal group at risk, older people clearly need to be involved in formulating policy responses to the mobility risks they routinely face.

Educational campaigns to promote maximum mobility and safety for older people

As governments address the safety and mobility needs of older people, it is important to ensure that all decision makers and stakeholders are well informed of these requirements and have access to information on the measures needed to promote them.

- Community awareness programmes need to be conducted over the next five to ten years, with the following objectives:
  - Inform all segments of the community and policy makers that older drivers do not represent a major risk to other road users.
  - Establish that older people in particular (and society overall) will benefit substantially by remaining mobile.
  - Persuade all age groups to support the transport options developed for older people.
  - Educate key decision makers in all areas relevant to older people, especially but not only those involved in transport.
- Educational campaigns that promote the concept that older people can most easily meet their transport needs by driving will pose sizeable political and policy challenges.
- Policy makers will also need to address the practical aspects of educational campaigns that promote existing (and new) transport options. In particular, it is important to convince designers of alternative transport modes that they need to be practical for all users and not just for the disadvantaged or disabled.
- Regular information and guidance will need to be provided about availability of services, schedules, location of stops, etc., in an easily understood and readily accessible manner, to support the perception, and the reality, that alternative transport systems are safe and user-friendly.
- These programmes should include informational materials to help the media correctly depict older adults' mobility and dispel inaccurate stereotypes.
- People need to be informed about the importance of preparing for access and mobility needs before they reach retirement age. This will enable them to make informed decisions while they have various options available.
- Governments may assist in these programmes by offering incentives to people to encourage them to reside closer to transport services and other facilities and to land developers to design accessible communities.

Recommendations for research and development

There is a pressing need for co-ordinated research and subsequent development in OECD Member countries if older people are to be provided with safe mobility through to 2030 and beyond. While each Member country may undertake efforts to address this challenge on its own, collaboration on research and sharing of best practices and relevant information offer great potential.

The eight research and development recommendations made here are:

- Improve older peoples' ability to avoid/survive crashes.
- Improve the assessment and rehabilitation of older drivers.
- Determine, demonstrate and promote the societal benefits of providing road improvements.
- Determine, demonstrate and promote the societal benefits of providing older people with continued, safe mobility.
- Provide transport options in an efficient and cost-effective way.
- Support health improvements for older adults.
- Enhance land-use planning and sustainable communities.
- Encourage cross-national co-operation in the development of data and information sources.

Improve older peoples' ability to avoid/survive crashes

- Automobile manufacturers, supported by motor vehicle regulators in Member countries, should work to develop better motor vehicle safety standards for older, more fragile road users as vehicle occupants, pedestrians and cyclists.
- Manufacturers and designers should examine the possibility of extending the driving life of older people by offering maximum assistance to compensate for functional limitations.

Improve the assessment and rehabilitation of older drivers

In order to promote continued safe use of motor vehicles:

- National governments, working with universities and other research groups, should develop a programme of research and development to identify the functional limitations that preclude safe driving.
- The programme should also aim to identify functional limitations that can be overcome and to describe effective rehabilitation options.
- Equally important is the need to work with health and social service programme developers to identify and demonstrate programmes that can reduce the likelihood of people becoming functionally impaired as they age.

Determine, demonstrate and promote the societal benefits of providing road improvements

National governments, working with universities and other groups, should develop programmes to demonstrate the road improvements that will enable older people to drive, walk and use alternative transport options safely well into old age.

- Guidelines to improve roads for older people developed in the United States and in Australia need to be evaluated through a series of demonstration projects so that the most beneficial aspects can be identified and applied in other Member countries.
- Since many measures, of varying cost-effectiveness, have been taken to improve the road system, co-ordinated demonstrations across co-operating OECD Member countries should be undertaken to identify the most cost-effective. The value of such measures in terms of design or remediation ("black spots") needs to be established to determine where funding can be most efficiently directed.

Determine, demonstrate and promote the societal benefits of providing older people with continued, safe mobility

International organisations should work together to foster co-operation in programmes aimed at improving the safe mobility of older people, including broad dissemination of results to promote best practices for transport options.

- Particular attention should be paid to activities that are initially costly and require time to prove their effectiveness, such as the development of sustainable communities that allow people to age successfully in place and the development of road improvement programmes and driver assessment and rehabilitation programmes.
- Additional areas that need to be addressed include transport options, health, vehicle crash worthiness and co-operative research.
- National and regional governments, working with universities, transport providers and other advocacy groups, should conduct co-ordinated demonstration projects using tailored approaches to provide transport to people with different types of impairment.

Support health improvements for older people

National and regional governments, in collaboration with universities, medical institutions and stakeholder groups should co-ordinate research and conduct demonstration projects to explore whether the functional limitations that affect the mobility of older people can be reduced.

- Particular attention should focus on health, fitness and wellness programmes that help to reduce frailty.
- There is a need for in-depth studies of the relationship between quality of life, welfare and health costs and the degree of mobility of older people in different OECD Member countries.

Enhanced land-use planning and sustainable communities

National and regional governments, working with universities and appropriate interest groups should conduct co-ordinated research and demonstration projects to enhance ageing in place through better land-use planning.

- Particular attention should be given to finding ways to locate residential areas closer to the goods, services and facilities needed by older people. To improve land-use planning, comprehensive cohort studies of travel patterns are needed. In addition, studies are needed on preferences for retirement housing and activities to improve knowledge of the "new old" in different social and cultural contexts as well as on mobility solutions for older people (public and private) in different countries.

Encourage cross-national co-operation in the development of data and information sources

- National and regional governments, working with universities and appropriate interest groups, should design a standardised, personal transport survey that Member countries can adopt and administer in order to identify changes in transport patterns over time and permit cross-national comparisons.
- A system needs to be designed to record annual driver licensing numbers and crash and injury numbers for road and other transport modes to be used by OECD Member countries to monitor possible shifts in transport safety.
- Finally, a health survey needs to be designed and conducted regularly across all Member countries to track the expected continuation of improvement, or identify specific areas of deterioration, in older people's health and well-being.

Chapter 1

THE AGEING SOCIETY

Introduction

In most OECD Member countries, older adults comprise the fastest growing segment of the population, and in many, one in every four persons will be aged 65 or over in 2030. Over the next three decades, the maturation of the "baby boom" generation, combined with greater longevity and declining birth rates, will markedly transform the developed world's demographics.

Providing for the ongoing, safe mobility of ageing baby boomers requires a rethinking of policies and strategies to support their continued health and well-being into and beyond retirement. This volume seeks to dispel many myths and misconceptions about older road users and provides the latest research findings to assist planners and decision makers to formulate sound policies, programmes and services that meet the mobility needs of their ageing populations.

The report's nine chapters address the following topics: demographic, social and economic aspects of an ageing society, travel patterns of older road users, safety of older road users, transport infrastructure, vehicle design to improve mobility and safety of older users, managing older drivers, alternatives to the car, land-use, and publicity and education.

To provide a framework , this chapter looks at the growth in the number and proportion of older people expected over the next 30 years, the economic impacts of this demographic change, the likely health status of future cohorts of older people and the implications for safe mobility arising from the ageing of society.

Demographic factors

The "greying" of society

The 21st century will experience a significant shift in the age distribution of populations. Experts predict that by 2030, there will be 261 million people aged 65 or more living in OECD Member countries. This represents a substantial increase over the 145 million currently in this age group.

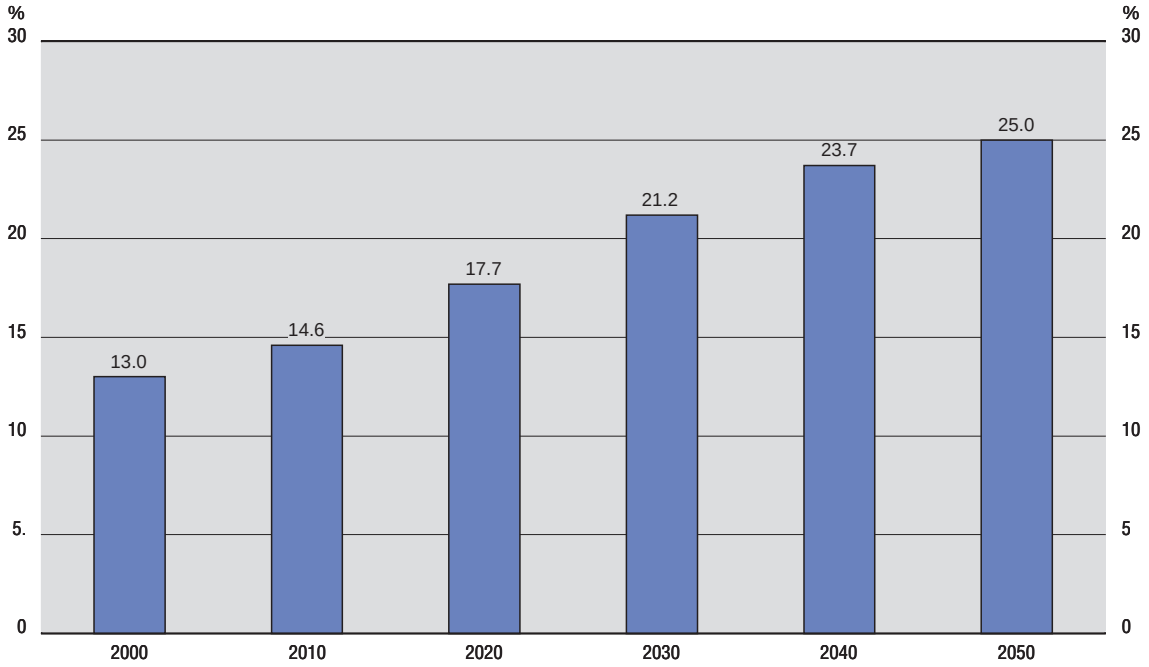
Figure 1.1 illustrates the projected increases in the share of the population aged 65 years or older between 2000 and 2050 for all OECD Member countries. As the figure shows, the gradual rise in the proportion of older people is expected to intensify so that by 2030, one in every four people in the developed world will be 65 years or older.

This change in the age distribution can be attributed to two main factors:

- D*eclining fertility*: in developed countries, the fertility rate has fallen below the replacement rate of 2.1 (Centre for Strategic and International Studies and Watson Wyatt Worldwide, 1999).
- I*ncreasing longevity*: In western Europe over the past 25 years, life expectancy has increased from an average of 1.3 to 1.6 months a year for men and 1.5 and 2.0 months a year for women (Oxley, 1998).

Table 1.1 displays the actual and projected percentage of the population aged 65 or more for individual OECD Member countries over the period 2000-50. By 2030, the number of people aged 80 or more will have doubled and by 2050, it will have tripled. This segment of the older population is expected to require specific attention, including the provision of safe mobility.

Figure 1.1. **Projected percentage of population aged 65 or more for all OECD Member countries, 2000-50**



Source: US Bureau of the Census, 2000.

Table 1.1. **Percentage of the population aged 65 or more in OECD Member countries, 2000-50**

	2000	2010	2020	2030	2040	2050
Australia	12.6	14.3	18.4	22.1	24.5	25.2
Austria	15.6	18.2	21.4	28.0	33.5	35.2
Belgium	17.1	18.4	22.3	27.8	31.4	33.3
Canada	12.6	14.2	18.2	22.8	24.2	24.7
Czech Republic	13.8	15.5	20.5	23.1	26.7	31.3
Denmark	14.9	17.0	21.1	24.9	29.0	30.3
Finland	14.9	17.1	22.9	26.7	28.1	30.2
France	16.1	17.2	21.6	25.8	29.4	31.8
Germany	16.5	20.5	23.2	29.6	34.6	36.0
Greece	17.2	18.9	21.5	25.7	31.6	36.6
Hungary	14.6	16.1	20.2	22.9	27.2	32.5
Iceland	11.9	12.9	16.7	21.3	23.8	26.1
Ireland	11.3	12.3	15.8	19.2	23.5	29.5
Italy	18.2	20.8	24.2	29.3	35.8	37.9
Japan	17.0	21.5	26.3	27.4	30.6	32.1
Korea	6.9	9.8	13.3	19.6	24.7	27.0
Luxembourg	15.2	17.5	21.8	28.0	31.2	32.1
Mexico	4.3	5.5	7.4	10.2	14.2	18.0
Netherlands	13.7	15.7	20.9	26.5	31.2	32.3
New Zealand	11.6	12.6	15.6	18.3	21.8	23.8
Norway	15.3	15.8	19.7	23.5	27.4	28.7
Poland	12.2	12.8	17.3	21.2	23.1	28.0
Portugal	15.5	17.4	20.4	25.5	31.7	36.0
Spain	16.8	18.1	20.8	26.1	33.0	37.9
Sweden	17.2	18.7	21.7	24.1	26.4	27.4
Switzerland	15.2	18.0	22.5	28.8	32.7	33.4
Turkey	6.0	7.3	9.1	12.6	16.6	20.2
United Kingdom	15.7	16.5	19.4	23.5	26.6	27.6
United States	12.6	13.2	16.5	20.0	20.3	20.0
All OECD countries	13.0	14.6	17.7	21.2	23.7	25.0

Source: US Bureau of the Census, International Database (IDB).

Table 1.2. **Percentage of the population aged 80 or more in OECD Member countries, 2000-50**

	2000	2010	2020	2030	2040	2050
Australia	3.1	4.2	4.8	6.6	8.4	9.7
Austria	3.6	5.0	5.9	7.8	10.6	15.0
Belgium	3.6	5.4	6.4	8.0	10.9	13.5
Canada	3.1	4.0	4.5	6.1	8.2	9.3
Czech Republic	2.4	3.7	4.3	6.9	8.6	9.9
Denmark	4.0	4.4	5.2	7.7	9.4	12.0
Finland	3.4	4.6	5.5	8.3	10.5	11.8
France	3.8	5.5	6.1	7.9	10.3	12.2
Germany	3.7	5.1	7.2	8.3	11.3	15.9
Greece	3.6	5.2	6.8	7.8	10.0	13.2
Hungary	2.6	3.9	4.8	6.5	9.0	10.3
Iceland	2.8	3.6	4.0	5.5	7.9	9.3
Ireland	2.7	3.0	3.6	5.2	7.1	8.6
Italy	4.0	6.0	7.6	9.2	11.4	15.5
Japan	3.7	5.7	7.8	10.5	10.9	11.9
Korea	0.9	1.6	2.8	4.0	6.7	9.3
Luxembourg	3.3	4.6	5.8	7.7	10.9	13.8
Mexico	0.6	0.9	1.3	1.9	2.9	4.4
Netherlands	3.2	4.1	5.0	7.5	10.1	13.3
New Zealand	2.8	3.5	3.9	5.2	6.6	8.0
Norway	4.5	4.8	4.8	7	8.9	11.1
Poland	2.0	3.2	3.9	5.2	8.1	8.6
Portugal	3.1	4.5	5.8	7.2	9.6	13.2
Spain	3.7	5.3	6.2	7.7	10.0	13.8
Sweden	5.1	5.5	5.7	8.0	9.0	10.6
Switzerland	4.0	4.9	6.0	8.4	11.1	14.5
Turkey	0.9	1.4	2.0	2.7	4.0	5.8
United Kingdom	4.1	4.8	5.2	6.9	8.5	11.0
United States	3.3	3.8	3.8	5.2	7.1	7.7
All OECD countries	3.0	3.9	4.6	6.0	7.6	9.1

Source: US Bureau of the Census, International Database (IDB).

In 2050, the following countries are expected to have one-quarter or more of their population aged 65 or more: Austria, Belgium, Finland, France, Germany, Greece, Italy, Japan, Luxembourg, the Netherlands, Portugal, Spain and Switzerland. Moreover, by 2050 the proportion of those over age 65 is expected at least to have doubled in most countries.

Growth of the share of older people is more marked for the segment of the population aged 80 years or more. Table 1.2 shows the actual and projected percentages of the population aged 80 or more for individual OECD Member countries, for the period 2000-50.

Other demographic changes

Changes in the age structure affect the size of the potential workforce relative to total population levels. Table 1.3 shows that by 2030, the working age population (25-64 years) is expected to decline in most OECD Member countries. Germany, Japan, Switzerland and the United States are expected to experience decreases of more than 5%. Ireland, Mexico and Turkey are notable exceptions, with projected increases in excess of 5%.

The reduced fertility rate is also affecting family structure. Today, older people typically have two or more children, who often live nearby. At least one is often willing to care for an ageing parent. This will change as baby boomers age, particularly in countries with low birth rates where they are more likely to have only one child or no children. They are also more likely never to have married. In other words, baby boomers will be less likely to have an immediate family member to act as caregiver in their old age (Centre for Strategic and International Studies and Watson Wyatt Worldwide, 1999).

Table 1.3. **Percentage increase of population aged 25 to 64 in OECD countries, 2000 and 2030**

	2000	2030	+/-
Australia	53.0	50.1	–2.9
Austria	56.3	52.3	–4.0
Belgium	53.9	51.3	–2.6
Canada	54.8	50.7	–4.1
Czech Republic	54.4	53.0	–1.4
Denmark	55.2	52.5	–2.7
Finland	54.2	50.2	–4.0
France	52.4	51.9	–0.5
Germany	57.4	51.5	–5.9
Greece	53.2	54.5	1.3
Hungary	53.4	55.3	1.9
Iceland	49.8	51.4	1.6
Ireland	49.5	54.8	5.3
Italy	56.0	52.3	–3.7
Japan	55.4	49.9	–5.5
Korea	54.8	53.0	–1.8
Luxembourg	55.8	50.7	–5.1
Mexico	41.2	52.4	11.2
Netherlands	56.4	52.2	–4.2
New Zealand	51.4	52.6	1.2
Norway	52.9	52.1	–0.8
Poland	51.7	51.8	0.1
Portugal	53.3	54.4	1.1
Korea	54.8	53.0	–1.8
Spain	53.8	54.3	0.5
Sweden	52.5	50.6	–1.9
Switzerland	56.5	50.7	–5.8
Turkey	44.5	52.7	8.2
United Kingdom	53.0	51.2	–1.8
United States	52.0	46.8	–5.2

Source: US Bureau of the Census, International Database (IDB).

Many OECD countries will experience these changes as their overall population is decreasing. Figure 1.2 shows that only in eight countries is the population expected to grow by 2030, with only six expecting growth in excess of 20%: Australia, Canada, Mexico, New Zealand, Turkey and the United States. All European countries and Japan can expect to see their population decrease, and by more than 20% in Austria, Belgium, Germany, Greece, Hungary, Italy, Portugal, Spain and Switzerland.

Some economic considerations

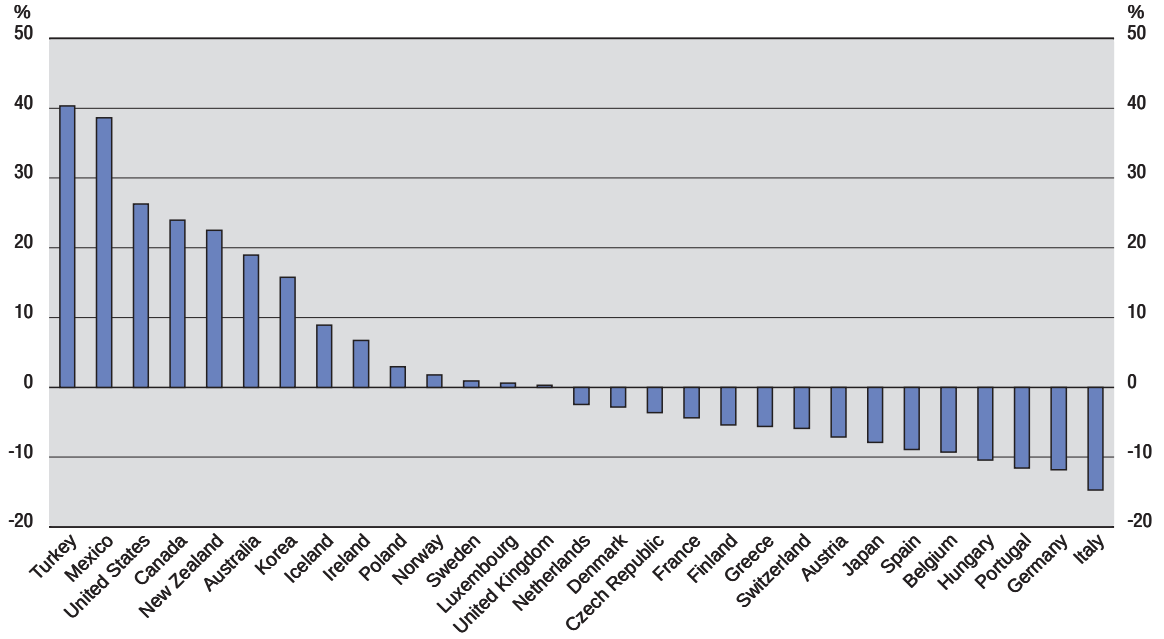
By 2030, the number of retired baby boomers will have mushroomed while the working age population will have dwindled.

- The current ratio of tax-paying workers to non-working pensioners in the developed world is 3:1.
- By 2030, this ratio is expected to decrease to 1.5:1 and in some countries may drop to 1:1 or lower (Centre for Strategic and International Studies and Watson Wyatt Worldwide, 1999).

By 2030, the decrease in the overall population and the dwindling tax base is also likely to lead to shrinking domestic markets. The decline in the share of the population aged 20-39 years – traditionally the principal consumer market for home-buying and family-raising activities – is expected to contribute to a widespread economic downturn (Centre for Strategic and International Studies and Watson Wyatt Worldwide, 1999).

Baby boomers have arguably received more services and social facilities than any other cohort in recent history. As older people, they are likely to be more affluent, better educated and more politically active than earlier generations. They are likely to pursue their needs vigorously. Given the economic projections, their demands may exceed what the economy can supply unless adjustments are made. It has been conjectured that as baby boomers confront retirement with insufficient personal

Figure 1.2. **Percentage change in total population of OECD Member countries, 2000-30**



Source: US Bureau of the Census, International Database (IDB).

savings and reduced public pension programmes, they may decide to continue working. This is likely to be welcomed by policy makers, as it will contribute to, rather than draw from, the public purse (Centre for Strategic and International Studies and Watson Wyatt Worldwide, 1999).

Economic forecasting is fraught with risk. It remains likely, however, that in the next three decades, health and pension costs will overshadow other demands. Table 1.4 shows actual and expected growth in government spending on health and pension benefits in G7 countries, 1960-2030.

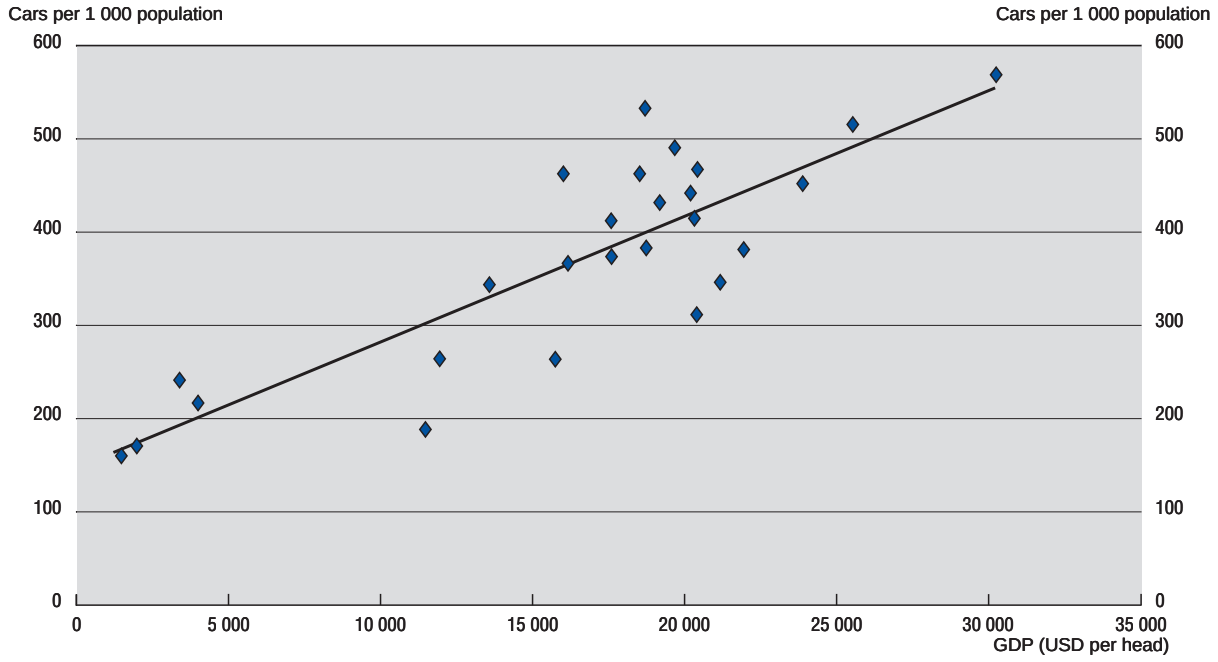
In particular, as they age, the baby boom generation will have high expectations with regard to maintaining personal mobility. Considerable changes and improvements to the transport system will be needed to provide older people with safe mobility, and these will inevitably require substantial funding. By 2030, it is likely that there will be insufficient public funds to make these changes, given the expected mushrooming of pension and health programmes. Accordingly, it is sensible to take a proactive rather than reactive stance to meeting these imminent transport needs at a time when the public purse can more readily afford them.

Table 1.4. **Government spending on pensions, health benefits and defence in G7 countries**
As a percentage of GDP

	1960	1995	2030
Pension benefits	4.8	7.9	12.1
Health benefits	2.5	6.3	11.6

Source: Centre for Strategic and International Studies and Watson Wyatt Worldwide, 2000.

Figure 1.3. **Numbers of cars as a function of per capita GDP**
1994 data



Note: Cars = 146 + .0136 GDP.
Source: Oxley, 1998.

The impending scarcity of financial resources may have another major impact in the transport context, namely, the reduced availability of private vehicles. Vehicle ownership is closely related to household income, as Figure 1.3 shows (based on 1994 data from Australia, Canada, Japan, New Zealand, the United States and 21 European countries).

The current trend towards greater use of the private car and the consequent decline in the use of public transport in many countries is discussed in Chapter 2. Figure 1.3 suggests that at least one factor may counter this trend in the foreseeable future and lead to a renewed demand for other transport options.

Ageing and disability

The onset of disability[1]

Approximately one-third of all people of retirement age are disabled in some way, and the association of ageing and the onset of disability has long existed. It has been estimated that in most developed countries, about 12% of the adult population are disabled, and about two-thirds of those disabled are aged 65 years or older. An illness may affect people differently and also affect mobility to differing degrees. For example, while dementia may affect 7% of those aged 65 or more, those with a mild form may be minimally disabled, while those with a severe form may be so disabled as to need being removed from the independently mobile population.

Table 1.5 shows sample prevalence rates for age-related diseases for those over 65 years of age, and Figure 1.4 shows the development of the association between ageing and disability in Great Britain.

1. The material presented in this section draws heavily on the data and conclusions of Oxley, 1998.

Table 1.5. **Sample prevalence rates for age-related diseases for people aged 65 or over**

Age-related disease, 65 years and older	Sample prevalence rates, by %
Dementia	6.4[a]-0.9[b]
After-effects of stroke	7[c]
Arthritis affecting function	11.6[d]

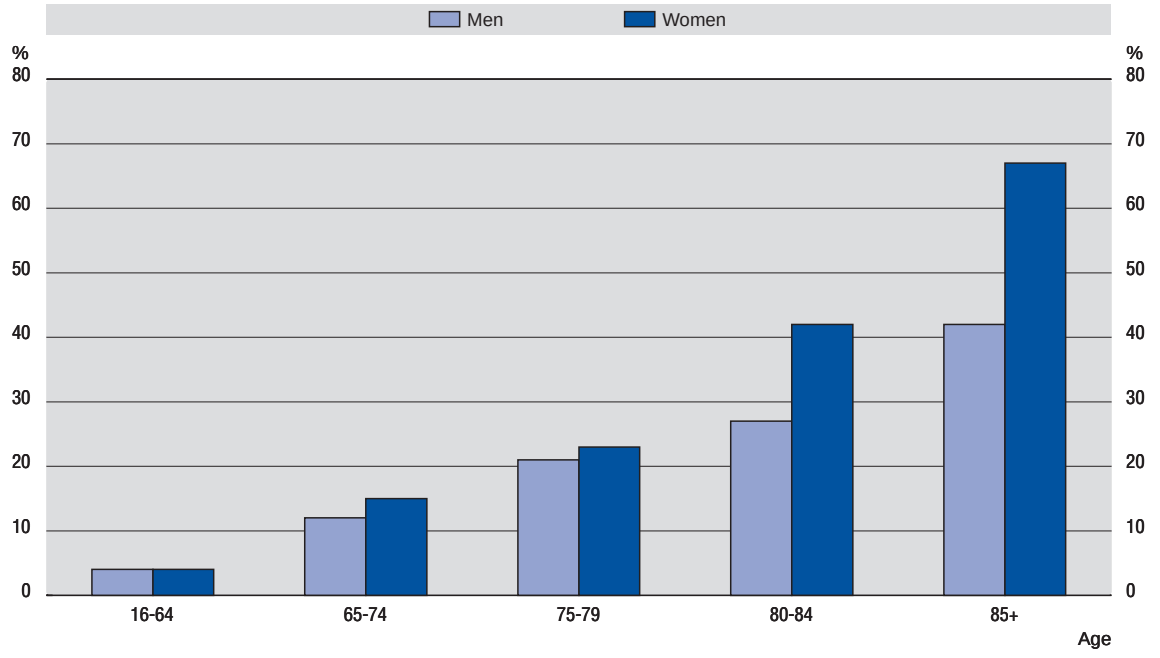
Sources: *a*) Lobo *et al.*, 2000; *b*) *Canadian Study of Health and Ageing*, 1994; *c*) Gresham *et al.*, 1979; *d*) MMWR *Weekly*, 1994.

Disabling conditions associated with ageing that have some impact on driving performance and/or crash risk include: visual conditions (cataracts, glaucoma, visual acuity etc.), cardiovascular conditions, cerebro-vascular conditions, insulin-dependent hypoglycaemia, reduced memory, cognitive skills and cognitive processing, dementia (including Alzheimer's disease), mental illness, severe muscular and skeletal disorders (including arthritis and back pain), loss of upper body strength, loss of lower body strength, neurological disorders (including epilepsy and multiple sclerosis) (Fildes *et al.*, 2000).[2]

In addition, these and other conditions have implications for using transport options other than the car, both in terms of access and risking injury when using them. These issues are discussed in more detail in later chapters.

Nonetheless, at present, most men and women can expect to maintain an active, largely disability-free life up to their mid- to late 70s. For men, the onset of more severe disability is liable to occur at the

Figure 1.4. **Percentage of people in Great Britain reporting mobility difficulties of any sort, 1996**



Source: Data from ONS/SSD, 1999.

2. A more detailed review of age-related impairments, including specific relative risks for crash involvement, can be found in Staplin, 1999.

end of their 70s and for women, in their early 80s. Figure 1.5 shows recent trends in life expectancy and disability-free life in certain OECD countries.

It is critical to social planners and others to determine whether longer life will be accompanied by continued good health or whether increased longevity will increase the number of years of disabled living. While the data to support the extension of disability-free life are still emerging, the evidence is promising:

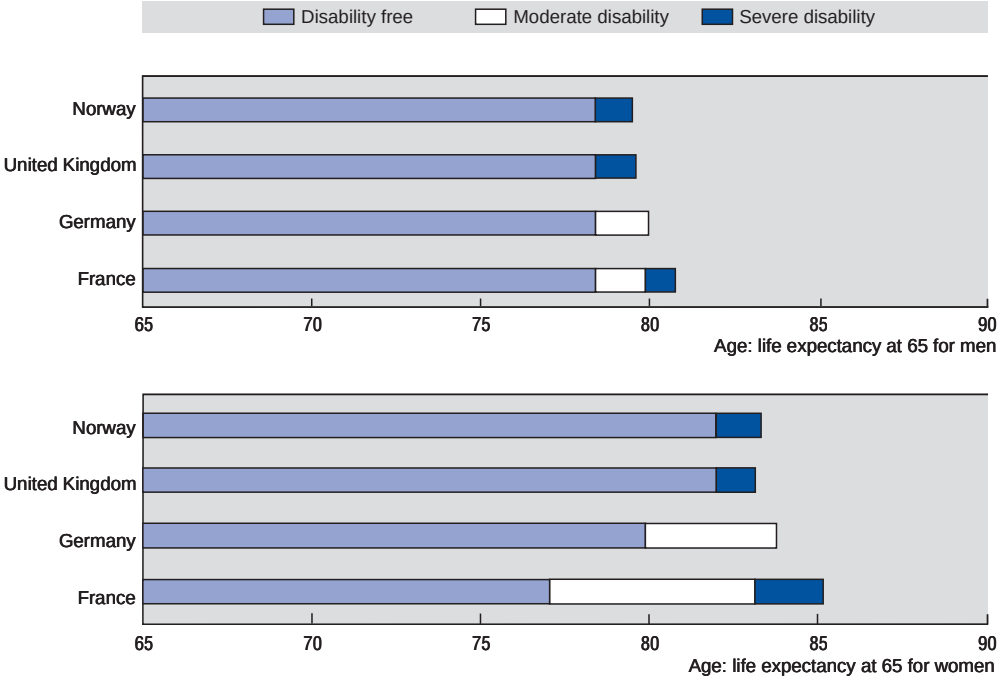
- US data show a decline of 1.3% in the annual disability rate of older Americans over the period 1982-94 (Manton *et al.*, 1997). This means that there are 1.2 million fewer disabled people in the United States at the present time than would have been expected.
- Survey data from other industrialised countries also point to an increase in the amount of time that older people can expect to live without disability. These countries include Belgium, France, Germany, Italy, the Netherlands, Norway, Switzerland and the United Kingdom.

There are, however, differences in the reduction of moderate disability compared to severe disability. The increase in a life free from moderate disability is consistently greater than the increase in life expectancy. The changes in a life free from severe disability relative to life expectancy are more variable. Some implications for mobility and safety

Reductions in age-related disability may well intensify in future years:

- At public health level, the development of lifestyle and environmental policies that favour healthy ageing throughout one's life are known to be effective and could have greater impacts in the future (Barker *et al.*, 2000).
- Specific interventions at the time of retirement have also been shown to promote health in later life. For example, control of high blood pressure in older people can halve their susceptibility to develop

Figure 1.5. **Life expectancy and the onset of disability**



Source: Oxley, 1998.

Alzheimer's disease and targeting lifestyle and risk factors for cardiovascular disease has also been effective (Forette *et al.*, 1999; Pearce *et al.*, 1995). Other illnesses that can be managed, thereby improving mobility and transport safety, include arthritis, cataract, stroke and dementia (O'Neill, 2000).

- Further, across-the-board improvements in detection and rehabilitation arising from advanced technology may well forestall or minimise difficulties posed by a range of disabilities currently affecting older people.

Nonetheless, absolute increases in the number of disabled older people can be expected. Although individual conditions rarely show a strong correlation with involvement in crashes, they can collectively make driving and other forms of mobility more difficult and place some older people at increased risk of involvement.

In assessing whether disabling conditions that are not susceptible to rehabilitation should lead to reduction of mobility options, particularly driving, a number of steps need to be taken:

- Determine whether an identified health condition has functional consequences that are relevant to mobility and the use of transport options.
- If functional consequences are identified, determine whether they necessarily lead to increased risk of injury or whether the individual can compensate for any impact.
- If substantial risk of injury remains, determine and, where feasible, implement countermeasures to reduce the risk.
- If there is still a heightened risk of injury, balance the costs of this risk against the cost of any consequent reduction in the individual's mobility.

Although diminished health and consequent loss of function are widely recognised as key determinants of putting an end to driving, older people rarely seek advice on means of improving their health status before they altering their behaviour as regards mobility. This may be attributed at least in part to the absence of widely disseminated information on ways to improve health related to mobility. It will be increasingly important to promote the development of means that enable primary care providers to promote mobility and social inclusion.

In summary and under the best of conditions, it is likely that by 2030 substantial numbers of older people will be disabled to such an extent that their mobility is reduced. Implications of this development are detailed in later chapters.

Conclusions and key points

- By 2030, when the last of the baby boomers has reached retirement age, the share of people aged 65 years or over in OECD Member countries will have almost doubled, with women in the majority. The rate of growth in the proportion of older people will be more marked for those aged 80 years and more.
- As part of the ageing of society, the size of countries' workforces will diminish relative to those on pensions or retired. Shrinking tax bases will mean reduced economic capacity to respond to the transport needs of older people, particularly owing to the expected mushrooming in pension and health costs.
- Because of reductions in family size, older people will have fewer or no immediate family members available to assist them as caregivers. Pressure on society to provide substitute services and facilities is therefore expected.
- It has been found that car ownership falls as GDP falls. If an economic downturn occurs over the next three decades, this may serve to create additional demand for public transport and other mobility options at a time when funds will be especially scarce.
- Future cohorts of older people are generally likely to be healthier and more active than the current ones. However, owing to the increase in the absolute number of people aged 80 or more, more people over 80 may have functional disabilities. This development has direct implications for mobility and safety.

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Chapter 2

TRAVEL PATTERNS

Introduction

Travel in everyday life

In Europe, public transport, walking and bicycling are common travel modes. In Australia, Canada and the United States, most trips are made by car, either as driver or as passenger. In the OECD region, on average, people spend 60-80 minutes a day travelling, and each person makes three to four trips a day (US Department of Transportation, Federal Highway Administration, 1997; Department of the Environment, Transport, and the Regions, 1999; Brög *et al.*, 1999).

"Suburbanisation" and widespread access to cars have facilitated the "urban sprawl" that characterises many modern cities in OECD Member countries, especially in North America. However, this is becoming increasingly common in certain European and Asian countries as well. This form of land development has led to high demands for mobility, often making the car indispensable for organising and carrying out everyday activities. As a result, walking and cycling are decreasing in many OECD Member countries. Moreover, people who live quite far from their place of work may be distant from friends, relatives and other social contacts. Frequently, shopping centres and other services are located in areas not served by public transport and beyond a reasonable walking or bicycling range from residential areas. They often require extensive travel by car.

The mobility offered by the car comes at a cost:

- In addition to road crashes, extensive car use has serious environmental consequences: noise, air and water pollution, visual blight and barrier effects and land allocation for transport purposes (such as roadways and parking lots).
- Focus on car travel reduces pressure to develop alternatives for those without a driving licence or access to a car, particularly the poor or disabled, including many older people.

The ability to travel is associated with freedom, activity and choice. The relation between mobility and quality of life is complex. When people have to travel a long distance to access services or shop because nearby alternatives are lacking, mobility becomes a necessary means to an end. For older people as for other age groups, easy access to activities and services is a better indicator of quality of life.

This chapter focuses on the following issues relevant to older road users' travel patterns:

- Analysis of travel survey data from a range of OECD Member countries, both to understand current travel patterns and to predict possible future changes arising from cohort differences.
- Assessment of the role of the private car in travel patterns and the likelihood of possible changes in current car use patterns, owing in particular to expected changes in licensing rates.
- Assessment of the impact of older people's health problems on their ability to use the various transport modes.
- Prediction of other changes in travel patterns.
- Review of the research relating to information and communication technology and its impact on travel needs.

Travel patterns: an effect of cohort, period and age

Today's older people represent a heterogeneous group in terms of health conditions, travel needs and preferences for mode of travel. Future cohorts may well present different patterns in this respect. Over the next three decades, many older people may defer retirement and continue salaried work, become more active in their leisure time and be more capable of driving without problems. Others may experience health problems, require assistance in managing everyday activities and have less money for discretionary spending.

Differences between the current and future travel patterns of older people may arise from three main sources: the age effect, which is related to the ageing process; the cohort effect, which is related to each generation's experiences; the period effect, a set of influences common to all generations at a given time.

Age effects, as reflected in disability and consequent functional loss, are documented in Chapter 1 and elsewhere in this volume. This chapter explores how and to what extent cohort and/or period effects will affect the travel patterns of tomorrow's older person.

Travel patterns and lifestyle in different groups of older people[1]

Access to a car and driving licence

Two prime determinants in choosing a travel mode are access to a car and possessing a driving licence. While most middle-aged people today have a licence, this is less true of today's older people. Consequently, a substantial proportion of them (particularly women) neither currently have nor have ever had a licence. Table 2.1 displays current licence rates for older people in a number of OECD Member countries.

By looking at current licensing levels in conjunction with the demographic projections presented in Chapter 1, it is possible to estimate the number of older licensed drivers expected by 2030. Projections for the 11 OECD Member countries for which licensing statistics were obtained are presented in Table 2.2.

Table 2.1. **Driving licence rates for older people in selected countries**

County and year of survey	Age group	Men (%)	Women (%)
Australia (Melbourne, 1993-94)	65 years and above	75	40
Finland (1998)	65-74 years	79	27
Great Britain (1995-96)	65-69 years	82	34
Japan (1998)	65-69 years	78	19
Netherlands (1998)	65-74 years	81	42
New Zealand (1997-98)	65-69 years	93	73
Norway (1997-98)	67-74 years	93	46
Spain (1998)	65-74 years	71	7
United States (1997)	> 65 years	92	67

Source: Licensing statistics provided to the OECD in response to an OECD survey, 2000.

1. The data discussed in this section are based on travel surveys conducted in Australia (Rosenbloom and Morris, 1998), the United Kingdom (Oxley, 1998; Department of the Environment, Transport and the Regions, 1999), Germany (Brög *et al.*, 1998), the Netherlands (Steenaert and Methorst, 1998; Tacken, 1998), New Zealand (New Zealand Household Travel Survey, 1997-98), Norway (Hjorthol and Sagberg, 1998, Hjorthol, 1999), Sweden (Kranz, 1999) and the United States (Rosenbloom, 2000; US Department of Transportation, Federal Highway Administration, 1997). Although the data occasionally differ in terms of definitions, time of survey, data collection methodologies, scope of information and analysis criteria, they can be compared in terms of overall trends and patterns.

Table 2.2. **Driving licence rates for older people, projected to 2030 for selected OECD Member countries**

	Percentage of licensed drivers aged 65+ in 2000	Percentage of licensed drivers aged 65+ in 2030	Percentage increase in licensed drivers aged 65+
Australia	12.6	22.1	75
Finland	14.9	26.7	79
France	16.1	25.8	60
Japan	17	27.4	61
Netherlands	13.7	26.5	93
New Zealand	11.6	18.3	58
Norway	15.3	23.5	53
Spain	16.8	26.1	55
Sweden	17.2	24.1	40
United Kingdom	15.7	23.5	49
United States	12.6	20	59

Source: Licensing statistics provided to the OECD in response to an OECD survey, 2000.

The 11 countries differ considerably in terms of projected growth rates. They range from a 40% increase in licensed drivers in Sweden, where a large share of the older population already have licences, to a 93% increase in the Netherlands, where a smaller proportion of older people currently hold a licence. Licensing rates among future cohorts of older drivers will be higher, especially for women, owing to the emergence of cohorts who have always had and will continue to expect access to a car. This trend is already evident in a number of OECD Member countries:

- In England in 1995-96, the licensing rate for men 65-69 years of age was 82% while only 34% for women in the same age group. By comparison, for the period 1996-98, for people aged 40-49, 90% of the men and 73% of the women were licensed.
- In Melbourne, Australia, for the age group 65 or more, 75% of all men and 40% of all women were licensed to drive in 1993-94. During the same period, for the age group 44-54 years, nearly all men and 90% of women were licensed drivers.

Holding a driver's licence does not necessarily mean access to a car. The discrepancy between licensing and vehicle access is particularly marked for women. For example, data from the 1997-98 Norwegian travel survey revealed that more than 90% of women aged 45-54 years had a driver's licence, but fewer than 80% had ready access to a car. In contrast, of the 93% of men in the same age group that had a licence, 90% had access to a car. Similar evidence is available from the Swedish travel survey conducted in 1994-96: 80% of the men aged 65-74 years had access to a car but only 45% of the women in the same age group.

A potential future scenario is an increased licensing rate among older people owing predominantly to increased rates for women. Increased licensing is likely to result in greater access to and use of a car. Forecasts for the United Kingdom suggest that by about 2030, 92% of households with two adults of retirement age and 50% of single person households in this age group will have at least one car (Noble, 2000). Because current gender differences in car access are likely to persist, it is likely that women will remain more dependent than men on public transport.

Driver behaviour and cessation of driving

Older motorists often avoid driving under stressful conditions. Studies conducted in many countries indicate that older drivers typically try to avoid driving at night, during congested periods, through unfamiliar areas and in inclement weather. In addition, they often also avoid driving on high-speed roads (motorways, auto routes, autobahns, etc.) and choose routes to avoid turns across traffic. In Great Britain, older drivers report avoiding driving on routes with roundabouts and gyratory, one-way systems (Simms, 1993).

Before older people stop driving, they usually reduce how much they drive and limit their driving to local journeys in familiar areas and under easy driving conditions. The better the provision of alternative means of mobility, the more likely a driver is to start using them for journeys he or she would prefer not to drive, long before ceasing to drive. This makes it easier to remain mobile after ceasing to drive. The lack of attractive and feasible transport alternatives to the private automobile, coupled with land-use patterns that make walking difficult or impossible, contributes to the problems experienced by people who have to stop driving, notably in North America. Similar problems occur in Europe for older people living in suburban and rural locations, as they increasingly do. In Great Britain, elderly drivers appear to be more likely to stop driving if they live in urban areas where walking, buses and taxis offer realistic mobility alternatives.

A survey conducted in Great Britain in the early 1990s, revealed that motorists gave up driving at an average age of 72.1 years (Rabbitt *et al.*, 1996). There was much variation, however, as some stopped driving in their 50s while others continued to drive up to and beyond their centennial celebration. Drivers in towns and cities were found more likely to have stopped driving than those in suburbs and rural areas, perhaps because of better availability of alternatives to car travel. The study reported that people who started driving at a younger age continue to drive to a later age.

Former drivers' stated reasons for ceasing to drive included: medical/ability (65%), accident/safety (52%) and financial (41%). A smaller survey of 20 former drivers reported their reason for ceasing to drive as: driving competence (35%), financial (35%), no longer needing to drive, *e.g.* availability of good bus services (20%) and health reasons (10%) (Simms, 1993). It is important to note that the respondents' reasons for ceasing to drive were attributed equally to declining competence and finance. In both surveys, nearly all former drivers decided to stop driving without any intervention by the driver licensing authority.

Health problems for using different transport modes

Public and private transport options are of little value if people cannot use them for health-related reasons. This section presents some examples of problems experienced in using different transport modes, taken from the Norwegian travel survey conducted in 1997-98.

As Table 2.3 shows, problems related to walking increase with age, particularly for women. Nearly half of women aged 78 years or older reported problems. The same tendency is found in regard to use of public transport, although fewer people reported difficulties. In contrast, very small shares reported problems using the car, especially among men, and there were no consistent age effects.

The Norwegian findings are supported by other studies:

- A Swedish study of mobility among older people and people with functional impairments found that both groups more frequently used cars than public transport (Ståhl *et al.*, 1993).

Table 2.3. **Problems related to the use of transport modes by different age groups, Norway, 1997-98**

Age groups	Problems related to walking (%)		Problems related to the use of public transport (%)		Problems related to the use of a car as a driver (%)	
	Men	Women	Men	Women	Men	Women
57-63	9	20	5	15	8	10
64-70	11	28	6	18	5	12
71-77	16	33	7	17	3	13
78+	32	47	10	27	8	18
Number of respondents	991	1 097	991	1 097	991	1 097

Note: The respondent was asked: "Do you have any permanent health problems that make it difficult for you to travel? Do you have large problems, some problems or no problems? By car as a driver/ by car as a passenger/ by public transport/on foot/by bike?"
Source: The Norwegian NTPS 1997-98, data processed for this volume.

Table 2.4. **Percentage of people having problems with different transport modes by age, health/disability and driving status**[1]

Age	50+	75+	85+	Driving status 75+		Health/disability status 75+	
				Driver	Non-driver	Poor	Excellent
Respondents	N = 2 422	N = 1 844	N = 496	N = 1 383	N = 461	N = 284	N = 167
Drivers reporting difficulties							
Night driving	11%	20%	24%			36%	11%
Problems with ride sharing							
Dependency	24%	19%		16%	29%	31%	14%
Imposing	21%	18%		15%	26%	30%	11%
Problems walking							
Too hard	24%	32%		28%	44%	68%	7%
Problems with public transport							
Difficulty boarding	5%	11%		6%	24%	33%	11%

1. Percentages shown are statistically significant within the age groups.
Source: American Association of Retired Persons, 2001.

- A 1992-98 British travel survey reported that 39% of people aged 65 years or more experience at least some health-related mobility difficulties and that driving a car was associated with the least number of problems.
- A US survey conducted by the American Association of Retired Persons found that as people grow older, their personal mobility is increasingly impaired by physical limitations (Table 2.4).

Collectively, these results identify a number of transport challenges:

- For both older men and women, driving a car is reported as less a problem than using public transport or walking. Particularly for men, the relative absence of health problems associated with driving a car is fairly stable across all age groups.
- Health-related differences between men and women are substantial for all transport modes and for most age groups.
- Walking long distances is not a viable option for most members of the oldest age groups.
- Over one-quarter of women (27%) aged 78 years and older have difficulty using the standard public transport system.
- The significant number of older people, especially men, who report no problems for driving indicates the difficulty of replacing car transport as the preferred travel mode for older people.

Changes in the use of transport modes

As with other age groups, car travel dominates everyday journeys made by older people. There remain, however, differences among countries:

- In Europe, half of all trips are made by private car.
- In Australia, it is estimated that about 70% of older people's trips are made as drivers or passengers in private cars (Fildes *et al.*, 1994).
- In the United States, at least 80% of older travellers' daily trips are made by car.

There are also substantial gender differences in preferred transport modes. In Sweden, for example, nearly 60% of men in the age group 75-84 drive their own car for their daily trips but less than 10% of women in the same age group. The same tendency is found in most other European countries. The typical gender division for older people is a male driver and a female passenger.

In some European countries, use of the car declines with age. A 1994 Dutch study found that 47% of daily travel is done by car for those aged 45-54 years, but only 26% for those 75 years or older (Netherlands Central Bureau of Statistics, 1995). In Great Britain, car use (as a driver) declines from 68% of trips for the age group 65-69 years to 40% for those 80 or more. For women, the figures are 19% and 7%, respectively.

The current differences indicate both cohort and gender effects. For younger cohorts, the gender differences in car use are much smaller, pointing to a more equal distribution of car use among men and women in the future.

A key question relating to future car dependence is whether the households of tomorrow will have the economic means to own two cars (if there are two or more licensed drivers in the household):

- A great proportion of older households will consist of one person, often a woman, and car ownership may be relatively low as a result of both age effects and economic situation.
- On the other hand, cohort analyses from the Norwegian travel survey data indicate that younger people may well maintain their car use habits into their 70s. People may be reluctant to change to other transport modes if they are used to driving a car and have the economic means and physical capability to continue to drive.

While use of public transport is relatively low in Australia, the Netherlands and the United States (less than 10%), it is higher in Scandinavia and Great Britain. British figures report that 20% of men and nearly 30% of women aged 70 or more use the local bus service for their daily trips. However, cohort effects may change public transport usage as the baby boomers age. The least use of public transport is found among those in their 40s, who may well prefer driving to public transport as they age.

Overall, trips on foot show a U-shaped curve in relation to age. Middle-aged people walk less than younger and older people. In Europe, walking is still an important transport mode for older people, with those aged 65 and older making 30-50% of their journeys on foot. A key question is whether this relative increase among older people will diminish in the future, due to cohort effects.

The absolute number of trips made by walking has decreased over time in England, the Netherlands, Sweden, Norway and the United States. In most cases, these have been replaced by car use. For Dutch people aged 65 years and older, the daily distance travelled on foot decreased about 20% over the period 1970-95. With the anticipated increase in the number of licensed older drivers, the next cohort of older people may walk less than today's.

Except in the Netherlands and Denmark, cycling is of minor significance as a transport mode for older people in OECD Member countries. About 20% of Dutch citizens aged 65 or older use a bicycle to make daily trips. In Germany, about 10% of people aged 65-75 cycle regularly; in Norway, the figure ranges between 2-3%, and in the United States it falls below 1%. Land-use development, traditions, physical provisions for cycling, climate and topography are some explanatory factors. The Dutch data in particular show that it is possible for older people to use this transport mode under favourable conditions.

In summary:

- Car use is becoming more dominant as a transport mode for older people, but there are differences among countries, especially between Europe and the United States.
- In Europe, walking is still an important transport mode for older people, with 30-50% of older people's trips made on foot.
- However, car use seems to be replacing walking and to a lesser extent, public transport.
- Older people use cars less frequently than other adult age groups.
- The gender differences in car use among older people today may be reduced by 2030.

- Currently, public transport is most commonly used by the oldest (over 75 years) age groups and by women.
- Land-use provisions and proper facilities can make bicycling a feasible transport mode for older people in some countries (it currently is in countries such as Denmark and the Netherlands).

Activity patterns during the life cycle

On average, older people travel less than other age groups in terms of number of trips per day, distance and travel time. While it is difficult to make exact comparisons on the basis of the data from different countries, Table 2.5 shows overall trends. In all countries listed, older people make fewer trips and travel shorter distances than younger ones.

In many countries, gender differences are substantial, mainly in terms of travel distance per day. For younger age groups in Norway, for example, the number of trips is almost the same for both genders, but travel length differs. These differences increase with age, and among those aged 75 years or more, men travel an average of 25 km per day, while women travel only 9 km. The same tendency is also found in Germany and Sweden.

The data for Sweden and Norway indicate that the most marked decrease in travel activity occurs at around 65 years of age, mainly because of the decrease in or cessation of paid work. The number of trips for other purposes (shopping, visiting friends, other leisure activities) remains almost constant from 75 years of age onwards. In the oldest groups, men again are more active than women. In the United States, older people make as many or more non-work trips than younger people.

Travel survey data from OECD Member countries show the following differences in older people's travel characteristics over time:

- In England, Sweden and Norway, the number of trips taken daily by older people (as well as other age groups) has remained reasonably constant over the last 10-15 years, but the daily distance travelled has increased.
- In the Netherlands, the number of daily trips and distance travelled increased in the 1980s for people aged 65 years or more and remained stable during the 1990s.
- In the United States, the number and length of trips have increased for people over 65 years of age, with faster growth for older people than for other age groups (Rosenbloom, 2000).

Much of the increase in travel distance among older groups can be attributed to better access to a car. Further, Australian results show that older, licensed drivers (80-84 years) make 33% more trips per day than their unlicensed peers.

Table 2.5. **Number of trips and travel length per day for older and reference groups in some countries**

	Age, elderly	Age, non-elderly	Number of journeys per day		Distance per day (km)	
			Elderly	Non-elderly	Elderly	Non-elderly
Germany (1997)	75-79	18-59	1.9	3.4	8	22
Sweden (1994-96)	75-79	40-49	1.5	3.2	12	35
US men (1995)	75-79	18-64	3.5	4.6	38	83
US women (1995)	75-79	18-64	2.9	4.7	26	60
Norway (1997-98)	65+	35-44	1.9	3.5	16	35
Melbourne, Australia (1993-94)	80-84	18-59	2.4	3.0	–	–
Great Britain, men (1996-98)	75-79	25-49	2.2	3.3	15	50
Great Britain, women (1996-98)	75-79	25-49	1.6	3.5	12	32

Source: Statistics provided to the OECD in response to an OECD survey, 2000.

The use of information and communication technology

Although many older people today are unfamiliar with computer technology, this will change over the next two decades. All age groups will increasingly use of information and communication technology (ICT) in many different ways. New technology will be useful to older people, both in road infrastructure (electronic information signs, route information, navigation systems, etc.) and in public transport systems (smart cards, trip planning services, automated information kiosks, etc.), provided that the interface is appropriate. In theory, ICT can also reduce the need for some everyday travelling. Whether this will happen in practice remains to be seen.

The distribution of new technology among age groups

Several surveys comparing those who own home computers to those who do not have shown significant differences in gender, age, education, income, employment and socio-economic status. More men than women own a computer and most computer owners are between 25 and 55 years of age. People in older age groups seldom own a computer. More owners than non-owner have higher education and people with high socio-economic status are more likely to own computers. Computer owners are likely to have greater access to a car.

The impact of technology on travel

The need to reduce travel has been recognised since the energy crisis of the early 1970s (Batten, 1989). Telecommuting and related technological advances hold promise for reducing the many environmental impacts of road traffic that are due to increased daily car travel (Batten, 1989; Capello and Gillespie, 1993; Engström and Johanson, 1996).

However, telecommuting pilot and demonstration projects have proved somewhat inconclusive. Some projects have not resulted in total reduced travel, but car usage was often reduced to some degree (Nilles, 1991). Some studies found an increase in car use outside of rush hours and a reduction in the total distance travelled by car (Balepur *et al.*, 1998). In the Netherlands, an experiment involving 30 telecommuting employees at the Ministry of Transport resulted in a reduction in their daily trips (Hamer *et al.*, 1991). However, a review of eight US telecommuting programmes led to the conclusion that one cannot expect any significant reduction in total travel activity (Mokhtarian *et al.*, 1995). Rather, it was found that ICT would result in greater flexibility. For instance, a reduction in travel time to work may lead to spending more time in leisure travel or shopping trips. Reduced car use by one member of the family may also result in increased use by another member.

Electronic shopping is increasing, but the impact on travel is not yet documented (Gould and Golob, 1997). It is also important to note that shopping does not simply involve purchasing merchandise. It is also a social activity, and this may be more important for older, retired people than for others. ICT cannot replace participation in activities with other people and the variety of social contacts and personal interaction.

Over the long term, use of ICT to organise daily activities can also affect land use. For example, a smaller number of weekly work trips can make a longer journey to work more acceptable, so that people may purchase homes in more distant and attractive areas where prices are lower. If so, urban sprawl and continued use of the car might intensify for all age groups.

Currently, familiarity with ICT is more common among younger age groups. However, in the future, older people are more likely to be both computer owners and users.

Conclusions and key points

- Older people continue to have travel needs after retirement, although their needs may change. Remaining mobile is a critical aspect of independence and is important to the welfare of older people, including those with functional limitations. Access to services, activities and other people is essential to maintaining one's well-being and quality of life.

- Older people have a lower licensing rate than other age groups, and more men are licensed to drive than women, especially in Europe. However, by 2030 more older people are likely to be licensed. Men may still be doing more driving than women owing to better access to cars.
- The private car is likely to remain the dominant form of transport in most OECD Member countries because of the expected increase in the number of licensed older drivers, particularly among women. However, the attractiveness and availability of other transport options and prevailing economic conditions will affect choice of travel mode.
- The available evidence suggests that as older people develop age-related health problems, they are likely to experience difficulties in walking and using public transport before experiencing difficulties with driving. This indicates the need to develop alternative options to the car with these limitations in mind.
- Older people who cease driving owing to functional limitations are likely to experience substantial difficulties in terms of mobility. Feasible alternative transport modes need to be available and accessible.
- Compared to earlier cohorts, older people are driving longer and for greater distances, partly because they have greater access to cars.
- In most OECD Member countries, car use by older people is replacing walking, and, to a lesser extent, public transport. However, there are marked differences between Europe and North America. In Europe, walking is still an important transport mode for 30-50% of journeys made by people aged 65 or more. In the United States, there has been a sustained decline in walking by those over 65 over the past 20 years.
- Overall, older people make fewer journeys, mainly owing to reductions in the number of work journeys. As age increases, the average length of journeys decreases regularly. The number of journeys made for non-work activities remains almost constant to age 75 and decreases thereafter. The average length of journeys also drops with age.
- The impact of information and communication technology on travel patterns generally and for older people specifically has yet to be determined. However, some evidence suggests that changes in overall travel will be minimal.
- More research is needed in terms of the relation between quality of life, welfare and health costs and mobility among older people in different countries. Comprehensive cross-country cohort studies are needed of travel patterns, preferences for retirement housing and activities in order to improve knowledge of the "new old" in different social and cultural contexts. Studies also need to be undertaken of mobility solutions (public and private) in different countries for older road users.

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Chapter 3

SAFETY OF OLDER ROAD USERS[1]

Introduction

Safety is perhaps the issue that most affects practices and policies regarding older people's mobility and transport. Many perceptions about the safety of older road users are unsupported by crash data. Attitudes and policies concerning older people are influenced by these views, despite their frequently dubious origin. As society ages, the safety and mobility of all older road users is important. In most European countries, the large number of older pedestrians killed in road crashes is a major safety issue.

The following analysis of crash and other data from OECD Member countries is intended to serve as the basis for formulating sound policies that reflect the latest research findings and better meet the needs of older people and of society as a whole. The discussion emphasises the difference between the vulnerability of older people to serious injury or death in a crash and their risk of involvement in an accident of any severity. Arguably, the most important safety issue for older road users concerns their increased frailty, which makes them more susceptible to serious injury. Although older people have fewer accidents than other age groups, they are over-represented in accident fatalities and serious injuries. The discussion draws a distinction between the risk that older drivers present to other road users, which is a public policy issue, and the degree to which they are at risk themselves due to their increased frailty.

The actual and expected growth in the number of older car drivers who are killed in OECD Member countries has made the older driver a focus of concern. Responses to this concern require careful consideration and planning. If/when older people stop driving (either voluntarily or otherwise), mobility options will be required as well as, ideally, improvements in land-use patterns and accessible transport to provide suitable living situations. A deliberate policy to keep older people driving safely longer will require improvements to road and vehicle design and traffic management. This will require government leadership and funding.

A brief history of research on the safety of older drivers

The "older driver problem" was recognised as a scientific and social issue following a first wave of research in the late 1960s and early 1970s. It was initially seen as a general age-related safety problem, and the focus was on the functional deficiencies of ageing drivers. The characteristics of the traffic system were taken largely for granted and were not seen as playing a role either in causing or preventing crashes. As a result, screening was the main safety measure proposed to eliminate high-risk, older drivers from the roads.

Research in the 1980s and 1990s delved into the accident epidemiology of older drivers in order to gain a better understanding of its general causes. This work showed that the over-representation of older drivers in serious accidents did not necessarily reflect their overall involvement in crashes. Rather, it was at least a combined product of frequency of crashes and marked liability to injury or death (Hauer, 1998).

1. Dr. Hakamies-Blomqvist contributed material from her work, "Safety of Older Persons in Traffic", which is part of the US Transportation Research Board report, *Transportation in an Aging Society*: A *Decade of Experience* (2001). Members of the OECD Working Group provided additional material.

The societal implications of the "older driver problem" were reconsidered, and the focus shifted from safety to mobility (Evans, 1991). The proposed preventive measures also shifted from drivers to include aspects of the road and transport system, especially roadway design.

As research in the 1980s attempted to ascertain the nature of the older driver problem, it became increasingly clear that the problem was not a general one. Gerontological research had repeatedly demonstrated that individual variance in terms of most performance variables increases with age. Clinical experience pointed to certain sub-groups of older patients, rather than older people as a whole, as major causes of safety concern. Older patients suffering from dementia, especially dementia of Alzheimer type, were identified as the most important high-risk sub-group (Morris, 1997).

Research in the 1990s further concentrated on moving from a general approach towards a differentiated one focusing on high-risk sub-groups (Hu *et al.*, 1998).

Older road users' crash trends

In all OECD Member countries, older drivers have higher fatality rates than other age groups. Older passengers also have higher fatality rates than do other vehicle occupants. Data from the United States illustrate this common safety problem. In 1986, 45 802 people were killed in road crashes; 5 895 of whom were 65 years or older. Traffic deaths of Americans aged 65 or more accounted for about 13% of all traffic fatalities, which was roughly proportional to their share of the population (12%). In 1988, it was predicted that this percentage would increase to 17% by 2020, owing to the increase in the number of older drivers and the expected increase in the distance they drive (TRB, 1988). However, as Table 3.1 shows, by 1996, just eight years later, older peoples' share of fatalities had already reached 16.9%, even though their share in the population had remained fairly stable.

In the United States, overall traffic fatalities and fatality rates per person and per distance driven have remained essentially unchanged since 1991. In contrast, older people's fatality rates in road crashes have steadily increased, and it is estimated that older driver fatalities will rise to 23 121 in 2030, a more than threefold increase from 1996 levels (Burkhardt *et al.*, 1998).

In 1997, for those aged 65 years or more, the fatality rate per 100 000 persons was 12.7% for drivers, 5.2% for car passengers, 3.4% for pedestrians and 0.2% for cyclists (Table 3.2).

These figures indicate that older people are at increased risk of dying as drivers, passengers and pedestrians (Table 3.3).

While other OECD Member countries have similar fatality rates for older populations, pedestrian fatalities are quite different, particularly between Europe and the United States (Table 3.4).

Older travellers in European countries (except the Netherlands) are more likely than in the United States to be killed as pedestrians. Pedestrian fatalities are most prominent in Great Britain and Norway,

Table 3.1. **Traffic fatalities and population by age, United States, 1996**

Age group	Fatalities		Population (%)	% fatalities/ % population
	Number	%		
0-14	2 778	6.6	21.8	0.30
15-24	10 464	24.9	13.7	1.82
25-64	21 584	51.3	51.8	0.99
65-74	3 203	7.7	7.0	1.08
75-84	2 919	6.9	4.3	1.60
All 85+	990	2.4	1.4	1.64
All 75+	3 909	9.3	5.8	1.61
All 65+	7 112	16.9	12.8	1.32
All ages	42 065	100.0	100.0	1.00

Source: FARS fatalities, US National Highway Traffic Safety Administration, 1996; US Bureau of the Census population estimate, 1996.

Table 3.2. **Number of fatalities and fatality rate per 100 000 persons for each age group and transport mode, United States, 1997**

Age group	Pedestrians		Bicyclists		Car drivers		Car passengers	
	No.	Rate	No.	Rate	No.	Rate	No.	Rate
0-14	592	1.0	230	0.4	78	0.1	1 711	3.0
15-24	605	1.6	139	0.4	5 797	15.8	3 428	9.4
25-64	1 651	1.2	373	0.3	14 338	10.3	3902	2.8
65-74	503	2.7	33	0.2	1 956	10.6	695	3.8
75-84	457	3.9	22	0.2	1 750	14.9	760	6.5
All 65+	1 156	3.4	62	0.2	4 290	12.7	1 783	5.2
All 75+	653	4.2	29	0.2	2 334	14.9	1 088	6.9
All 85+	196	5.0	7	0.2	584	14.9	328	8.4
All ages	4 004	1.5	804	0.3	24 503	9.2	10 824	4.0

Source: FARS fatalities, US National Highway Traffic Safety Administration, 1996.

Table 3.3. **Risk of fatality by age**

	Drivers' fatality risk	Passengers' fatality risk	Pedestrians' fatality risk
Age 65+	12.7%	5.2%	3.4%
Under 65	9.2%	4.0%	1.5%

Table 3.4. **Fatalities per mode of transport for people aged 65+ in several OECD Member countries, 1998**

	As a % of all traffic fatalities for the 65+ age group			
	Pedestrians	Car drivers	Car passengers	Bicyclists
France	29.2	60.7		5.6
Finland[1]	28.4	44.4	27.2	–
United Kingdom	48.8	30.5	15.9	2.7
Netherlands[1]	5.5	79.9	14.6	–
Norway[1, 2]	49.0	20.0	31.0	–
Spain	44.6	29.6	25.8	–
United States[1, 2]	18.0	52.0	29.0	–

1. Excludes bicyclists and motorcyclists.
2. Data for 1997.

Source: OECD, 1999.

where they account for nearly half of all crash fatalities for people aged 65 or more. Pedestrian fatality levels are lowest in the Netherlands, owing perhaps to extensive traffic-calming measures, reduction of speed limits to 30 kilometres per hour in developed areas, and special design features of the Dutch public infrastructure.

It should be noted that even in countries where pedestrians represent the largest single group of older person traffic fatalities, this does not represent the largest group of injuries of all levels of severity (mainly slight) from road crashes. For example, in Great Britain in 1998, for people aged 60 or more, pedestrians constituted 21% of the total number of casualties, compared to 38% for car drivers, 25% for car passengers and 10% for bus passengers.

The 1998 British data reveal another important crash statistic. Of the total number of pedestrian injuries that occurred in 1998, 15% involved people aged 60 or more, a percentage lower than their share in the population, and similar figures apply to car occupants. The question of whether older road users in other countries are similarly under-represented once all crash data are taken into account remains open.

This issue has not been totally resolved, largely due to difficulties in constructing consistent and comprehensive data over time and across countries. This constitutes a major data need.

However, one finding is clear-cut: the over-representation of older road users in population-based fatality rates rapidly disappears when injury data are included. To illustrate this, Table 3.5 shows the numbers and per-population rates for road crash involvement by age of driver for three European countries. The rates may vary owing to differences in national accident databases. Table 3.5 shows accidents causing any injury.

All three countries show a similar pattern. The overall rate of crash involvement declines steadily with age up to about 75, after which it increases slightly. In all instances, the rate for the older age groups remains well below the rates for the youngest groups. Women have lower crash rates than men; however, there is some suggestion that the increase in crash rates beyond age 75 is greater for women than men.

Table 3.6 illustrates the fact that older people are under-represented in injuries of all levels of severity but over-represented in fatalities.

Table 3.5. **Involvement in transport crashes causing injury in three European countries, 1998**
Number and rate per thousand drivers for each age group

Country and gender		Age of driver							
		15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Great Britain, men	No.	59 841	82 213	58 915	40 879	22 670	10 344	4 642	741
	Rate	28.0	20.9	15.7	12.0	9.5	6.0	6.2	7.1
Great Britain, women	No.	24 405	35 929	25 719	16 315	6 992	3 392	1 545	237
	Rate	14.1	11.2	8.4	6.1	4.4	3.5	4.6	10.1
Netherlands, men	No.	14 463	13 610	9 339	7 303	3 851	2 262	1 453	
	Rate	32.0	11.3	7.9	7.4	5.2	5.2	7.2	
Netherlands, women	No.	6 059	5 296	3 836	2 723	1 535	1 148	746	
	Rate	15.0	4.7	3.6	3.3	2.7	4.2	5.7	
Spain, men	No.	37 628	37 461	23 687	17 157	10 533	5 050	1 373	
	Rate	28.7	13.1	9.0	8.1	7.1	5.4	6.9	
Spain, women	No.	7 595	8 697	5 242	2 776	1 057	363	93	
	Rate	8.4	4.0	2.9	2.7	2.6	2.8	6.2	

Source: OECD, 1999; Netherlands Ministry of Transport and Public Works, AVVBGVO Database; Mitchell, 2000.

Table 3.6. **Older people as road accident casualties in Great Britain, 1998**

Severity	Percentage of older road user casualties					
	All road users	Pedestrians	Bus passengers	Bicyclists	Car drivers	Car passengers
	People aged 60+ (20.5% of the population)					
Killed	**25.4**	**46.6**	**52.9**	19.6	**20.6**	**24.4**
Seriously injured	14.1	**21.8**	**50.3**	7.8	13.8	15.3
All types	9.8	14.6	**33.8**	5.0	8.8	10.4
	People aged 80+ (4.6% of the population)					
Killed	**8.2**	**19.0**	**23.5**	1.3	**5.6**	**6.2**
Seriously injured	3.3	**7.1**	**16.0**	0.6	2.5	3.1
All types	1.6	4.1	**6.7**	0.5	1.1	1.6

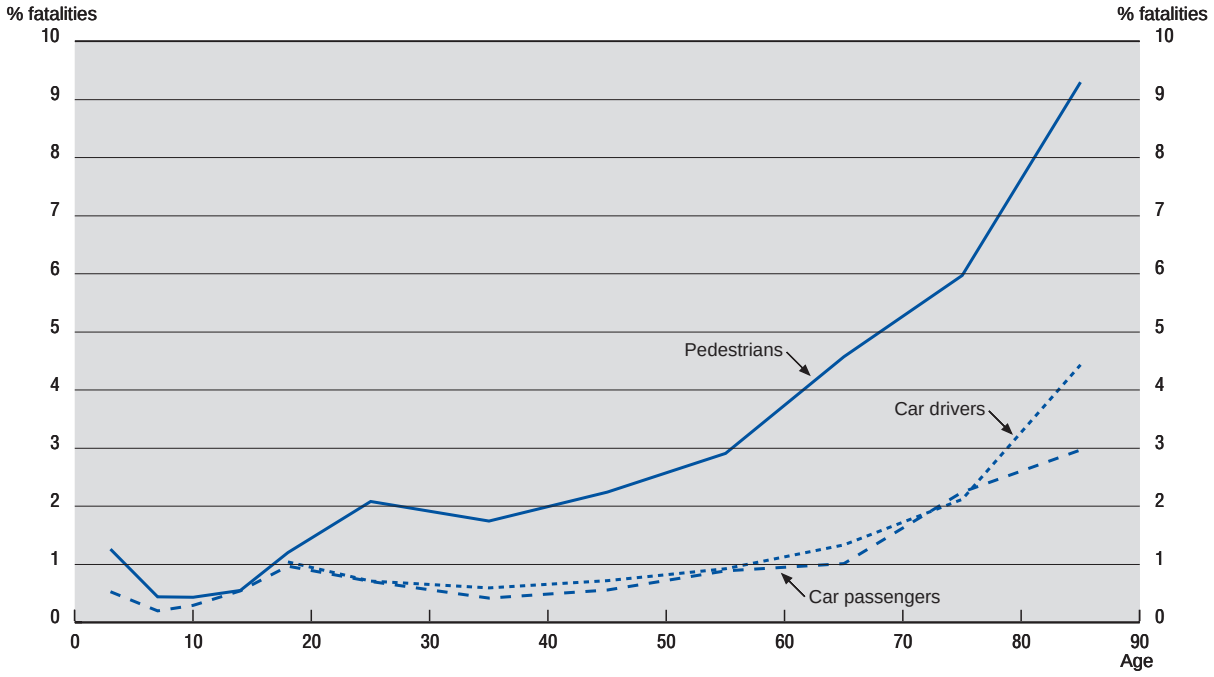
Note: Figures in **bold type** indicate where the percentage of older road user casualties is greater than the percentage of older people in the population.
Source: Mitchell, 2000.

The under-representation of older people in all casualties for all transport modes except buses strongly suggests that they are involved in fewer crashes than other age groups. This may be a result of reduced exposure (older people travel less), safer behaviour or some combination of factors.

The fragility of older people

The association between age and increased risk of fatal injury evident in Table 3.6 highlights the greater fragility of older people. Figure 3.1 shows the variation with age in the percentage of road traffic injuries that are fatal, based on British crash data for 1998.

Figure 3.1. **Fatalities as a percentage of all injuries by age and mode of travel**

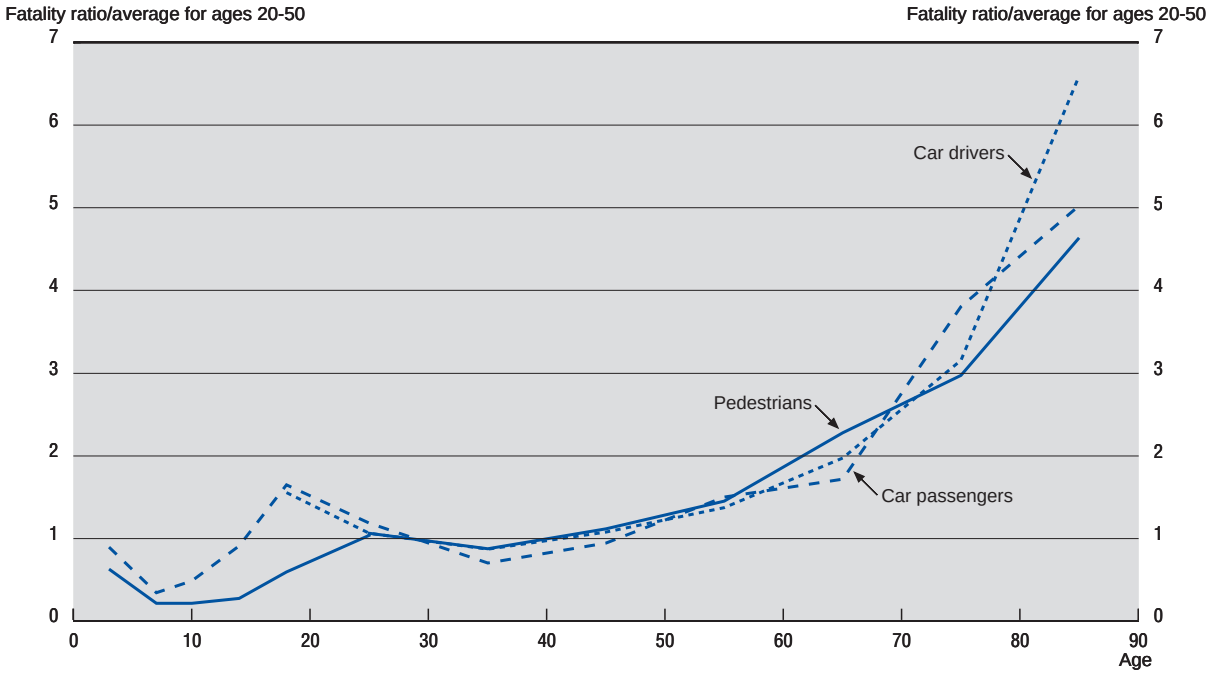


Source: Mitchell, 2000; Department of the Environment, Transport and the Regions, London.

The percentage of injuries that prove fatal differs by type of road user, but the increased risk for older people is similar for all. For those aged 20-50, about 2% of those injured as pedestrians are killed. This percentage increases steadily with age, so that for people aged 80 or more, more than 9% of all pedestrian injuries are fatal.

For other road user groups, the percentages are lower, but the increased risk with age is similar. Figure 3.2 illustrates this increasing fragility by setting the fatality index (the risk of an injury being fatal) at 1.0 for the age group 20-50 years. This "fragility index" increases with age in the same way for car drivers, car passengers and pedestrians, rising from a defined 1.0 for ages 20-50 to 1.75 at age 60; 2.6 at age 70; and 5-6 for people aged 80 or more. The results for UK drivers and passengers are similar to US results for car occupants (Evans, 1991).

Figure 3.2. **Fragility index: fatality ratio at different ages normalised by the average for ages 20-50**



Source: Mitchell, 2000; Department of the Environment, Transport and the Regions, London.

Older drivers' safety problems

Are older drivers over-represented in accidents?

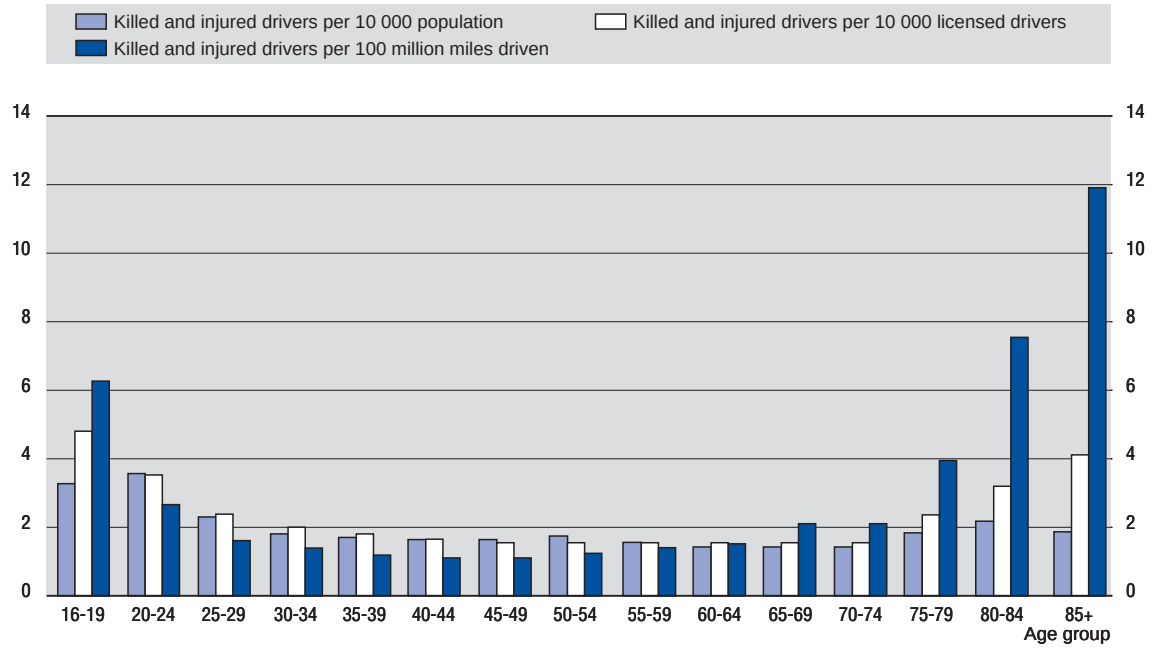
In traffic safety forecasts, reference is often made to older drivers' "over-representation in crash statistics" or "higher risk of crash". Empirical research does not support this. Figure 3.3 shows the 1997 injury and fatality rates for US drivers in different age groups using different exposure measures.

The age-related risk of increased casualties is reasonably minor when compared to population levels. It is higher, but remains modest, when compared to the number of licensed drivers. However, there is a sharp, age-related increase of risk when distance driven is used as the basis. This last rate has frequently led to the conclusion that older drivers become more dangerous as they age but compensate by driving less. This overlooks certain methodological difficulties in interpreting the above figure.

In comparing different groups, the equation *risk = accidents/exposure* is often used. However analyses that are restricted to casualty data have a sampling bias, the "frailty bias". A larger share of older drivers' total accidents is included in casualty statistics because an older person is more easily injured or killed by a given physical impact. Indeed, half of the increased risk of fatality in drivers aged 75 years or more compared to drivers aged 30 years may be due to the frailty bias rather than to any higher probability of incurring accidents (Maycock, 1997).

This sampling bias affects all three measures presented in Figure 3.3 and makes the age-related increase of risk appear larger than it actually is. The different exposure measures are also liable to produce different conclusions.

Figure 3.3. **US driver fatalities and injuries by age relative to population**
Number of driver's licences and mileage driven, 1997



Source: FARS, National Highway Traffic Safety Administration, US Department of Transportation, 1999.

It has been repeatedly shown that older drivers compare favourably on the basis of accidents per capita and per driver's licence. Due to different licensing rates among age groups, licences provide a more accurate basis on which to estimate the collective risk of any given age group. However, this measure does not provide a fully valid basis for age comparisons, since the ratio of licensed drivers to active drivers may differ greatly among age groups (Eberhard, 1996). In addition, active driver groups of comparable sizes travel different distances and therefore have different exposure to accidents.

It is often argued that to compare accident or injury risks for different groups of drivers, an accident rate based on a "hard" estimate of actual miles driven is needed. Such estimates, particularly of fatalities per mile driven, show a substantial increase in risk for those over 65, much of which is due to their greater fragility. In addition, the accident rate per mile driven is higher for low-mileage drivers than for high-mileage drivers at any age. A further bias can be attributed to the type of roads typically travelled by older drivers. Many avoid driving on highways, the safest type of road, and tend to drive on streets with intersections, which are, by their very nature, less safe and have more crashes (Janke, 1991). Hence, older drivers' risk estimates based on injuries or fatalities per mile driven will be overestimated when compared to those of younger drivers with higher yearly mileage on safer roads.

In conclusion, none of the measures in Figure 3.3 permits a straightforward conclusion about whether drivers' overall risk of accident involvement changes with age. Owing to the frailty bias and to the limitations of currently available exposure measurements, older drivers' apparent over-representation in fatality and perhaps serious injury data cannot be interpreted as heightened accident proneness.

Older pedestrians have a very high fatality rate per person per year and per journey. The increase in pedestrian fatalities with age is partly due to the greater fragility of older people.

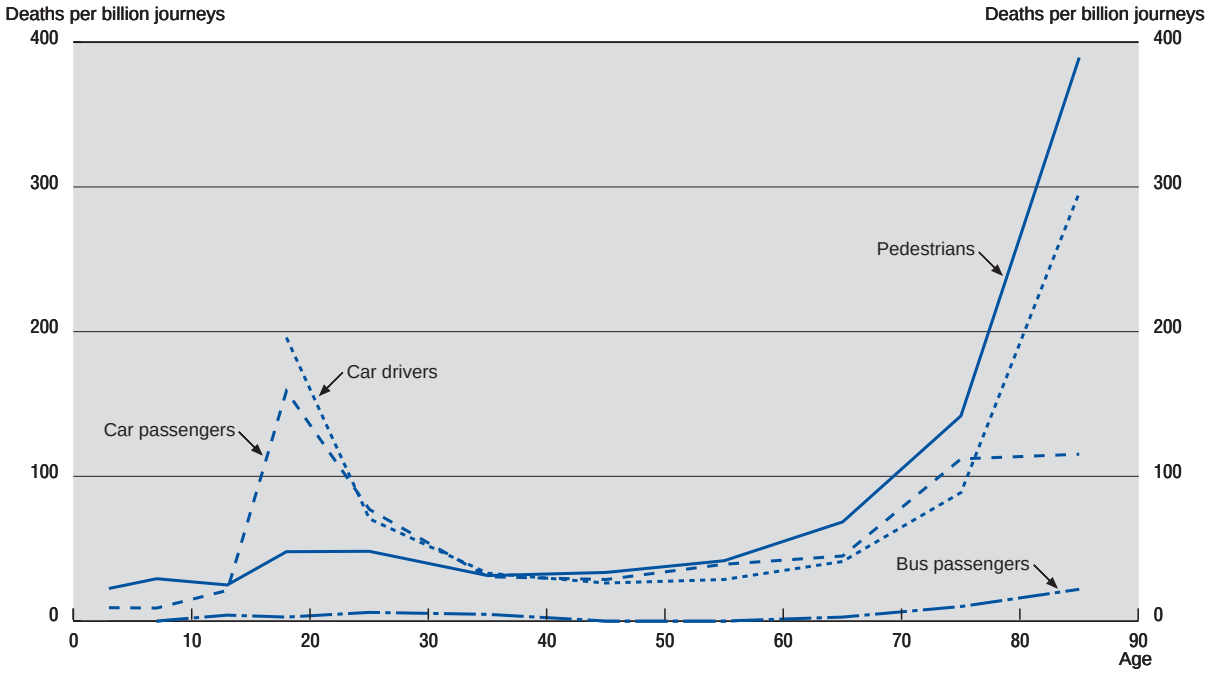
However, there is some evidence of such an increase despite their apparent attempts to behave more safely and responsibly as pedestrians. The reasons are not fully understood and deserve further study.

It can be concluded that whatever their safety risk as drivers, older people are at greater risk of death if they walk or cycle rather than if they use a car. This is most evident when using casualty or fatality rates per journey as a measure of risk. This measure recognises that journeys by one mode can be different in length, timing and destination from journeys made by another mode, and that journeys by any mode tend to be shorter for older travellers. This is most evident when using casualty or fatality rates per journey as a measure of risk. Figure 3.4 shows the fatality rate for injuries of all levels of severity per journey by age group in Great Britain in 1998.

Per journey rates drop to a minimum for people in their 30s and 40s and then rise with increasing age. For those aged 30-55, fatality rates per journey are similar for car drivers, passengers and pedestrians. The rate for pedestrians in their 30s increases by a factor of 12 for those over 80, and the rate for car drivers by a factor of 11 from those in their 40s to those over 80. The fatality rate is higher for pedestrians than for car users, whether drivers or passengers, for every age over 30. The fatality rate is very low for bus passengers and very high for bicyclists (not shown).

The data in Figure 3.4 allow for concluding that policies that cause older car drivers to become pedestrians or, more rarely, bicyclists are likely to increase the total number of road accident fatalities. This is because travel as a pedestrian or bicyclist is more dangerous per journey than travel as a car driver. (It should be noted, however, that a different pattern exists with regard to total casualty outcomes per journey. In that case, car trips are more hazardous than other transport modes, with the exception of cycling.)

Figure 3.4. **Fatality rate per journey, Great Britain, 1998**



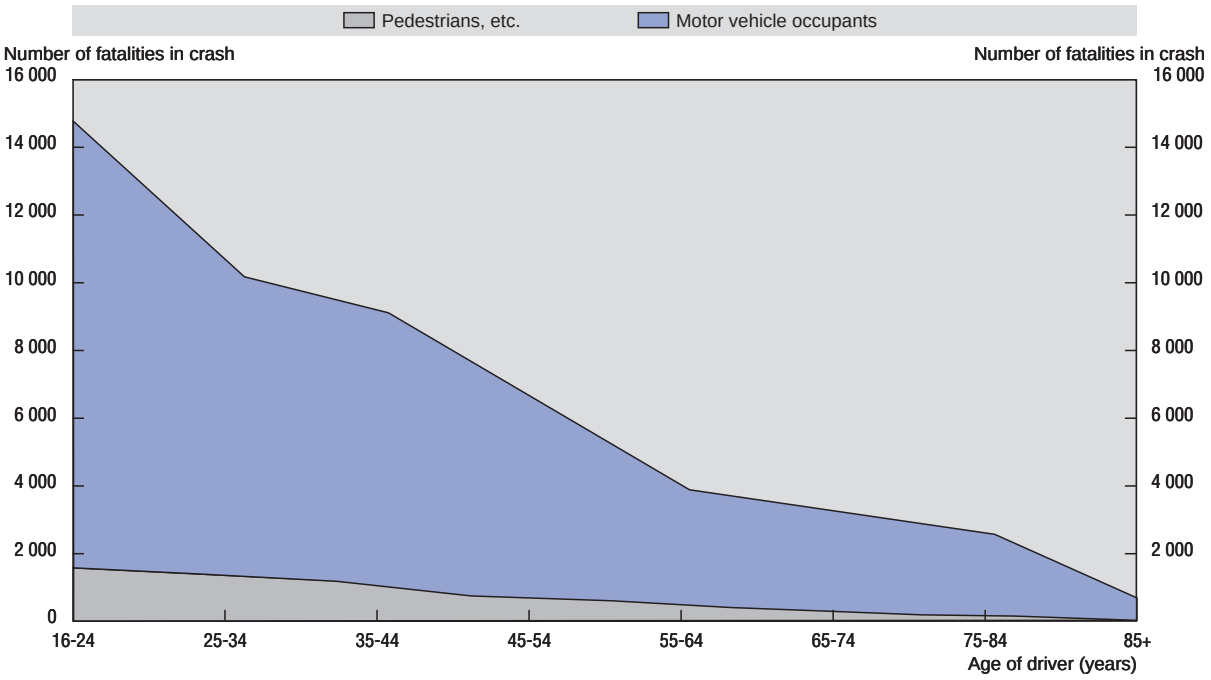
Source: Mitchell, 2000.

Are older drivers a threat to other road users?

Recent research in both the United States (Dulisse, 1997) and the United Kingdom (Maycock, 1997) has proven that, contrary to common belief, older drivers do not present an excessive risk to other road users. However, they are more likely to be injured themselves in accidents, both because of their greater physical frailty and because of their typical accident patterns.

Moreover, older drivers do not present a special threat to other road users. US data from 1997 show that older drivers were involved in a smaller number of accidents resulting in the death of other motor vehicle occupants or pedestrians than other age groups (Figure 3.5).

Figure 3.5. **Older drivers cause fewer road user fatalities than other age groups, United States**



Source: US National Highway Traffic Safety Administration, 1999.

Older drivers' accident patterns

As a group, older drivers have different types of accidents than younger drivers. A larger share of accidents of older drivers involve collisions with another vehicle. They have a smaller share of single-vehicle and speed-related accidents. Older drivers tend to be legally at fault in their collisions. A greater proportion of older drivers' crashes occur at intersections, where typically the older driver is turning against oncoming traffic with right of way on the main road. On the other hand, older drivers' small share of accidents per number of licensed drivers probably reflects their slow, conservative and cautious driving style. The predominance of older drivers' involvement in transport-related fatalities is illustrated in Table 3.7, based on all fatal collisions in the United States in 1997.

Older drivers are "under-represented" in single-vehicle accidents involving loss of control or collisions due to speeding or risky overtaking. For those aged 80 or more, the percentage of angle

Table 3.7. **Transport-related fatalities in the United States, 1997**

	Total fatalities	Pedestrian fatalities	Bus occupant fatalities	Bicyclist fatalities	Passenger car driver fatalities	Passenger car passenger fatalities
All ages	41 717	4 939	59	754	14 186	6 676
Aged 60+	8 562	1 310	28	82	3 568	1 438
Aged 80+	2 454	401	8	11	1 140	519
	% of total fatalities	% of pedestrian fatalities	% of bus occupant fatalities	% of bicyclist fatalities	% of passenger car driver fatalities	% of passenger car passenger fatalities
Aged 60+	21%	27%	47%	11%	25%	22%
Aged 80+	6%	8%	14%	1%	8%	8%

Source: National Highway Traffic Safety Administration, 2001.

collisions, typically involving intersection situations, is more than double that of the youngest group. The high percentage of angle collisions where the older driver's vehicle is hit from the side by an oncoming vehicle helps to explain why older drivers tend to be the ones injured in their accidents.

Older drivers and behavioural adaptations

Older drivers modify their driving patterns in several ways.[2] They drive less, in part because of changing mobility needs, especially following retirement, and also, it seems, by choice, on the basis of subjective judgement of increased difficulties for driving. They tend to avoid driving under conditions such as darkness, wet roads, rush hours and under other stress-inducing situations. Their driving style becomes calmer and decision-making in traffic becomes more conservative: they drive more slowly, prefer longer time gaps for merging at intersections and avoid simultaneous activities such as smoking or adjusting radio controls while driving.

These changes have been interpreted to reflect both their mature judgement and their behavioural adaptation to age-related changes in certain performance areas. It may not be entirely accurate to label these adaptations "compensatory", however, since that term implies response to a loss. At least some changes may simply reflect personal preferences. For example, all drivers would probably avoid rush hours if not required to travel at that time.

It is also important to note that the general description of older drivers' behaviour masks considerable individual differences. For example, older women drivers report self-imposed limitations on their driving more often than their male counterparts (Hakamies-Blomqvist, 1998). It is also likely that older drivers with illnesses affecting their higher mental functions do not display as cautious driving behaviour as those whose judgement is intact.

The situations in which older drivers' accidents occur reflect their adjusted driving habits and behaviour. Older drivers' accidents are more likely to occur during daytime and in good weather conditions, during off-peak hours, away from major freeways and highways and in low-speed zones.

Older drivers, functional changes and accident risk

Towards an explanation of older drivers' accidents

The large proportion of older driver accidents that occur at intersections prompts the following question: Since older drivers successfully avoid accidents involving loss of control or judgement errors

2. For this section specifically and for the chapter generally, the usual practice has been to omit detailed references to points that are commonly accepted in regard to older drivers. Full references can be obtained from Dr. Hakamies-Blomqvist's paper.

while overtaking, why are they not equally successful at avoiding accidents in complex environments such as intersections? Two factors merit consideration:

- While older drivers' main strategy to ease the driving task is to drive slower, manoeuvring through intersections is rarely a self-paced task. Rather, pacing is determined by external factors, such as the number or roads and lanes to be scanned, the volume and speed of traffic entering the intersection and sight distances. Therefore, older drivers may be forced to perform under a time pressure that exceeds their capability.
- Negotiating an intersection is a complex task involving perceptual and motor functions that are known to deteriorate with age (Kausler, 1991). For example, drivers have to divide their attention between scanning different road directions and handling the vehicle; they must select, focus their attention on and switch between the task-relevant aspects of the traffic situation.

Negotiating an intersection represents a "testing of the limits" type of task, since it combines a host of age-sensitive functions while simultaneously limiting the usefulness of normal safe driving strategies. Therefore, it would seem plausible that the individual's increased risk is related to the combined deterioration of a number of relevant perceptual and cognitive functions rather than to the deterioration of single functions. This theory is supported by some research literature which shows that, despite repeated efforts, correlations between single functions and accidents rates are at best slight and often only found in extreme sub-populations of older drivers (Friedland *et al.*, 1988).

It may be relatively easy for an older driver with intact judgement to compensate for a single loss of function, such as moderate shrinkage of the visual field. In contrast, simultaneous deterioration of several relevant functions probably places greater demands on higher-level monitoring and compensating activities. If a higher-level function such as judgement is also impaired, one would expect a considerable increase of risk.

Which older drivers have accidents?

Moderate functional changes related to normal ageing do not appear to lead to a discernible increase in accident risk. Much of the risk that has been generalised for all older drivers may in fact be attributable to specific sub-groups with functional deficits linked to certain illnesses that become more prevalent with age, especially illnesses leading to cognitive deterioration, such as the different dementias.

Some studies have shown that dementia of the Alzheimer type significantly increases a driver's risk of accident (Morris, 1997). Other studies have also indicated some increased risk due to dementia. However, it has also been shown that the risk does not necessary increase at the outset of the illness and that many patients have intact driving ability (Hunt *et al.*, 1997). One study compared crash rates of those with dementia to young drivers and found that the former had fewer crashes than the latter (Drachman and Swearer, 1993). Consequently, it has been recommended that early or mild dementia should not lead to an automatic loss of driving licence.

It has been suggested that several other medical conditions, such as epilepsy and insulin-treated diabetes, may increase a driver's accident risk (Janke, 1994). Many of these conditions are not as strongly associated with ageing as are the various forms of dementia. In addition, for many medical conditions, conclusive evidence of increased risk in traffic is still limited.

Older drivers and future developments

Cohort effects

As noted in Chapter 2, today's older drivers often learned to drive as adults, whereas future cohorts will have driven since their youth. In addition, today's older drivers are being required to adjust to profound and continual changes in road and vehicle technologies, the design of cars, roads and road rules, as well as to the volume and speed of road traffic. Hence, the experience of today's older drivers may have produced behavioural and safety outcomes that will not be repeated by future cohorts with

relatively homogeneous and stable driving experience. Therefore, it is difficult to identify which aspects of the current older driver accident epidemiology are age-related and thus a valid basis for predictions, and which are cohort-specific phenomena. Nonetheless, two reasonably confident predictions can be made:

- As Chapter 2 indicated, later cohorts of older drivers will be likely to have more driving licences and to drive greater distances and thus be more exposed to risk of accidents. However, several studies indicate that older drivers' accident rates do not increase in proportion to their representation in the licensed driver population, and that later cohorts have proven safer than earlier ones (Evans, 1993; Stamatiadis and Deacon, 1995; Stutts and Martell, 1992).This finding should help to alleviate the expected increase in fatalities and serious injuries of the older population over the next 30 years.
- The types of accidents experienced by older drivers will also change somewhat. A study based on Finnish data showed that for both men and women drivers aged 60-79, the tendency to have accidents at intersections increased with age (Hakamies-Blomqvist and Henriksson, in press). However, more recent cohorts show this accident pattern at a later age. Thus, intersection accidents seem to be age-related but to appear at a later time for later cohorts.

Gender effects

A major source of uncertainty for predicting accident patterns for older drivers is the future driving behaviour of older women. While a greater number and share of older women will be driving by 2030, the impact on accident patterns is unclear, since even risk estimates for present older women drivers are ambiguous.

Gender differences in driving patterns and accident rates include:

- Older women make shorter work trips, make greater use of public transport, make more trips for the purpose of serving another person's travel needs and drive fewer annual kilometres/miles than men (Wachs, 1987; Rosenbloom, 1995).
- Per licensed driver, older women are less likely to be involved in an accident than men. On a per mile basis, however, they are almost twice as likely to be involved in an accident (Chipman *et al.*, 1993). However, given the considerably lower annual mileage of older women drivers, the latter estimate is subject to error, as noted above.
- Older women have more self-declared problems at intersections (Bishu *et al.*, 1991) and with navigation (Burns, 1999), and are more likely than men to limit their driving to avoid difficult driving conditions (Hakamies-Blomqvist and Wahlström, 1998).
- At the same time, the typical older driver accident profile, with a high share of intersection accidents, seems to concern women at an earlier age than men (Stamatiadis *et al.*, 1991; Hakamies-Blomqvist, 1994).

How these factors will interact is not clear. In particular, cohort effects within gender effects are difficult to predict, as gender differences in driving habits and histories are likely to diminish in the later cohorts.

System changes

It can be reasonably expected that the transition of older drivers from a minority group with special needs and habits to one of the largest sub-groups of drivers will affect the dynamics of the total traffic system, including the behaviour of other road users. Today, an occasional slow, older driver may be a source of irritation to others, but by 2030, older drivers will constitute nearly one-third of all drivers. The increasing probability of having to interact with an older driver may elicit profound changes in the behaviour of all drivers, as well as in patterns of interaction among the participants in the traffic system.

An analogy may be drawn with Smeed's "law", which states that while the first few private cars in a country have high fatality rates per car, increasing car density lowers those rates (Smeed, 1968). A

similar development has been observed for other phenomena whose frequency increases over time, such as bicycle use in general and bicycle densities in specific intersections (Ekman, 1996). If a general "unit density law" is hypothesised, it may be that the increasing participation of older drivers in traffic may lower the accident rates for older drivers.

Older pedestrians

Older pedestrians' accident patterns

Older people's risk of injury or death as road users goes beyond car occupancy to include walking and bicycling. This is particularly true in countries where older people currently take fewer trips by car. In western Europe for example, pedestrians aged 65 or more accounted for 45% of all pedestrian fatalities, but represented only 15% of the population. Overall, older people have a substantially greater risk of becoming pedestrian fatalities than the population at large for 18 countries examined in a recent review (US Department of Transportation, 1997).

The number of crashes involving older pedestrians may increase in future years as the population ages. This will depend on whether they are more likely to drive than current older people.

A series of studies (Fontaine and Gourlet, 1997; Sjogren *et al.*, 1993; Hunter *et al.*, 1995; Oxley *et al.*, 1995) have reached a number of similar conclusions regarding accidents involving older pedestrians. Complicated traffic situations, such as crossing an undivided street or a roadway in a busy location, often play a role. Accidents involving older pedestrians typically involve crossing the road in urban areas. Accidents are as likely to occur in the inner as the outer travel lane. They often involve turning traffic or a failure to see cars reversing direction. Compared to younger pedestrians, older pedestrians involved in crashes are more likely to have jaywalked and failed to yield to a vehicle. Most accidents involving older pedestrians occur during daylight hours, in good weather, in familiar surroundings and near their homes. Such accidents are equally frequent among men and women and tend not to involve alcohol. The lack of exposure data makes it difficult to determine the extent to which these aspects represent risk factors or merely indicate exposure patterns.

As with older drivers, the over-representation of older people in pedestrian fatalities is partly explained by their greater fragility. Therefore, falling to the ground or being struck by a car causes more severe, disabling and often fatal injuries to an older person. However, their over-involvement in pedestrian accidents may also be explained at least in part by other factors:

- Difficulties in walking owing to narrow pavements with inadequate surfaces or in poor condition, obstacles blocking sidewalks such as parked cars and/or street furniture and inappropriate kerb heights. In addition, poorly lighted streets or bad weather conditions may cause slips or require additional concentration at the expense of other functions.

- When crossing a road, older pedestrians report the high speed of vehicles and the infringement of their right of priority by drivers as major problems. Thus, crossing at complex intersections with high traffic density represents a challenge, especially when there are no centre refuges.

- Older pedestrians often express concern about the short time programmed for the walk phase at controlled intersections.

Older pedestrians and functional changes

Factors that either alone or in combination may significantly affect older pedestrian safety are vision, hearing, attention, reaction time and information processing and motor skills (Eberhard *et al.*, 1997; Monteagudo, 2000; US Department of Transportation, 1997).

Vision: depth and motion perception

Gradual decline of the ability to discriminate fine detail (visual acuity) can lead to problems in viewing oncoming vehicles, traffic signals and signs. With increasing age, the field of view may also decrease and restrict perception of the traffic environment.

A decline in depth perception with age may affect the ability to estimate the distance of approaching vehicles. The perception of vehicle motion, which depends on estimating distances travelled and speed of travel, may become less efficient. This has a direct effect on "time of arrival" judgements (the estimated time at which a moving object reaches a point) and "gap acceptance" (estimate of gap between oncoming vehicles), both of which are crucial to safe road crossing.

Hearing

Hearing impairment increases with age. This may cause difficulties in discriminating and localising the sound produced by an approaching vehicle, especially in situations characterised by high background noise.

Attention, reaction time and information processing

Older people may search and scan for relevant stimuli less efficiently. Further, they may have greater difficulty sorting and separating relevant from irrelevant stimuli. A general slowing in processing information and selecting and executing responses may also occur. This involves significant differences in older people's ability to simultaneously process multiple sources of information, as in complex traffic situations or heavy traffic. While younger adults assess all relevant aspects simultaneously, older people tend to process information sequentially.

Motor skills

The mobility of older pedestrians may be progressively impaired by general physical changes experienced in the ageing process such as loss of agility, flexibility and endurance, reduced cardio-respiratory capacity, postural mechanisms and deteriorating balance. These factors lead to slower walking, as a result of taking shorter steps and precautions to maintain balance. In addition, reduced neck flexibility can make it very difficult for older people to rotate their head to look around before or while crossing the road to ensure that it is safe (Kent and Fildes, 1997).

The percentage of older people with varying levels of sensory, cognitive or motor disabilities, associated or not with a specific pathology, increases with age. Furthermore, a large number of older people are taking medication that frequently affects their ability to walk safely. As pedestrians, this adds more complications to their behaviour by slowing decision-making process and the actual road crossing.

However, the association between age-related losses and pedestrian safety is, in most cases, conjectural. As with older drivers, there is no evidence of a clear connection between impairment and the occurrence of pedestrian accidents (Hagenzieker, 1998).

Conclusions and key points

- The main safety problem for older people is their increased physical frailty and heightened vulnerability to injury if involved in a road accident. All else being equal, the tripling in the number of those aged over 80 by 2050 is likely to produce a marked increase in older road user fatalities.
- When involved in serious accidents, older drivers are more likely to be killed or injured themselves than to cause others to be killed or injured. The question of whether older drivers have a higher overall accident involvement remains unanswered.

- A large part of what seems to be increased driver risk with age is due to difficulties inherent in the measurement of risk – in particular, the frailty bias and limitations arising from the various measures of exposure.
- Any true increase in risk for older drivers as a group may be illness-related rather than age-related.
- The risk of accident for older drivers suffering from illnesses affecting their mental capabilities, such as dementia of the Alzheimer type, increases markedly as their illness progresses. Other illnesses also may contribute to increased risk, although the association is less clear.
- Older drivers' accident patterns reflect both their strengths and their weaknesses: they have a large share of their accidents at intersections but are seldom involved in accidents due to speeding or unsafe overtaking.
- Older drivers' share of traffic accidents will undoubtedly grow during the next few decades. However, future trends in accident rates may present a discontinuous development because of differences among different cohorts of older drivers, changes in the gender distribution, in the operating environment of the driver in the road system.
- Older people account for a disproportionate share of pedestrian fatalities, particularly in European countries. Relative to public transport and the private car, their risk of being killed in a road accident is higher as a pedestrian. Further research is needed to identify key risk factors and to develop countermeasures.

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Chapter 4

INFRASTRUCTURE

Introduction

The term "infrastructure" includes both the physical infrastructure needed to promote safe mobility and the policy, administrative and regulatory frameworks required to provide equitable access to the physical infrastructure. This chapter concentrates on issues related to physical infrastructure. Many of the policy and related issues that affect elderly drivers are discussed in greater detail in Chapter 6.

This chapter advocates changing infrastructure design to better meet older people's safe mobility needs. Design should not focus solely on technical efficiency and lowest cost. At a minimum, the design of new roads and future road improvements should begin with consideration of the requirements of all road users, and the best and most appropriate technology should be applied to meet them. Moreover, all reasonable cost implications (which will usually be minimal) must be accepted. Most important, infrastructure improvements made specifically to accommodate older road users will benefit all age groups.

This chapter addresses the following issues:

- Identification of difficulties commonly experienced by older road users, together with road design countermeasures being developed to mitigate them.
- In road and street design, the need for physical design features and measures to support safe mobility for all users, particularly older people.
- The increased use of motorised wheelchairs as a transport option for older people and the consequent infrastructure changes needed to ensure safety.
- Means to improve older people's access to and use of public transport.

Balance in the road and street environment

Before considering the needs of specific road user groups, it is worthwhile examining the more general issue of balance in the road and street environment. As the population ages, there will be pressure to maintain safe mobility for older pedestrians, cyclists and drivers, especially in residential neighbourhoods and shopping/commercial areas. Established techniques for allowing safer co-existence include slowing traffic and encouraging the diversion of through traffic, lowering speed limits and altering roads and roadside environments by reducing roadway widths, creating speed humps and improving intersections (see below). In addition, variable speed limits in mixed use areas (such as strip shopping centres) that provide for lower speeds during shopping hours and signalised pedestrian crossings that sense and adapt to the users' crossing pace can also increase safety.

Another excellent safety measure involves redirecting motorised traffic away from areas where other road users, especially pedestrians, are concentrated. A mix of physical measures, low speed limits and substantial enforcement may successfully reduce traffic and improve safety around many shopping, residential and recreation areas.

Traffic calming measures and various practices such as the establishment of 30 kilometre per hour zones, "home zones" and the "Woonerf" used by the Dutch in residential areas have helped all road

users. Many of these measures have been integrated into Sweden's "Vision Zero" framework, which aims to alter the road structure and associated rules of use so that no user will be exposed to mechanical forces above the threshold for producing serious injury.

Formal road safety auditing provides a useful and systematic means to introduce these improvements to the road system. Auditing may be reactive, in which case it usually involves the identification of locations with high crash frequencies or where large numbers of crash types have occurred (involving pedestrians, older drivers, etc.), determination of the causal factors and the development and implementation of cost-effective treatment while still ensuring appropriate levels of mobility. Recently, road authorities have recognised the need to be proactive by using road safety auditing in all key planning and design stages of road construction.

Infrastructure for older drivers

General

The key objective in the design of roads and traffic facilities is to provide an appropriate balance of mobility and safety for all road users. Older drivers are doubly disadvantaged in terms of the mobility/safety mix. Many avoid driving under difficult or high-risk conditions and restrict their driving to times and situations they feel comfortable handling (Fildes *et al.*, 1994). Their fragility increases the rate of serious and fatal injuries per year, self-regulation notwithstanding.

It is not surprising that older drivers experience difficulties with the road infrastructure. Most jurisdictions have built their road networks using design standards based on the performance of younger, fit adult drivers (Fildes *et al.*, 1999).

Beyond improvements to the road and street infrastructure, the safety and mobility of older drivers (and their passengers) can be enhanced by using modern technology to improve vehicle design and handling. Advances in this area are detailed in Chapter 5.

Road and traffic engineering

Chapter 1 established that the ageing process may include the development of functional impairments that cause driving difficulties. Although individual impairments rarely show a strong correlation with involvement in a crash, taken together they can make the driving task more difficult and place some older drivers at increased risk.[1]

In a US survey, older drivers identified the following tasks as particularly difficult (Benekohal *et al.*, 1992): reading street signs, crossing intersections, turning at intersections, following road markings and responding to traffic signals. They stressed the value of lighting at intersections, pavement marking at intersections, dedicated turn lanes, wide travel lanes, raised channelisation for turns at intersections and larger traffic signals.

Predictably, intersections figure prominently among older drivers' concerns (O'Leary and Atkins, 1993; Fildes *et al.*, 1994, 1999; National Research Council, 1988; Elliott *et al.*, 1995). Specific recommendations for improvement include:

- Use of one-way systems (provided they do not lead to increased speeds), prohibiting dangerous turns, separating traffic flows and staggering the decision processes through use of roundabouts or offsetting crossroads.
- Dedicated turn-across-traffic lanes and traffic signals allowing protected turns.
- Pavement curb markings and raised channelisation for turns.
- Improved road geometry at intersections (US Department of Transportation, 1998) (Table 4.1).

1. A valuable review of age-related impairments and the consequent relative risks for involvement in crashes is found in Staplin (1999*a*).

Table 4.1. **Contents of the US *Older Driver Highway Design Handbook***

I. Intersections (at grade)	
Intersecting angle (skew)	Traffic controls for right turn movements
Receiving lane (throat)	Street name signage
Channelisation	One way/wrong way signage
Intersection sight distance	Stop- and yield-controlled intersection signage
Left-turn lane geometry, signing, delineation	Traffic signal performance issues
Edge treatments	Fixed lighting installations
Curb radius	Pedestrian control devices
Traffic controls for left-turn movements	
II. Interchanges (grade separation)	
Exit signing and delineation	Fixed lighting installations
Acceleration/deceleration lane design	Traffic controls for prohibited movements
III. Roadway curvature and passing zones	
Pavement markings and delineation, curves	Advance signing for sight restricted locations
Pavement width, curves	Passing zone length and passing sight distance
IV. Construction/work zones	
Advance signing for lane closure	Delineation of crossovers/alternative paths
Variable message signing practices	Temporary pavement markings
Channelisation practices	

Source: Federal Highway Administration, US Department of Transportation, 2000.

Other improvements that might be made to the road infrastructure to make the driving task easier and safer for older drivers, include:

- Better sign luminance to counteract loss in legibility distance.
- Improved conditions for night driving, especially by increasing the reflectivity of roadway delineation and adequate maintenance of the reflectivity of signage and other road markings.
- Larger sign symbols (with symbols preferred to text).
- More relevant, conspicuous and timely information about required driving manoeuvres, complemented by multiple signage for advanced warning.
- Regular maintenance of signage to prevent redundancy and to eliminate clutter.
- Improved merging design features.
- Improved features at "give way" or "yield" situations.
- Reduction of speed through road design or traffic controls where complex manoeuvres are required.
- Safer roads, incorporating wider lanes and shoulders, with non-obstructed roadsides without trees and other obstacles.
- Longer sight distances to allow for older drivers' slower response times.
- Appropriate placement of signs and signals both laterally and vertically. This is critical, given reduction in peripheral vision, particularly for height above eye level.

Programmes under way

To address these infrastructure design issues, the US Federal Highway Administration's Research and Development Program has produced *The Older Driver Highway Design Handbook*, which is intended to supplement existing standards and guidelines for highway geometry, operations and traffic control devices (US Department of Transportation, 1998). Based on research on accident patterns and age-related impairments, it provides detailed design recommendations for four broad site types: at-grade

intersections, interchanges (with grade separation), roadway curvature and passing zones and highway construction/work zones. To initiate these infrastructure changes and enhancements, the Handbook is being disseminated throughout the United States in seminars targeting road engineers and designers. Its contents are listed in Table 4.1.

Many of the measures advocated by the Handbook have been identified as "ready to go", at little or no additional cost relative to what is spent for current practices (Staplin, 1999*b*). Recommendations for their implementation recognise that full-scale changes to the existing road infrastructure are cost-prohibitive and not a feasible option. Rather, implementation of these design features is advocated for new construction, existing facilities undergoing reconstruction or maintenance and for "spot" treatment at locations where safety problems are present or anticipated.

The Australian Transport Authorities' federated organisation, Austroads, has adopted and expanded the American work (Fildes *et al.*, 1999). Following extensive investigation of older drivers' crash patterns at "black spot" sites in Australia and New Zealand, Austroads has recommended the adoption of new Australasian design standards.

Infrastructure for older pedestrians

General

Pedestrian-priority residential zones were introduced in Europe in the late 1970s, a practice particularly influenced by the Netherlands' "Woonerf" concept. Even earlier, many European cities featured pedestrian shopping streets from which vehicular traffic was banned. Over time, efforts to produce pedestrian-friendly zones have been widely adopted throughout OECD Member countries, especially for residential streets frequented by children and older people. For example, urban speed limits in Europe are generally set at 50 km/h for inner city and town roadways, with many residential streets zoned at 30 km/h with appropriate signage and other traffic controls (Fildes *et al.*, 2000; Via and Kaal, 1993; Minnen, 1997).

Environmental beautification of multi-purpose European urban roads and streets has also contributed directly to pedestrian safety. Many designs include use of innovative pavements and landscaping with trees, shrubs, flowers and planter boxes that collectively serve to slow traffic. Frequently, bollards are used to separate cars from pedestrians, and slalom layouts of streets are adopted to reduce speed and beautify the area.

These facilities are less evident outside of Europe. Australia has long been reluctant to adopt a 50 km/h urban speed limit, although resistance is gradually lessening.[2] Except in school zones, the United States has not lowered speed zones to protect pedestrians.

Road and traffic engineering

The quality of footpath and pedestrian-crossing surfaces and the avoidance of abrupt changes in level and steep inclines are particularly important for increasing the confidence of older pedestrians and facilitating their mobility. In particular, these qualities allow for shifting concentration from walking to observing and responding to other road users' actions. (Footpath quality in relation to motorised wheelchair users is discussed below.)

On major arterial roads, the provision of central median pedestrian refuges in association with pedestrian crossings will allow older pedestrians to cross in two stages. This offers greater safety for older (and other) pedestrians while maximising safe traffic flows at the crossing point. Other road treatments likely to facilitate older pedestrians' mobility include:

- Kerb extensions to minimise exposure time on the roadway.
- Bollards or other treatments to prevent parked vehicles from blocking pedestrian pavements.

2. The State of Victoria, Australia, announced a residential street speed limit of 50 km/hour. Media Release, Minister for Transport, 25 May 2000.

- Adequate footpath widths to accommodate all users safely.
- Reliable pedestrian access to public transport, given the difficulties often posed by steps, the customary absence of handrails and access difficulties for wheelchairs and walking frames.
- Adequate pedestrian access to shopping facilities which are often blocked by extensive parking lots or street furniture.
- Pedestrian-only areas where possible.

Formal pedestrian crossings can be useful, although older pedestrians often prefer to take the most direct path and are unlikely to walk very far to a crossing point if they have difficulty walking. Further, full signal pedestrian lights at signalised intersections are often too brief for slower walkers who may be intimidated by impatient drivers. The use of a "flashing red" period to indicate that a crossing signal's cycle is coming to an end often causes anxiety in older people. Some strategies using new technology to address these two issues are presented below. Selective use of barrier fencing may also be used to improve the safety of pedestrians by preventing crossing in dangerous locations. Both sides of the road should be fenced to avoid stranding a pedestrian in traffic. Some pedestrians view fences as an impediment to mobility, so a balance is needed in their use.

Improving facilities for smaller groups of road users is not a straightforward task, given the complexity of the transport system. The task is made more difficult when older and disabled pedestrians are being targeted as a specific sub-group. Improving the situation for one group (for example, by providing kerb ramps) may adversely affect another group (for example, visually impaired pedestrians who use kerbs as a guide to determine the boundaries of roads). However, most improvements for older people will help all pedestrians.

While aiming at improved mobility for pedestrians, infrastructure improvements must also ensure that overall safety is preserved. In general terms, the most effective way to prevent pedestrian accidents is to install infrastructure that separates pedestrian from vehicular traffic. Such infrastructure includes use of barriers between the pavement and the roadway and traffic controls that balance pedestrian and vehicle movements efficiently at intersections.

As pedestrian safety is not just an engineering issue, the efficacy of these measures also relies on appropriate human behaviour. Realisation of the full safety and mobility benefits intended by pedestrian design features and elements depend on users' respect for and proper use of them.

New technology options

In addition to a number of in-car applications that may reduce pedestrian crashes (see Chapter 5), technology can assist older pedestrians in other ways in order to improve the safety of road crossing for older (and other) pedestrians.

The key issue for older pedestrians is the amount of time allotted to complete the crossing at signalised intersections. Since pedestrian facilities on highways, roads and streets are generally based on young adult performance levels, many older people have difficulty walking at the 1.2 m/sec assumed by most traffic engineering manuals. Moreover, engineers are often reluctant to introduce an across-the-board increase in signal times because of the likely disruptions to traffic flow.

Technology now allows the green signal to match the time required by pedestrians to cross the road by tracking pedestrian movements through use of infrared detectors or other devices. This type of crossing, known as a "PUFFIN" crossing (Pedestrian User Friendly INtelligent), was first introduced in the United Kingdom, where early work indicated that the crossings were likely to be safe and well accepted by the public (Davies, 1992). A more recent evaluation showed that all pedestrians, regardless of age, took longer to cross the road, an indication of a less stressful interaction with traffic. Older pedestrians' crossing time increased the most, a sign that they derived the greatest benefit (Reading *et al.*, 1995). A similar evaluation using a trial PUFFIN crossing site in Australia indicated that while pedestrian crossing times increased, average delays to motorists were reduced owing to the overall reduction in pedestrian green times (Catchpole *et al.*, 1996).

Other types of intelligent crossing devices are being developed in OECD Member countries. For example, the European DRIVE programme trialed microwave pedestrian detectors which would either extend the vehicle red signal or advance the pedestrian green signal if a pedestrian was detected approaching a crossing at a suitable point of the signal cycle (Ekman and Drazkowski, 1992).

Optical detection also offers a solution for allaying older pedestrians' anxiety about crossing times. "Countdown signals" provide a display showing the amount of time remaining to complete the crossing before the steady red signal appears. Singapore has installed 160 sets of countdown signals and plans to install more.

Optical detection of pedestrian movement has the potential to be self-governing in terms of signal operations, to measure pedestrian numbers and to take trajectory information into account (*e.g.* allowing the system to predict when a pedestrian is likely to arrive at a crossing or complete a crossing). It also has a number of disadvantages that can make it difficult to apply in practice, particularly in terms of coping with changes in weather conditions and light. Optical detection also requires a relatively large amount of computing capacity. Further research and development is needed to overcome these disadvantages before the technology can be regarded as fully practicable.

Hand-held route guidance systems represent another technology that offers assistance to older pedestrians. These systems can provide continual feedback to pedestrians in a number of ways. They can plot the best route between two points on the basis of specified criteria and indicate the location of rest areas along proposed routes as well as warn of barriers or obstacles and offer advice on alternative routes. They can indicate the location of bus stops along the route and furnish information on pavement conditions. Finally, they can incorporate a "Mayday" emergency notification system in the event of a fall, injury or attack. Again, further research and development is needed before these systems become fully operational and widely affordable. However, rapid advances are being made to bring these products and services to fruition.

Infrastructure for other older road users

Cyclists

It is more financially feasible to provide appropriate infrastructure for safer cycling than for cars, buses and trucks. Bicycles' light weight and low speeds make it possible to establish separate bicycle paths at a fraction of the cost of providing roadways for heavier and faster vehicles.

Many cities in OECD Member countries and elsewhere have improved bicycle safety by providing bicycle facilities. For example, a Danish study found that the crash risk of cyclists was reduced by 25-60% on rural road sections with separated bicycle lanes (Hansen and Jorgensen, 1988). The same study also highlighted a major limitation to bicycle paths. They inevitably cross roads at various points, and this periodic interaction with motorised traffic places cyclists at heightened risk, particularly if they are on the right of a vehicle that is making a right turn.

In addition, dedicated bicycle paths are inappropriate in other contexts. If the path does not lead directly to the desired destination, commuting cyclists in particular will reject route deviations and will resort to the main road network. The difficulties for developing direct routes can be considerable. In many cities, the shortest route to the central business district will be via arterial roads, making it difficult to provide an alternative route of shorter or equal distance. The Dutch experience suggests that placing bicycle lanes on urban arteries is not demonstrably cost-effective (Wegman and Dijkstra, 1988). On the other hand, separate cycle paths have been proven to be cost-effective.

Despite their shortcomings, separated cycle paths offer considerable protection in many circumstances and, at the very least, clearly identify the points of greatest risk (where the path intersects with a road.) This in turn allows for concentration on particular, appropriate treatment: for example, use of traffic lights or other protected road crossings. However research is required to identify other feasible changes to the road infrastructure that can offer greater safety to older and other cyclists, while not noticeably impairing the mobility of other road users.

Motorised wheelchair users

Motorised wheelchairs are usually designed for use in areas normally reserved for pedestrians, such as shopping centres, theatres, cinemas, railway stations and footpaths. While these units offer tremendous mobility advantages for disabled people, the physical infrastructure is currently unsuitable for their widespread use. In rural areas in particular, operators of these vehicles are sometimes forced to use streets and roads to travel, either because footpaths do not exist or because the surfaces do not allow comfortable or safe travel. Although reliable data on the involvement of motorised wheelchairs in crashes are not available, their presence on streets and roads introduces a new hazard as they mix with heavier, faster traffic.

Where footpaths are available, other difficulties exist. For wheelchair users as well as for pedestrians, uneven, discontinuous or soft surfaces constitute a barrier to mobility. Ramps are required when changing levels, as when moving from the roadway over the kerb to the footpath. The ramps should facilitate a smooth transition from the roadway to the footpath and need to be constructed so that their lateral edges do not cause the wheelchair to tip. Guidelines exist for good practice in the design of infrastructure for disabled pedestrians and wheelchair users (The Access Board, 1999; Institution of Highways and Transportation, 1991).

Median pedestrian refuges and clearly delineated pedestrian paths across roads are to the benefit of older pedestrians. However, such paths are often narrow and delineated by raised concrete barriers. While this configuration may adequately serve pedestrians in both directions, it may not be wide enough to accommodate both a wheelchair and pedestrians, thus potentially leaving people stranded in traffic lanes in the path of vehicular traffic. Pedestrian routes need to be complete. Otherwise, wheelchair users may travel along a well-designed path only to encounter a hazardous situation or an insurmountable obstacle that impedes further movement. In addition, street furniture and signage may be placed so as to obscure the view of approaching traffic.

The European Conference of Ministers of Transport (ECMT) advocates maintaining all directions of principal pedestrian (and wheelchair) movement as "pedestrian clearways," that is, clear of shop displays and street furniture (ECMT, 1999). Similar provisions should be made with respect to outdoor café seating in heavily trafficked areas.

It has been estimated that there are about 3 million wheelchair users in Europe alone. As the population ages and the demand for mobility increases, more people may use wheelchairs, particularly the motorised ones that allow them to make longer journeys. A British survey shows that 26% of motorised wheelchair users are now making round-trips of over 5 miles (8 km) in good weather.[3] The need for an appropriate infrastructure to support motorised wheelchair use is increasingly urgent.

Public transport infrastructure

General

Public transport services of various types are described in Chapter 7. This section covers specifically the infrastructure required to provide public transport services that are easy for older people to use. This infrastructure should be linked to the infrastructure for older pedestrians in order to provide access to public transport stops or stations.

Transit stops

Generally, transit stops are now designed with the disabled in mind and thus also cater to older people. A detailed list of recommended features for railway stations, which is generally applicable to all transit stops, has been developed (Oxley *et al.*, 1996). It includes: provision of ramps and/or elevators where stairs are located; location of ticket windows and transit fare vending machines at heights that

3. Personal correspondence with Jo Kavanaugh, Banstead Mobility Centre, Carshalton, Surrey, August 2000, covering a survey of users of powered wheelchairs and scooters from July 1998-99.

can be reached by those in wheelchairs, easy-to-use fare machines and easy-to-follow directions to them, including tactile paths for the visually impaired and availability of waiting areas, preferably heated and monitored, that provide seating.

Bus stops should connect to the surrounding network of sidewalks and pedestrian paths and provide sufficient space to allow a passenger in a wheelchair to board a bus. If a bus cannot get close enough to the kerb, use of an extended ramp to the road surface is recommended (Balog *et al.*, 1992). Older transit users have expressed concern about lack of personal security at transit stops. This is another important element of safe mobility (Smith *et al.*, 1997).

Tactile paving

Tactile paving is used to signal the visually impaired as they approach a potentially dangerous location, such as the edge of a train platform. It is important to provide different pavement types to help users distinguish the type of hazard and to provide general guidance and orientation.

In this context, a trial conducted in the United Kingdom recommended different pavement types for different uses. A number of countries have introduced regulations or standards for tactile warning surfaces, and recommendations relating to different types of tactile paving have been made (Crain and Associates Inc., 1997). They include: a modified blister pattern for light rail crossings, a lozenge-shaped blister pattern for on-street platforms, a corduroy "proceed with caution" tactile surface and an "information" surface to indicate where travel and other information can be gathered.

It is recommended that this practice be made standard in all OECD Member countries (Savil *et al.*, 1996). In addition, audio messages should be used to support tactile paving wherever possible. The use of tactile pedestrian surfaces has also been suggested as appropriate for application in other pedestrian areas.

Conclusions and key points

Older people have distinct accident patterns as users of road infrastructure (vehicle occupants, pedestrians, cyclists and public transport patrons). To best ensure their mobility and safety, the infrastructure needs to take account of these patterns, in particular to accommodate older users' changed abilities and functions. This chapter has highlighted the following infrastructure needs and issues:

- The use of physical features in road and street design to support safe mobility for all users, particularly older people.
- The difficulties commonly experienced by older road users, together with road design countermeasures being developed to overcome these difficulties.
- The difficulties commonly experienced by older cyclists, including an assessment of bicycle paths as an option to mitigate them.
- The emergence of motorised wheelchairs as a transport option for older people and the consequent infrastructure modifications required.
- The means to improve older people's access to and use of public transport.
- The starting point for safe mobility of older people is to ensure the application of a range of measures to roads and streets to produce a safer environment for different user groups. Measures may vary from the specific (*e.g.* reduced vehicle speeds) to the integrated (*e.g.* the Dutch "Woonerf" concept and the Swedish "Vision Zero" approach).
- Infrastructure design should not focus solely on technical efficiency and lowest cost. Designs for new roads and future road improvement programmes should at least recognise the inappropriateness of standards based on the abilities of a fit, young adult driver for members of an ageing society and meet the needs of all categories of road users (vehicle occupants, pedestrians, cyclists, motorised wheelchair users, etc.). The best technology to satisfy those

requirements should be used, and all reasonable cost implications (which will usually be small) should be accepted.

- Formal safety audits can benefit all road users through the identification and correction of deficiencies in current infrastructure and the elimination of such deficiencies in future road development.
- The driving skills that cause particular problems for older drivers are negotiating intersections and understanding and responding to signs and signals. The means to mitigate these problems exist.
- The United States and Australia have investigated the suitability of road design for older drivers. One published design handbook, with another in production, advocates design changes in response to the reduced performance levels of some older drivers. The cost-effectiveness of the new standards remains to be demonstrated.
- The quality of footpath and pedestrian-crossing surfaces and the avoidance of abrupt changes in level and steep inclines are particularly important to older pedestrians. In addition to affecting ease of use, improvements in these areas will also yield safety benefits, allowing older people to shift their concentration from walking to responding to other road users' actions.
- All pedestrians, and older pedestrians in particular, are likely to benefit from the use of new technology to improve road-crossing facilities. New optical detection technology offers promising resolutions to a number of issues in this area, in particular the time needed by many older pedestrians to cross the road, anxiety about being stranded mid-crossing and the need to ensure adequate traffic movement.
- Older cyclists are over-represented in crash statistics and intersections represent a major problem. While cycle paths represent a potential solution, further research is required.
- Motorised wheelchairs are an emerging transport option for older people. Traffic engineering practices need to take better account of this trend, notably to enable a compatible mix with other motorised vehicles and pedestrians.
- Public transport stops and interchanges need to be designed to take account of the requirements and limitations of older people, especially those with walking difficulties. Bus stops must be directly and easily accessible from footpaths and/or to networks of pedestrian paths and, where appropriate, be equipped with a ramp leading to the street surface.

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Chapter 5

VEHICLE DESIGN

Introduction

The association between ageing and disability described in Chapter 1 indicates that over the next three decades, older people's health and level of functioning are likely to improve. Nevertheless, by 2030, there will be substantial numbers of older people afflicted with some type of disability that threatens and possibly impairs their mobility. As noted earlier, ageing is frequently associated with cognitive or neurological impairments that can affect driving performance, particularly in complex traffic conditions and specifically at intersections. If these impairments become sufficiently serious, the individual may need to cease driving (Chapter 6 offers a possible approach to management).

Age-related conditions may affect mobility by severely reducing physical access to many transport options. Muscular-skeletal impairments such as osteoarthritis, rheumatoid arthritis and decreasing strength may all affect the range of motion of limbs, compromising older people's ability to walk, enter and exit vehicles and reach driving controls or handle the steering wheel. These conditions can also restrict access to transit vehicles by making it difficult to cross streets, to climb a few steps, to stand in a moving vehicle or to move about in it.

The ageing of society provides compelling reasons for improving vehicle design to meet the problems experienced by older people. Because ageing is associated with frailty and increased vulnerability to injury in the event of a crash, older transport users are likely to be the prime beneficiaries of continuing improvements to protect vehicle occupants.

This chapter therefore addresses the following issues: vehicle design improvements to counter the assorted problems experienced by older people and advances in passive safety of vehicles, including occupant protection options to improve older driver and passenger safety.

Designing the car for older users

Car body design

Height of doorframe, width of door aperture, seat height, doorsill height and floor-well depth are design elements of a car that may encumber older drivers and passengers. Two studies conducted in the 1980s in England (Institute of Consumer Ergonomics, 1985) and Sweden (Petzäll, 1991) recommended improvements to vehicle design to facilitate older peoples' entry and exit. They advocate comparable dimensions (Table 5.1).

Recent car models appear closer to providing ease of access for older persons than cars of the late 1980s, when these studies were conducted. Further design improvements advocated for older occupants are:

- Handhold and supports for assistance in entering and exiting the vehicle. While handles are often provided on the passenger's doorframe, similar features are rarely provided for drivers. In the absence of this feature, drivers can get some support by grasping the door window frame or ledge.

Table 5.1. **Recommended car access dimensions**

Car part	Recommended dimension (cm)
Door frame height above ground	133-138
Width of door aperture (A to B pillar)	80-100
Seat height above ground	50-60, 50 optimum
Doorsill height	36-40
Doorsill to car floor	4-9, 6 optimum
Seat front edge to A pillar	35-45
Door opening angle	70°, 90° when assistance needed

Source: Institute of Consumer Ergonomics, 1985; Petzäll, 1991.

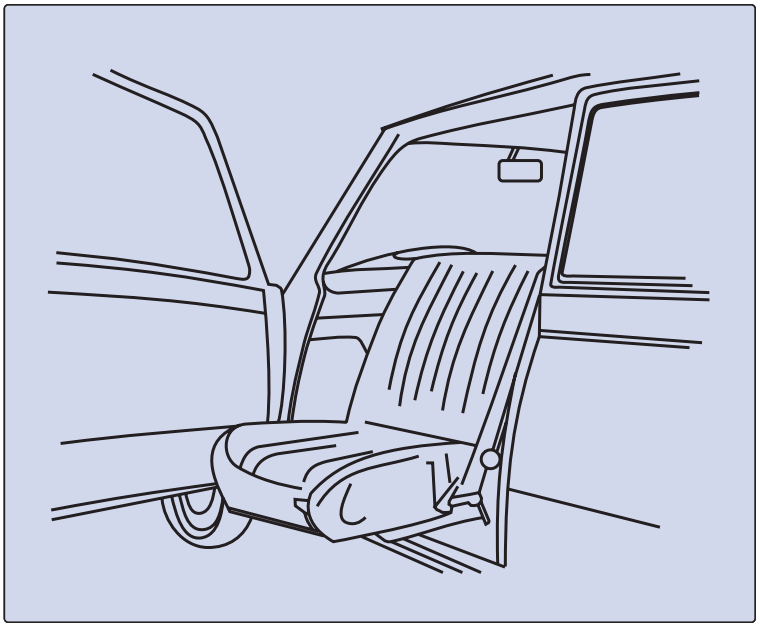
- Car seat adjusters. A handle is more easily grasped than a knob to adjust the angle of the seatback and fore and aft position. The controls need to be within easy reach. Many cars are now equipped with power-operated seats, many of which store the preferred seat position and adjustments in memory.

Adaptive equipment

An assortment of optional, after-market car features has been developed, particularly for disabled people. Many of these can also reduce the effort required by an older occupant to enter or exit a vehicle. They include:

- Swivel seats that turn sideways to a 90° angle and slide and swivel out of the doorframe (Figure 5.1). In Europe, these seats require testing for compliance with safety regulations.

Figure 5.1. **Swivel seat feature**



Source: Department of Transport, 1985.

- Additional handles on the doorframe may provide support during entry and exit. Portable grips may help the occupant reach the seat belt (which may be positioned far behind the seat occupant in two-door cars) or the door catch.
- Additional steps may assist in entering and exiting vehicles with a high doorsill. Alternatively, an optional high seat cushion could be added to some vehicles.
- Severely impaired drivers or passengers requiring wheeled mobility aids may require a powered hoist to help stow the mobility aid in the trunk or on the rooftop. These are expensive pieces of equipment, but may be necessary to maintain an older person's mobility.

Ease of driving

Powered controls

Powered steering and automatic transmissions are commonly available as standard equipment in many new cars. They are particularly useful for drivers with declining strength in upper or lower limbs.

In addition, many car manufacturers provide remote control of the car radio set as a standard feature in new models. The station selection controls are commonly placed on the steering wheel, so that the driver's eyes can remain focused on the road.

Adjustment of the driving position

The driving position is easier to adjust in many modern cars, allowing modification to the seatback's fore and aft movement, cushion and tilt. Seats in some models also have adjustable support, usually for the lower back. Power-operated seats can be ordered as optional items for most models.

Adjustable steering wheels also facilitate use by older drivers. The fore-aft motion along the axle and the up-and-down motion (less frequently provided) may help clear the space available for entry and exit as well as make the steering wheel position more comfortable.

More recently, some vehicle manufacturers have begun offering adjustable pedals, allowing the driver to adjust the seat position for both upper limb and lower limb "reach".

Adaptation equipment

A knob on the steering wheel is a simple feature that helps the driver maintain control of the steering wheel when turning and parking.

Extension or relocation of controls may help to operate step-on parking brakes (common in North American cars) or the ignition key. More sophisticated relocation controls, such as pedal hand controls, are available for severely impaired drivers. Several OECD Member countries have prepared guidelines on helpful adaptation equipment (Koppa, 2000).

Rear-view mirror adjustments

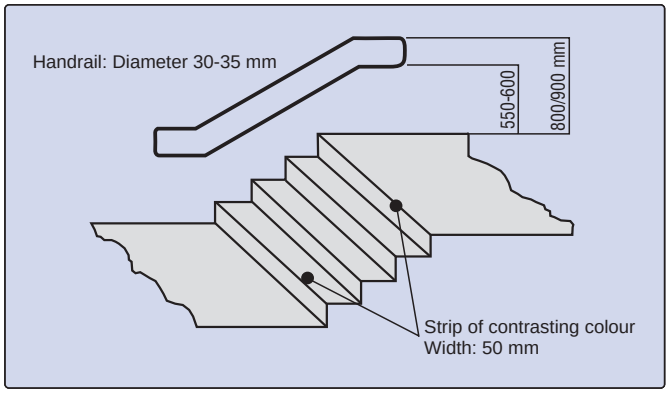
Wide-angle and planar rear-view mirrors may help older drivers suffering from impaired field of vision or restricted head movements. Standard car mirrors have succeeded in greatly reducing the "blind spots" in rear visibility. An older driver who is reluctant to change his/her car may consider adding a modern rear-view mirror with this capability.

Electrically operated outside rear-view mirrors are another recent feature. The button-operated control makes it easy to modify the side and rear visual control for standard driving on the road and for making reverse parking manoeuvres.

Designing other vehicles for older users

Various types of vehicles are used to operate transit, paratransit and taxi transport services. Researchers have investigated the difficulties encountered by older people in their use of such vehicles and have recommended design features to improve the situation (Oxley and Benwell, 1985; Mitchell, 1988; Dejeammes *et al.*, 1988; Minaire *et al.*, 1989; Petzäll, 1993).

Figure 5.2. **Design guideline for staircases**



Source: CERTU, 2000.

Key recommendations include: requirements for descending three steps using a handrail for different age groups, gap requirement for a mobility-impaired person to board a vehicle, steps and handrail requirements for a doorway staircase (Figure 5.2).

Accessibility is even more difficult for people in wheelchairs. If they are capable of transferring to the vehicle seat, the access dimensions need to be adequate. If a person is unable to transfer to the vehicle seat, he or she needs to travel seated in the wheelchair, in which case, the vehicle needs to be fully accessible, either as a result of suitable design or through provision of special access equipment (boarding devices). An example of the latter is an access ramp, the slope of which should not exceed 16% for powered and manual wheelchairs.

In these instances, safe mobility also requires suitable restraint for passengers in wheelchairs. International standards to address this need are currently being developed. This issue requires further research and development of suitable security devices and occupant restraints.

The following discussion provides examples of innovative vehicle design and describes features that should be considered when choosing a vehicle that is appropriate to serve older travellers.

Accessible or adapted taxis

Taxi services using standard vehicles should have a body design that facilitates older passengers' entry and exit. Taxi companies with facilitated access offer their older clients a higher quality of service which should result in continued patronage. Adaptations for easy access such as a swivelling seat for the front passenger and well-located handholds should be encouraged. In contrast, a space wagon or mini-van may be inappropriate because of the higher seat cushion and doorsill.

OECD Member countries such as Australia and the United Kingdom operate accessible taxicabs. The earliest models are converted mini-vans or space wagons with a low floor of 300-350 mm above the ground (Figure 5.3).

A person in a wheelchair can board and alight using an access ramp that is controlled by the driver. It is preferable to locate the seats in the rear of the van close to the door to enable a disabled passenger to enter the vehicle and then move easily within the compartment.

In the United Kingdom, a new regulation requiring some wheelchair-accessible taxicabs to be on call has led to the adaptation of London cabs and other space wagons and their release on the market.

In Sweden, a larger mini-van called "TaxiRider" (Figure 5.4), has been developed. Its rear compartment, which is full low-floor, provides space for five to seven passengers who can move in a

Figure 5.3. **A mini-van's conversion to a low-floor vehicle**

Source: CERTU, 2000.

Figure 5.4. **"TaxiRider" accessible taxi**

Source: CERTU, 2000.

nearly upright position (1.80 m) to reach their seats. It includes a kneeling system, which lowers the entrance height to 22 cm from ground level, and a fully flexible interior layout. There are two rearward facing positions for wheelchair users, which may accommodate two other passengers when the foldable seats are opened. The remaining space can accommodate passengers with three-point safety belts, or can be used by wheelchair users, facing forward and with an appropriate wheelchair-securing system.

Accessible minibuses

In many countries, minibuses accommodating 8-12 seated passengers are used for specialised transport services or demand-response services. Typically, they are converted cargo vans and often lack some of the comfort features frequently found in passenger vehicles.

Recently, some manufacturers have introduced "low-floor" design (320-350 mm high) in the rear compartment of these vans and have improved the suspension and interior comfort (Figure 5.5). Features that improve accessibility include: flexible seating arrangement with handholds, provision of spaces for wheelchair users, attachment systems and occupant restraints, a movable ramp for wheelchair access, controlled by the driver in most instances, a kneeling system in order to lower the vehicle sill for easier access at stops.

The Swedish "multipurpose vehicle" by OmniNova offers another example of an accessible van with a flexible seating arrangement.

Figure 5.5. **Low-floor minibus**

Source: CERTU, 2000.

Accessible buses and rail coaches

Light-rail coaches and urban transit buses in France and Germany have been designed to provide ground-level access to disabled and older passengers. Technology now allows these vehicles to be built with a low floor over either part or all of their length (Figure 5.5). The height of the low floor ranges from 320 to 350 mm above ground (and even 280 mm for one light-rail model).

Major accessibility features desirable for light-rail coaches and buses include: minimum doorway and gangway specifications, handrails and handholds to assist movement down the aisle, provision of access ramps for wheelchair users and safe designated wheelchair spaces inside the vehicle.

Similar requirements apply to long-distance buses commonly used for inter-city services or tours. Accessibility is made more difficult because of the high floor (to accommodate luggage compartments underneath), which requires passengers to negotiate a flight of steps that are often 30 cm high (sometimes even 40 cm from ground level to the first step). Two features now on the market to help passengers in negotiating the high first step are a kneeling system that reduces the height of the first step to 23-30 cm from ground level or a retractable step at the front entrance.

Immediate transit improvements would include the provision of staircases with well-designed handrails and contrasting floor colour to the background and the widening of bus aisles, which are presently only 60-65 cm in most vehicles.

Low-floor buses have been introduced for inter-city services in France, Germany and the United Kingdom to improve access for people with reduced mobility. However, there has been criticism of the smaller number of seats and a less comfortable environment.

In the United Kingdom, some "double-decker" inter-city coaches have been brought into service which offer a number of seats on the easily accessed lower deck for those who do not wish to or who cannot climb steps. In Spain, public transport patronage increases of up to 10% have occurred since the introduction of low-floor buses, with this increase in ridership attributed mainly to older passengers (COST, 1995). This is a strong indication of the potential customer appeal and consumer response to transport systems made "friendly" to older people.

Accessible buggies (low-speed vehicles)

Some older or disabled people find it difficult to walk even short distances. Buggy services – small electric vehicles used at large transport transfer points (for ferrying between airport terminals or circulating through large shopping centres or pedestrian areas) – constitute an innovative solution. Typically, the vehicles are converted electric golf carts or small industrial vehicles. In addition to ensuring that these vehicles allow easy entry and exit, their operating safety should be verified, including their interaction with the infrastructure, pedestrians, cyclists and other vehicles.

Crashworthiness and occupant protection

Historically, most vehicle safety improvements have been directed at improving crashworthiness. Improvements include better structural performance, improved vehicle in a crash and more effective restraint systems (seat belts and airbag systems in particular) to minimise occupant contact inside and outside the vehicle.

Since the 1960s, these improvements have effectively halved the risk of suffering serious injury in a crash (Newstead *et al.*, 2000) and have saved the lives of many involved in automobile crashes. Moreover, many crash victims have experienced less debilitating injuries as a result of these improvements. These advances have been of particular benefit to older occupants. Given their frailty and increased vulnerability to injury, safety features should be a prime consideration for older people purchasing a car.

Seat belts and airbags

Passive safety improvements commonly stem from analysis of real-world crash data that illustrate particular problems or trends. Analysis of these data has highlighted some patterns and trends from crashes involving older drivers, many of which are discussed in Chapter 3.

Crash data suggest that injuries involving rib and sternum fractures and chest complications are more common among older car occupants. While not usually life-threatening to younger adults, rib fractures pose serious risks to frail, older people. In-depth studies show that an older person with one

Table 5.2. **Airbag benefits to vehicle occupants in Australia**

Type of case	No. of cases	Mean injury severity score	Harm (AUD)	Probability of injury		
				Abbreviated injury score of 2+	Abbreviated injury score of 3+	Injury severity score of 15+
Airbag	63	2.6	9 200	0.19	0.03	0.02
Non-airbag	85	5.4	29 200	0.31	0.07	0.05

Source: Fildes *et al.*, 1996.

or two rib fractures may have a higher incidence of lung problems and require intensive care and long-term rehabilitation. In some cases, a rib fracture can even lead to an older person's premature death.

In their current state of development, seatbelts are beneficial, overall, to older occupants. However, in some crash circumstances, they may also contribute to the incidence of chest injuries. Recent developments suggest that this drawback is well on its way to being resolved, by the use of a "force limiting feature", which controls the maximum restraining force exerted by the shoulder belt.

In addition, crash data suggesting that older drivers may be particularly vulnerable to injury from impact with the steering wheel have prompted the development of driver airbags to mitigate life-threatening injuries. Airbags are designed as a safety supplement to seat belts and especially to provide additional protection against injury from the steering wheel. In the United States, they are also required to offer protection to unbelted occupants.

Table 5.2 shows the effectiveness of supplementary airbags in mitigating severe injuries and the substantial reduction in harm associated with their use. While not illustrated here, these benefits are likely to be even greater for older drivers, given their greater frailty.

Vehicle mass

The effect of vehicle mass on crashworthiness in frontal crashes is well documented (Evans, 1994; Fildes *et al.*, 1993). These benefits are expected to be even greater for older drivers. Therefore, large cars offer two distinct advantages to older occupants:

- The force of impact (and hence the stress on the occupant) is more moderate for the occupant of a larger car when it strikes another of lesser weight.
- A larger car is better able to absorb the impact energy in its structure than a smaller one. Less energy transmitted to an (older) occupant means a lower risk of serious or life-threatening injury.

Vehicle "aggressivity"

"Aggressivity" refers to a vehicle's tendency to inflict additional damage in a collision with another vehicle as a result of the vehicle's intrinsic features. It follows that by virtue of their size, larger vehicles are more aggressive and more injurious to occupants of smaller cars.

However, the role of mass on aggressivity is more complex. Recent comparative analyses carried out by the Insurance Institute of Highway Safety in the United States show that the vehicle's geometry is the major aggressivity factor, and that mass and, to some degree, structure are less critical (Lund, 1999). Other research carried out in the United Kingdom and in other parts of Europe confirms these findings. Development and implementation of recommendations to counter these features are required.

In the meantime, vehicle aggressivity is an issue that affects older vehicle occupants more than most other age groups. The protective options available to them are limited to the use of crashworthy vehicles and occupant protection systems. Older pedestrians are particularly at risk and lack even these limited forms of protection.

Technological advances in the protection of passengers

In addition to force-limiting seat belts and supplementary air bags, advances likely to be especially relevant for older occupants include (Pike, 1989):

- Intelligent restraint systems, capable of adjusting for lighter, older occupants.
- Dual-stage airbags to minimise aggressive airbag contacts in moderate crashes.
- Integral seat and seat belts to optimise fit of the belt to the occupant.
- Active head restraints to minimise soft tissue injury to the neck.
- Side airbags to protect the head and chest in a side collision.
- Active head restraints to minimise whiplash injuries to the neck.
- Floor structural improvements and airbags to better protect the ankles and feet.

Technology and crash avoidance

The most effective way to avoid injuries is to prevent the crash in the first place. To date, most in-vehicle interventions have focused on preventing injury through improved crashworthiness, but certain means of increasing the ability to avoid a crash have been introduced. They include advanced braking systems to prevent the wheels from locking and the vehicle from skidding, cornering stability systems which prevent the vehicle from over-steering during cornering by automatically braking the vehicle in a distributed manner at high speeds, better ride and handling characteristics generally achieved through improved suspension systems and better vehicle design and improved vision, seating and ergonomic characteristics.

The European DRIVE II Project EDDIT evaluated intelligent transport system (ITS) equipment being used by elderly drivers (Oxley and Mitchell, 1995). The reactions of users were very positive, with only one system found to have created a distraction from the driving task. Participants in these road tests and trials using simulators emphasised the importance of user-friendly technology. When testing on-dashboard displays, it was found that, as complexity increased, older drivers performed relatively poorer than young ones. For a variety of ITS systems, audible signals or messages were found to be extremely helpful to elderly drivers. The auditory cues reduced the amount of time spent looking at the visual display. The most important conclusion for the collision warning devices was that the "safe gap" setting for the system needs to be tailored to the abilities of the individual driver and not set at a single, universal level.

The effectiveness of these technological features for avoiding accidents has yet to be fully assessed. Other new technological devices expected to appear widely on the market – intelligent cruise controls, following distance meters, enhanced visual image displays and route guidance systems – could prove valuable for older drivers and passengers (Table 5.3).

Vehicle design and testing involve using crash-test dummies and models essentially based on average, fit young men (and more recently women). Test dummies capable of modelling the effects of an older occupant are needed. Lowering acceptable test criteria to better suit older occupants would also be valuable once the effects of frailty on the human body are firmly established.

Moreover, automotive designers tend to be younger engineers with little personal experience of the problems and difficulties facing older drivers. These engineers need to think about how their grandparents would fare in the models they are designing (Huelke, 2001). The Ford Motor Company is addressing this issue by having their ergonomics engineers in training don a "third-age" suit, which makes the wearer feel physically 30 years older. The suit, which is akin to an astronaut's outfit, mimics restricted body movement, inability to turn the head, stiff fingers and joints and increased sensitivity to glare (Roach, 2000).

Table 5.3. **Active intelligent transport systems devices expected to improve vehicle safety in the coming years**

Device	Operation
Improved sensing systems	Provide information to the driver on a range of manoeuvres such as blind spots, parking distance, braking, following distance, etc.
Intelligent cruise control	Vehicle senses a rapidly closing distance to the vehicle in front and can alter its speed and braking behaviour accordingly.
Enhanced visual image	Projects an enhanced visual image of the road ahead during poor vision conditions such as night, rainstorms and fog.
Route guidance systems	These are starting to appear in a number of cars and comprise displays (visual and auditory) of preferred route to a selected destination.
Intelematic speed control	GPS (global positioning system) satellite hook-up to ensure that the vehicle maintains or does not exceed speed limit.
Emergency call unit	GPS and mobile phones enable drivers to be automatically connected to rescue units in case of breakdowns or crashes.

Source: Fildes, 2000.

Finally, fast and effective post-crash trauma management is crucial for older people. Systems are presently being tested in the United States and Australia to provide automatic notification of a crash and immediate dispatch of suitable medical intervention and transport.

Conclusions and key points

- Older people are more likely than younger people to die in a road crash. Given the projected increase in the number of older drivers and passengers in the next two generations, improved crashworthiness of vehicles must be given the highest priority.
- Vehicle manufacturers need to improve the usability of vehicles for older people while maintaining vehicles' crashworthiness. Facilitation of entry and exit, more user-friendly controls and displays and greater use of power-assisted devices are areas for improvement.
- Vehicles used for both public and private transport need to take greater account of the reduced capabilities of the increasing number of older, functionally disabled users and of their mobility aids. Design standards to enable these improvements already exist.
- The safety of special-purpose vehicles such as buggies and low-speed scooters needs to be investigated, including their interaction with the infrastructure, pedestrians, bicyclists and other vehicles.
- Occupant protection should be enhanced by further development of seat belts and airbags, particularly through force-limiting features.
- Generally, larger vehicles offer more protection to occupants. This feature is particularly pertinent to older people, given their greater vulnerability to injury.
- Some current car designs can cause severe and fatal injuries to older pedestrians. Design features that offer older pedestrians better protection need to be identified and evaluated for implementation.
- New technologies for improving vehicle control and safety should continue to evolve and be designed and evaluated in light of older drivers' use patterns and functional abilities. Possible developments include navigational aids, in-vehicle collision warning systems, vision enhancement facilities and intelligent cruise control.
- In-vehicle emergency call ("Mayday") systems promise to be of particular benefit to older people in terms both of increased personal security in the event of vehicle breakdown and earlier treatment of injury in the event of a crash. These systems need to be evaluated, and if deemed beneficial, promoted.

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Chapter 6

MANAGING OLDER DRIVERS

Introduction

It has been well established that loss of mobility can have serious consequences for older people. Loss of independence and its adverse effects on an individual's sense of well-being may carry greater weight than any risk of harm from traffic accidents. Given the high rate of older pedestrian fatalities, particularly in Europe, policies that cause older travellers to increase walking or cycling to maintain mobility may increase their overall accident risk.

Given its convenience and relative safety, driving remains the preferred mobility option for many older people. For the immediate future, the main purpose of any older driver programme should be to support continued driving as long as drivers are able to meet specified safety requirements. Programmes that entail restrictive licensing practices need to demonstrate that, overall, they will be beneficial.

When older drivers are required to stop driving, they will have to rely on other transport modes to meet their mobility needs. In preparation for this eventuality, special provisions to ensure their safe access and facility of use of such modes should be undertaken. While some may be quite costly, it will be more costly to society in most instances to defer or to decide against providing them.

Driver programmes

Procedures for older drivers

Practices in OECD Member countries governing the licensing of older drivers vary. In some countries (*e.g.* Australia and the United States), practices also vary across licensing jurisdictions. Table 6.1 illustrates some of the differences in medical requirements for licence renewal.

In addition to requiring medical reports at various ages, some countries require older drivers to pass driving tests. Like the structure and scope of required medical reports, the driving tests differ widely in design and in validity.

The effectiveness of procedures for older drivers

Older driver licensing programmes based on medical and/or driving tests are aimed predominantly at detecting drivers who are unable to drive safely. To be effective, a programme must have two qualities:

- ***Sensitivity***: it must be able to detect a driver who is sufficiently impaired to pose an unacceptable risk to the public.
- ***Specificity***: it must not mistakenly identify fit drivers as unfit.

It has been impossible to obtain sensitivity and specificity measurements for any of the known older-driver testing programmes. In all likelihood, such measurements have not been made. Even assuming perfect sensitivity and specificity, "unsafe" drivers need to represent a very large risk if testing is to be cost-effective or beneficial. Accidents are rare events and many at-risk motorists can complete their entire driving life without mishap. Consider the following set of figures:

- Assume that the "acceptable" risk of a serious accident is 1 per 100 000 drivers a year.
- Assume that a factor is targeted that doubles the crash risk, making it 1 per 50 000 drivers a year.

Table 6.1. **Licensing procedures in some OECD Member countries**

	Renewal procedures	Renewal interval	Medical requirements for renewal
Belgium	No	No renewal required	None
Denmark	Yes	At age 70, issued for four years. At age 71, issued for three years. At ages 72-79, issued for two years. At ages 80+, issued for one year. If ill, shorter terms possible.	– – Doctor's certificate required. – –
United Kingdom	Yes	From age 70, mandatory renewal for three-year periods.	Self-declaration of ability to meet vision standard required. Any medical condition that could affect driving must be reported to the Licensing Agency.
Finland	Yes	At age 45, renewal every 5 years. As of age 70, renewal period depends on the physician.	After age 45, medical review every five years, covering general health status and vision. Renewal requires medical exam and verification of ability by two people.
France	No	No renewal required.	None
Germany	No	Renewal not determined by age.	None
Ireland	Yes	Annual renewal regardless of age.	At 70, a certificate of medical fitness is required.
Italy	Yes	Ten-year renewal up to age 50. Five-year renewal after age 50. Three-year renewal at age 70.	Medical test required with renewal.
Netherlands	Yes	At age 70, medical review required every five years.	Depending on physical condition, medical review may be more frequent, vision test required.
New Zealand	Yes	No renewal required until age 71. At age 71, renewed for five years. At age 76, renewed every two years.	From age 71 onwards, medical review and eyesight test required.
Portugal	Yes	At age 70, renewed every two years.	At age 70, a medical exam is required every two years.
Sweden	No	No renewal required.	None.

Source: Data provided to the OECD in response to an OECD survey, 1999.

- Assume that a test with 100% sensitivity and specificity for finding drivers with this risk factor has been developed.
- To prevent just *one* accident a year, 50 000 at-risk drivers would have to cease driving.
- 49 999 ex-drivers would then be required to use other, perhaps less safe, modes of travel and may run a greater risk of serious accidents than they did as drivers.

The risk factor of 1 in 50 000 is spread across all drivers with the specific condition. Therefore, a person having the condition will not necessarily have a crash, but each driver's risk is doubled, *i.e.* from 1 in 100 000 it becomes 1 in 50 000. Thus, for the total distribution, 50 000 drivers would have to cease driving to prevent a single crash.

Increasingly, researchers recognise that age-based mandatory assessment programmes targeting older drivers are unlikely to produce safety benefits and may have counter-productive results. One of the few evaluations of existing driver testing programmes has compared Finnish and Swedish licensing practices (Hakamies-Blomqvist *et al.*, 1996). Finland requires regular medical check-ups in conjunction with licence renewal starting at age 70, whereas Sweden has no such age-related control. A comparison of Finland and Sweden shows no apparent reduction in crashes as a result of the Finnish programme. However, Finland had a higher rate of fatalities among unprotected older road users than Sweden, arguably the result of an increase in the number of older pedestrians who had lost driving licences.

An Australian study reached a similar conclusion. Although the State of Victoria has no age-related licensing controls, its crash statistics for older drivers are no worse than those of other states with established testing programmes (Torpey, 1986).

Given the variation in older-driver licensing programmes in OECD countries, it is understandable that evidence relating to the effectiveness of age-related controls is inconclusive. However, one outcome is clear: many drivers (especially women) voluntarily stop driving rather than undergo a medical examination or a driving test (Levy, 1995; Hakamies-Blomqvist and Wahlstrom, 1998).Some yield their licences for health reasons or owing to difficulties in driving, although it remains to be established whether these factors are severe enough to warrant cessation of driving. It is also likely that many older drivers cease driving prematurely, and the crash data can be interpreted to suggest that age-based testing selectively deters safer, more conscientious drivers from seeking the renewal of their licences (Lange and McKnight, 1996).

The outcome of such procedures is mixed. On the one hand, they reduce the overall exposure of older drivers and therefore reduce crashes of older drivers (perhaps at the cost of increased crashes among other older road user groups). On the other hand, they appear to lead to premature cessation of driving and a substantial loss of mobility, with detrimental ramifications including increased depressive symptoms and sometimes a range of social and health disadvantages (Marottoli *et al.*, 1997, 2000).

Cessation of driving in cases where it is demonstrably necessary should be one component of a package of mobility options that allow an older person to continue to lead an independent life. At the very least, a more comprehensive service is needed to determine and meet the mobility needs of older drivers who may be on the verge of ceasing driving.

Assessing medical fitness to drive

Mandatory medical assessment of all drivers of a certain age to detect those who are unfit to drive is neither cost-efficient nor beneficial. This is due in part to the fact that a driver's health does not necessarily determine his/her fitness to drive. When a health problem has been identified, the question of whether to continue driving depends not on a medical diagnosis but on the functional consequences of the illness. Moreover, a given condition may affect an individual's fitness to drive in different ways and to varying degrees.

Although medical assessment seldom provides sufficient grounds for an absolute assessment of driving ability, it does play a role when there are genuine reasons to question older drivers' functional capabilities. Physicians, especially those working in primary care, represent an important first contact and information source and are in a position to make judgements and give advice to the patient about fitness to drive.

In addition to assessing specific conditions and disabilities, physicians also need to advise on the effects of any prescribed drugs on driving and on the effects of alcohol consumption in combination with such drugs.

Other elements of driver assessment

This section discusses other components commonly present in older driver licensing programmes in OECD Member countries.

Assessment referrals

Most jurisdictions, particularly those without mandatory re-licensing procedures, rely heavily on physicians and law enforcement agencies to refer "unfit" older drivers for assessment. The consequent variety of expectations, practices and legal protection illustrates the lack of standardisation in this area.

The case of physicians is a prime example. In some Member countries, doctors are required, either routinely or as appropriate, to assess a patient's fitness to drive. Typically, the outcome is communicated by issuance of a certificate or by reporting patients who are judged unfit to drive. In

these instances, doctors are usually, but not always, given immunity from litigation that might be initiated by the patient. Elsewhere, doctors are neither expected to make a ruling about fitness to drive (this decision remains the responsibility of the licensing authority) nor required to report a driver with a condition that might impair driving (that is the driver's responsibility). Still other jurisdictions require doctors to report a patient only if the patient refuses to do so him/herself.

Many countries provide guidance for physicians about drivers and their medical conditions. In the United Kingdom, for example, a guide for medical practitioners details the legal provisions relating to the standards of medical fitness required for holding a British driving licence and defines those disabilities which require notification to the licensing authority's medical advisory branch.

In the United States and elsewhere, actions are under way to make the referral process more proactive and at the initiative of the drivers themselves. A recent development is the promotion of "Wellness Fairs". These events, held in convenient locations within communities, are designed to enable older people to assess their driving performance. As with many similar schemes, older people have been reluctant to take advantage of these services. Most drivers (of any age) tend to rate their driving as good or above average and are unwilling to have their driving assessed, perhaps because they fear potential negative ramifications.

Assessment by licensing authorities

Most jurisdictions require that a driver undergoing assessment appear at an approved testing centre. The subsequent procedures vary considerably, but usually entail an interview with a licensing official to obtain information about the client's background and to form an opinion of his/her cognitive state.

The interview may cover aspects of the client's lifestyle, education, work, mobility requirements and, possibly, interests and hobbies. The reasons for referral are discussed. In the case of medical referrals, clients may be encouraged to talk about their condition, in particular whether it is likely to remain stable, to improve or to worsen. Courses of treatment might be explored as well as the client's use of prescribed drugs and medications.

The client may be required to undergo a series of more elaborate physical, sensory and cognitive tests, the nature of which vary from centre to centre. Finally, the client may be required to undergo a driving test, either on public roads or elsewhere.

As previously mentioned, there is increasing doubt about whether most on-road tests make it possible to detect the effects of age and impairment. Driving is usually a self-paced task and many drivers can adjust their driving style to compensate for declining abilities, even in relatively severe cases. On the other hand, the testing process may prompt older drivers to choose to relinquish their licence, with the result that any apparent association between testing and improved safety performance can be traced to lower licensing rates.

At a more technical level, most driving tests are designed for young novice drivers and focus on vehicle control skills rather than the consequences of possible functional deficits. Attempts to develop driving tests specifically for older driver assessment are under way in Finland, New Zealand, the United Kingdom and the United States, but it is too early to judge their effectiveness.

Remedial options for impaired older drivers

Medical treatment

In some instances, driver impairment may arise directly from specific medical conditions. In these instances, the first remedial option is to consider possible medical treatment of the underlying condition. As discussed in Chapter 1, illnesses that may be managed to improve mobility and safety include arthritis, cataract, stroke and dementia (O'Neill, 2000). Similar options may also be possible for a range of sensory-related conditions.

Older driver retraining courses

In many OECD Member countries, agencies (usually either the licensing authority or commercial enterprises) offer refresher or retraining courses which may be useful for some impaired older drivers whose condition cannot be improved through medical treatment. The courses are often classroom-based and may cover the following topics: the effects of ageing and associated impairment on driving; the effects of medication and alcohol on driving; advice on physical fitness and diet; traffic laws, including the role of new traffic control devices and new highway elements; aspects of vehicle design and technology to improve safe driving; and advice about defensive driving and self-regulation through adapting driving patterns to minimise accident involvement.

In addition to classroom-based retraining, courses may include referral options for detailed psychophysical assessment and on-road refresher courses. In some jurisdictions, training facilities are available for improving visual and cognitive functions.[1] The effectiveness of these courses in reducing involvement in a crash has yet to be evaluated.

Licence restrictions

For some impaired older drivers, it may be appropriate to issue them a restricted licence rather than oblige them to forfeit their licence. There is preliminary evidence from the State of Utah in the United States that drivers with restricted driving licences have lower crash rates (Vernon, 1999). General and specific licence restrictions are displayed in Table 6.2.

Table 6.2. **General licence restrictions and recommendations for specific licence restrictions**

Corrective glasses or contact lenses
Hearing aid or vehicle equipped with outside rear-view mirror
Automatic transmission
Automatic turn signals
Daylight driving only, doctor's recommendation required or based on driving evaluation given at night
Proof of financial responsibility
Left outside mirror
Right outside mirror
Adequate seat adjustment
Home area only (a defined radius that must include the driver's residence address)
No freeway or interstate highway driving
County or town roads
No driving in the city of _____ (specify)
Within city or village limits only
Highways posted ___mph or less only
Between residence and work only
Daylight driving only; driving restricted to certain hours (*e.g.* between 0900 hours and 15:00 hours)
Power-assisted brakes
Re-arrangement of pedals or controls
Foot brake extension
Accelerator extension
Hand-operated dimmer switch
Specially equipped van or automobile

Source: Staplin and Hunt, 1999.

1. Studies have been done of equipment designed to improve visual scanning and enlarging the driver's useful field of view. Information has been obtained from Staplin and Hunt (1999) and Staplin (1999).

Driving cessation: counselling and assistance

The loss of driving privileges can cause considerable distress and a lowering of self-esteem and dignity, as well as create difficulties for daily activities, shopping and social contact. Counselling and advice on coping with loss of licence and developing alternative transport strategies can aid the transition to non-driver status. Counselling can be provided by a variety of sources, but two immediate resources are the individual's physician and the licensing centre.

Physicians also play a role prior to cessation of driving. With the consent of the patient, they can counsel the partner of a slightly impaired older driver to assume a share of the driving or to resume driving. If both partners aim to maintain their driving skills, they will collectively maintain their independence in the event that one must cease driving.

Peer counselling organised by health services or other agencies provides an additional option. One US programme has five goals for counselling older drivers: to show empathy, respect and genuine care when helping an older driver in crisis; to help the older driver by listening to his/her situation and then to help to solve the problem; to use the counsellor's awareness of issues involved in retiring from driving and to communicate those to the older driver; to use the counsellor's knowledge of the ageing process to counsel older adults; to familiarise the counsellor with local transportation resources and increase older adults' access to those resources (Staplin, 1999).

Along similar lines, a handbook detailing how to retire from driving has recently been prepared for older people in the Australian Capital Territory (Oxley and Fildes, 2000). The handbook covers the following issues: ageing and possible driving risks, maintaining safe driving, recognising the signs of when to stop driving, planning ahead to anticipate a time without a car and alternative transport options.

Referral to health and social service agencies can also result in assistance. In the United States for example, local area agencies on ageing assist older drivers who have been required to cease driving. These agencies differ in their operation, but a best practice has been identified in Kansas, which consists of three main activities: planning for retirement from driving, learning how to drive safely longer and peer counselling to help ease the transition (Staplin, 1999).

The role of mobility centres

Mobility centres address problems arising from impaired mobility for all age groups. Their activities extend beyond driving to help with a range of transport options, including public and private transit services. They provide information on powered wheelchairs and scooters. They also evaluate older drivers' capacity to continue driving safely and can help to develop transport solutions tailored to the needs of individuals required to stop or restrict their driving.

In the United Kingdom, a network of mobility centres helps older and disabled people achieve independent mobility as drivers, passengers and wheelchair users. They are funded from a variety of sources and are usually staffed by physiotherapists or occupational therapists and driving instructors. The services typically include:

- A free service for disabled and older people, their families and professionals, featuring information on vehicle choice, control options and advice on learning, continuing or returning to driving.
- Assessment and advice on entering and exiting vehicles, advice on the selection and use of wheelchairs and on car adaptations to accommodate both drivers and passengers with disabilities.
- Retraining for experienced drivers with mobility problems and training in driver assessment for other professions (such as physicians and driving instructors).
- Continuous evaluation of the service and long-term follow-up research to monitor the outcomes of assessment and training.

Clients can go to these centres independently or they may be referred by their doctor, therapist or social worker. Fee quotations are made available on request and financial assistance is sometimes provided.

Model licensing procedures for older drivers

As previously discussed, current age-based, mandatory assessment practices are not considered an appropriate response to the safety risks posed by some older drivers. At the same time, it is recognised that licensing jurisdictions will continue to bear – and be expected to bear – responsibility for ensuring that drivers are indeed fit to drive. This report maintains that driver testing can be most effectively and equitably conducted by targeting those older drivers who pose discernible risks to others.

In this context, three related licensing models are of particular interest: the California model, the Maryland model and the Australian model.

The California model (United States)

Between 1993 and 1997, the California Department of Motor Vehicles conducted two pilot studies to develop an assessment system to identify and evaluate the driving performance of drivers with age-related impairments, especially cognitive decline. The studies, which involved various tests, envisioned three measurement tiers in an operational testing system that could be applied regardless of age:

- ***Tier* 1** consisted of a set of brief and inexpensive screening tests to identify drivers requiring more extensive assessment. Promising tests recommended for this preliminary screening were (in addition to the standard California renewal tests of high-contrast static visual acuity and driving-related knowledge), a test of high-luminance, low-contrast static visual acuity (broadly speaking, contrast sensitivity) and a checklist recording by licensing staff of operationally defined signs of possible impairment.
- ***Tier* 2** consisted of more intensive and lengthy tests for those who failed the first tier. Initially recommended tests include an automated variant of Trails A, a paper-and-pencil test of general cognitive function that is needed to safely operate a vehicle. The test includes a perceptual-time module from the "useful field of view" test (UFOV). Computers were used to administer a complex-choice reaction speed test to subjects' driving competence. Depending on his/her test performance, a driver was in most cases either passed as safe to continue to drive or required to proceed to the third tier of testing. If a driver's impairment was determined to be so severe as to prevent her/him from taking a road test, such a driver would be required to cease driving.
- ***Tier* 3** consisted of an on-road test developed for impaired drivers. As a result of the road test, a driver in an operational testing system would be assessed as unfit to drive, fit to drive, fit to drive with advisory or mandatory restrictions or would be referred to a retraining or rehabilitation centre for further assessment and advice.

The contribution of the California model, apart from its rejection of road-testing drivers on the basis of age alone, lies in its introduction of the notion of a tiered rather than a universal assessment procedure. Preparations are under way for an extensive field trial of the model that will collect data from drivers of all ages to determine the utility and feasibility of tiered assessment for all renewing drivers under operational conditions.

The Maryland model (United States)

This model, developed by a multidisciplinary group of professionals in Maryland, explicitly rejects age-based testing and targets only those older drivers considered to be at risk of unsafe driving. Older drivers whose fitness to drive is questionable are referred to the Medical Advisory Board of the Motor Vehicle Administration. Referrals may come from families, friends and concerned citizens as well as from professional groups, and they are often investigated for validity prior to the medical review.

Referred drivers are required to complete a comprehensive medical health questionnaire and have their medical provider send a detailed report to the Medical Advisory Board. In addition, they take a battery of 11 gross impairment screening tests (GRIMPS) which assess physical, visual and other perceptual and cognitive functions. A physician reviews all of these results and may call for an additional interview to make a final judgement of fitness to drive.

- This case-by-case review allows for several different outcomes: no action may be taken and the driver retains his/her licence; a restricted licence may be granted; the licence may be suspended until a rehabilitation programme is completed, after which the drivers is again reviewed. However, if doubt about the driver's fitness to drive remains, a driving test may be given to determine if an unrestricted or restricted licence is possible or if the licence should be revoked.

Rehabilitation options may include one or more of the following:

- Medication may be modified to bring the disease and the associated functional impairment within acceptable limits.
- Evaluation by an occupational therapist may be recommended in order to develop a prescription for physical and/or visual treatment. The behind-the-wheel test likely to be included in this evaluation may indicate whether the therapist needs to provide further training.
- Other driver rehabilitation specialists may identify adaptive equipment and training required for safe driving.
- Cognitive training procedures may be recommended for cases for which useful approaches have been identified.
- For many drivers, driving school training may be sufficient to remedy the problems noted on the screening tests.

The Maryland model only requires assessment of drivers suspected of being substantially functionally impaired.

The Australasian model (*Australia, New Zealand and surrounding islands*)

Key aspects of the proposed Australasian model (Fildes *et al.*, 2000), which evolved from the California and Maryland approaches, include:

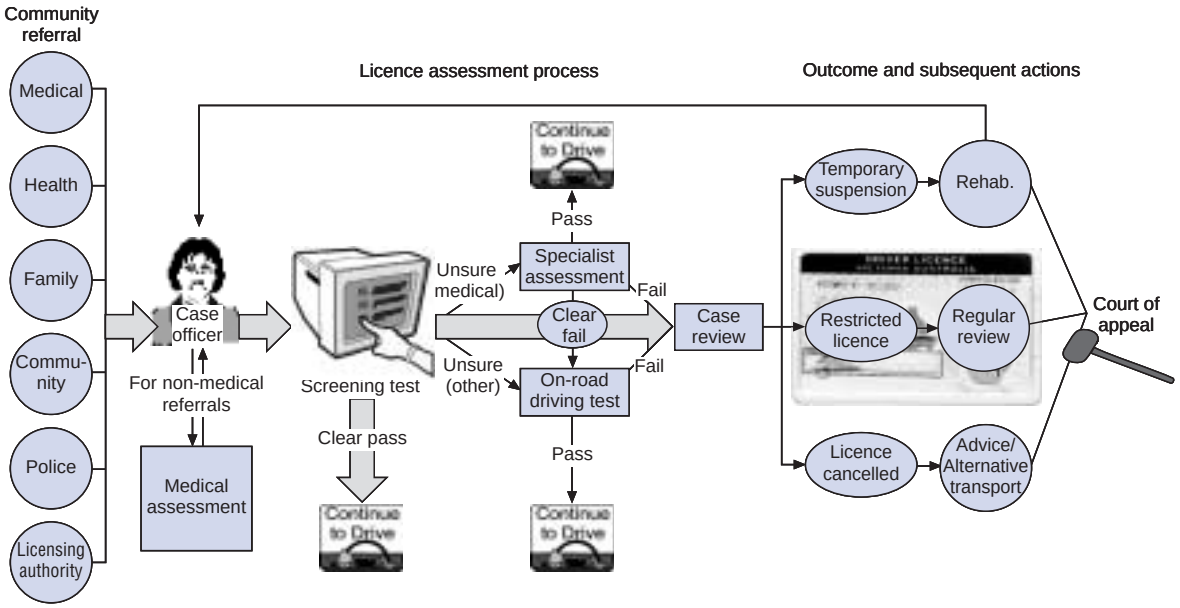
- The expansion of community notification sources, whereby older drivers and others suspected of being at high risk of a crash are identified and referred for formal assessment.
- Continued use of multi-tiered assessment, including the involvement of general practitioners, occupational therapists and other health specialists at more elaborate levels of assessment.
- A case officer to take responsibility for and work closely with referred drivers as well as with the referral sources. The case officer's role extends to providing post-assessment counselling regarding alternative transport options, if appropriate.
- The identification or development of assessment instruments of known validity for testing safe driving.

The model licensing procedure developed in Australia is shown in Figure 6.1.

The four levels of assessment proposed include:

- ***Tier* 1** requires various community referral sources to make a preliminary assessment of older drivers' fitness to drive. Only drivers suspected of being a possible risk are referred for further assessment.
- ***Tier* 2** occurs in the licensing office and consists of a battery of screening tests that are quick to administer and applicable to a licensing setting. Drivers suspected of substantial impairment will either have their licence revoked or proceed to further testing.
- ***Tier* 3** consists of a variety of specialised assessment services that may involve some combination of occupational therapists, neuro-psychologists, ophthalmologists and other

Figure 6.1. **Model licensing procedure, Australia**



Source: Austroads, 2001.

medical specialists. This level of assessment is undertaken only if deemed necessary by Tier 2 assessment results or by the initial referral.

- ***Tier 4*** consists of a driving test administered by the licensing authority to be given to all drivers who fail the Tier 2 and 3 assessments, unless the results indicate that it is unsafe to do so.

Like the Maryland model, the Australasian model only requires drivers suspected of being functionally impaired to go through at least the first tier of testing.

Overview

The three models indicate directions currently being followed in terms of procedures involving older drivers. First, there is a movement from age-based assessment to targeting only those considered to have functional impairments relevant to safe driving. Second, multi-tiered assessment is emerging as the preferred option, with the more elaborate (and expensive) forms of assessment being reserved for those who show evidence of substantial impairment. Third, it is increasingly recognised that older drivers themselves need to be active and informed participants in the assessment process, if only to encourage their acceptance of the final outcome. Finally, it is understood that the role of licensing authorities needs to extend beyond making decisions about whether or not to renew licences to providing advice and assistance on other transport options, especially, but not only, for those judged unfit to continue driving.

Much more research is needed before any of the three models becomes fully operational. In particular, valid assessment devices must be identified or developed which can be used at all assessment levels to assist in determining fitness to drive. All three models are undergoing extensive study and the results are awaited.

Conclusions and key points

- Many tests of sensory and cognitive functions are available for assessing older drivers; however, none is considered sufficiently sensitive or specific with respect to potential involvement in accidents to be used as the sole criterion for licensing decisions.

- Age-based mandatory assessment programmes targeting all older drivers are considered unlikely to produce safety benefits and may indeed create counter-productive results. In particular, they are likely to contribute to premature cessation of driving and loss of mobility for many older drivers who would be able to continue driving without heightened risk of accident.
- Driving tests are the most obvious basis for making licensing decisions but may have little correlation with potential for involvement in accidents. Work is needed to develop specific driving tests for older drivers, to cross-validate driving tests and functional tests and to establish their respective roles in assessing likely involvement in accidents and subsequent licensing decisions.
- Systems for assessing older drivers' fitness to drive are currently being developed for licensing authorities. Such assessment systems need to be closely evaluated, particularly to assess their capacity to differentiate safe from at-risk drivers. Common features include: increased community involvement in the referral of at-risk drivers, involvement of both government and private agencies in assessment, involvement of appropriate specialists in assessment and rehabilitation, the presence of case officers in the licensing system who work closely with referred drivers as well as with the referring professionals, provision of outcome options and advice on alternative transport and, finally, provision of counselling and, if appropriate, training.
- Older drivers should be given licensing restrictions only when it is determined that they pose a significant danger to other road users.
- Decisions on fitness to drive should be based neither on age nor on the diagnosis of any particular disease, but rather on a judgement of the functional abilities required for safe driving.
- Many retraining courses aimed at older drivers exist. There is a need to determine whether these courses have road safety benefits and if so, to find ways of persuading the drivers who require retraining to attend them.
- Specialised mobility centres for older drivers with disabilities or chronic medical conditions may be able to help these drivers to function better. Physicians and the general public should be made aware of their existence so that they make greater use of them.
- Mobility centres function best when staffed by multidisciplinary professionals, including occupational therapists, driving instructors (with specialised training on mobility issues) and psychologists with expertise in the administration and analysis of cognitive tests. Centres should also be able to call upon medical expertise, including optometrists and audiologists, as necessary.

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Chapter 7

ALTERNATIVES TO THE CAR

Introduction

The availability of means of transport other than the car is one of the most important ways to maintain older people's mobility. Such options allow older people to travel. Viable transport options need to provide opportunities for spontaneous travel and flexibility in modal choice in order to enable older users to reach the desired destinations. Such options need to ensure that the complete travel chain is suitable for older people, taking account of older people's capabilities and limitations. It is necessary to provide older drivers with travel alternatives when they do not wish to drive and enable them to continue travelling once they have stopped driving. As noted in Chapters 3 and 6, many older drivers try to avoid driving at night, in bad weather, in congested areas and during peak periods. The travel patterns of older people are described in Chapter 2. The mobility alternatives described in this chapter benefit not only older people but all travellers who are unable to drive or prefer not to. This chapter reviews mobility alternatives to the car for older people and offers recommendations on measures that may improve them.

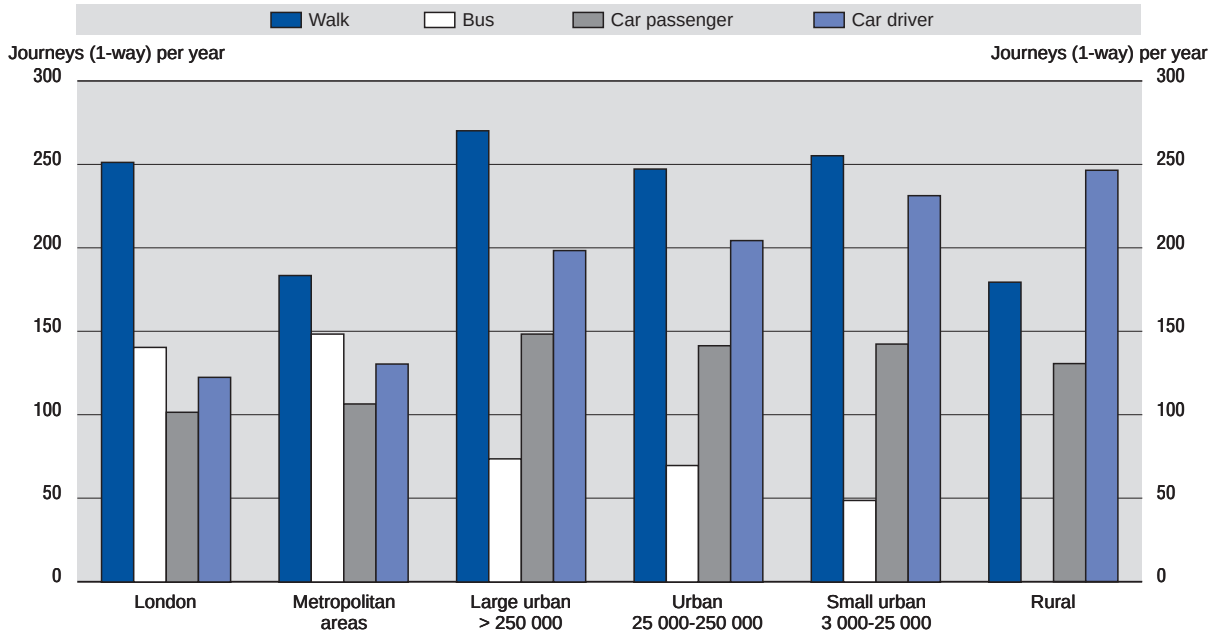
Between Europe and North America, there is a great difference in the use of alternatives to the car. In Europe, older people walk and use local buses, particularly if they live in reasonably large towns. In 1997-99 in the United Kingdom, people aged 70 or more made more than one-third (35%) of their trips on foot. They made 29% of their journeys as car driver, 20% as car passenger and 12% as bus passenger (DETR, 2000). In contrast, the car is the dominant means of transport for older Americans. They make only about 6% of their journeys on foot and 2% by public transport (Rosenbloom, 1998). High rates of car use are attributable to a variety of factors including geography, land use and transport planning, provision of public transport and alternatives to the car, fuel costs and cultural and attitudinal differences.

The extent to which older people use alternatives to the car also varies with the characteristics of residential areas. Figure 7.1 shows the number of annual journeys taken by British people aged 70 or more residing in different areas (DETR, 2000). More than one-third (35-37%) of all journeys were made wholly on foot, except in developed metropolitan areas and rural locations. In London and the metropolitan areas, local buses provide 21-25% of journeys (in London, a further 9% of journeys are made by rail), but the use of buses is much lower elsewhere. The percentage of journeys by car, both as driver and passenger, increases steadily in rural areas. These results indicate the difficulty of providing attractive bus services outside the largest towns, but emphasise that walking is a viable option for local journeys even in small towns and, possibly, in rural areas. In urban areas of all sizes, more journeys were made on foot than by car.

Alternatives to the car are often provided by community transport and paratransit (Dial-a-Ride) services. These can be useful, particularly when they are well matched to local travellers' needs. Drawbacks to these services are that they often require advance booking and are best suited to well-planned lives. They rarely permit spontaneous travel of the kind made by car, via high-frequency bus service or on foot.

Powered wheelchairs, scooters and golf carts constitute another class of mobility alternative that does not require a driving licence. These vehicles allow spontaneous travel and are being used for

Figure 7.1. **Journeys made annually by people aged 70 or more in Great Britain, 1997-99**



Note: Number of bus journeys taken in rural areas not statistically significant.
Source: Special tabulation from the National Travel Survey (1997-99), Department of the Environment, Transport and the Regions, by C.G.B. Mitchell.

journeys made under favourable weather conditions of up to about 4 km.[1] Pedal cycles can also be considered a class of unlicensed vehicle with the potential to improve the mobility of older people who have stopped driving. While cycling may raise safety concerns in some OECD Member countries, in others such as the Netherlands, cycling is a major form of transport.

A family of mobility options

For some time it has been recognised, particularly in Scandinavian countries, that no single form of transport provides mobility for all people under all circumstances. A family of services or options arranged to enable travellers to select the one that best suits their requirements for a particular journey is needed (Ståhl, 1992). These options include:

- Conventional public transport services that are easy to use and, if possible, accessible to passengers in wheelchairs.
- Bus service routes using small vehicles that pick up and discharge passengers close to origin and destination of journeys in order to reduce walking distances to/from stops, at the expense of a longer travel time. Easily accessible vehicles with specially trained staff and flexible schedules so that passengers can board and alight without feeling rushed.
- Conventional taxis, often with user-side subsidies in order to reduce the fare to little more than that charged for a bus journey.

1. Personal correspondence with Jo Kavanaugh, Banstead Mobility Centre, Carshalton, Surrey, England, August 2000, covering a survey of 60 users of powered wheelchairs and scooters from July 1998-99: 16 users were making round trips of 8 km in good weather, and another 34 were making trips of 2-8 km.

- Dial-a-Ride service for passengers who need door-to-door travel, who require assistance at the start and end of their journey, who may need help during a journey and/or who use a wheelchair that cannot be accommodated by a taxi or accessible bus.
- Accessible pedestrian infrastructure to allow access to the available public transport and taxi services, and the freedom to make journeys wholly on foot or by wheelchair or scooter.

With the exception of Dial-a-Ride services, all of these options are available to the population at large and may be used by all travellers to satisfy their trip requirements. The freedom to walk safely and conveniently is fundamental to independent mobility. Many countries are already developing alternative transport options that target older people, including more flexible routing and a range of paratransit services. These programmes should be closely monitored and if effective, promoted. The family of alternative mobility options is described in greater detail in the remainder of this chapter.

Walking and assisted walking

Walking is an important travel mode, as it forms part of nearly every journey, even if only from one's door to a transit stop or to the car. As walking is a common, everyday activity, its importance as a means of transport is often overlooked and pedestrian needs often take low priority in transport planning. In most European countries, 30-50% of all older people's journeys are made wholly on foot. Safe, convenient and comfortable walking is the key to local mobility.

"Assisted walking" is the term used to describe walking with a cane or other walking aid, or with a guide dog or travelling in a wheelchair. Facilities for pedestrians need to be suitable for walkers and assisted walkers, if they are to satisfy the needs of the whole population. While users of powered wheelchairs are considered to be assisted walkers, the categorisation of scooters, golf carts and other unlicensed vehicles is still being debated.

Walking and assisted walking require thoughtful planning, the provision of quality infrastructure and support of programmes that encourage people to walk and train them to do so safely. Examples of some programmes are provided below.

Planning for pedestrians

Chapter 4 addressed the infrastructure requirements of pedestrians in some detail, and Chapter 8 looks at the land-use patterns that encourage people to make journeys on foot. Most people typically choose to walk for short journeys of up to about 1 km. Pedestrians often prefer direct routes that offer smooth, flat walking surfaces, with places to rest during the journey. About 10% of the adult population cannot walk more than 400 metres without resting (Martin *et al.*, 1988). Obstacles for pedestrians include diversions at road crossings, long delays at signal-controlled intersections and changes in grade due to underpasses or pedestrian bridges. Transport planners should provide facilities that address these problems. Local authorities can encourage this by giving higher priority to pedestrians than to vehicle traffic when planning facilities.

High-quality pedestrian facilities with direct paths that are drained, well-surfaced, well-signed, well-lit, monitored for security and away from heavy traffic encourage walking. Where such facilities do not exist, planners should consider installing sidewalks and pedestrian paths to improve walker and assisted walker mobility.

Users of powered wheelchairs and scooters

Powered wheelchairs and scooters are special types of vehicles that provide mobility for those with disabilities. Their format varies from a chair on wheels with an electric motor to various three and four-wheeled vehicles, with some recent models resembling an electric golf cart. The vehicles are usually designed for use in areas normally reserved for pedestrians, such as shops, theatres, cinemas, railway stations, trains, buses and footpaths. Either through design or regulation, their speed should be limited to ensure pedestrian safety.

While these units offer tremendous mobility advantages for disabled people, the physical infrastructure is often unsuitable for their widespread use. In rural areas in particular, powered

wheelchair users are sometimes forced to use roads, either because of lack of footpaths or because their surfaces do not permit comfortable or safe travel. There would appear to be scope for these units to use cycle lanes or paths where these are available, but this has yet to be assessed. Chapter 4 discusses in detail the infrastructure requirements of users of powered wheelchairs and scooters.

The safety of older pedestrians

Chapter 3 establishes that pedestrian accidents involving older people are a significant road traffic safety problem, and Chapter 4 outlines physical infrastructure improvements that can be made to improve the safety of pedestrians. Although infrastructure improvements seem to offer the most promise for reducing pedestrian accidents, other approaches should not be overlooked.

Public education, publicity and training for a wide audience are the most important non-infrastructure measures for promoting mobility and preventing accidents involving older pedestrians. A description of the relevant general principles is provided in Chapter 9. Additional detail can also be found in two previous OECD publication, *Traffic Safety of Elderly Road Users* (OECD, 1985) and *Guidelines for Improving the Safety of Elderly Road Users* (OECD, 1986). In Australia, the State of Victoria introduced a "Walk with Care" programme in 1991, specifically to counteract the over-involvement of older people in pedestrian accidents. The programme uses a combination of educational, promotional and engineering countermeasures and is being implemented, with the support of local governments, in municipalities with high accident rates among older pedestrians.

The educational component of the programme aims to provide behavioural strategies to address issues such as complex road crossing situations (undivided roads and roundabouts), anticipating unexpected events (turning vehicles, failure to give way) and the function of traffic management devices and road rules. This component is delivered either through small, interactive discussion workshops or through large information sessions, each with various forms of follow-up and support material. The programme has not been evaluated in terms of its road safety outcomes.

Cycling

Pedal cycles are another class of unlicensed vehicle that can potentially provide mobility for older people. In practice, cycles are used for a significant amount of local travel in a number of European countries, particularly in Belgium, Denmark, Germany, Sweden and the Netherlands. In cities such as Groningen, Västeras, Münster, Oulu and Cambridge, bicycle trips account for 25-39% of all journeys (European Commission, 1999).

The main barriers to cycle use are terrain, weather and, above all, traffic and safety. As already noted, older people are more vulnerable in traffic accidents. In some OECD Member countries, the accident rate for cyclists is high, and unless excellent facilities for cyclists are available, it is difficult to advise older people to cycle. The infrastructure requirements for safe cycling are described in Chapter 4.

If it proves practicable for cyclists and users of powered wheelchairs and scooters to share cycle paths and lanes, this could increase the justification for the provision of safe facilities for cyclists and would in turn increase mobility options for older people. The push to make transport more sustainable and less energy-intensive should also encourage the provision of facilities for cyclists.

Public transport[2]

General

Public transport improvements made specifically for older people benefit everyone. Moreover, many public and private alternative transport schemes targeting older people are proving financially

2. In addition to the specific references mentioned, this section is generally indebted to Bundesministerium für gesundheit (1996); Geehan (1996); Mitchell (1997); Gowda and Meadors (1995).

sustainable and therefore make continued mobility economically viable for an ageing society. At transfer points and within public transport vehicles, visual and audible information needs to be presented to enable older people to plan their destinations easily and check on their progress regularly.

Surveys of older public transport users conducted in European countries that are well served by public transport indicate that mass transit bus and tram services commonly lack a number of desirable features, such as: short distances between bus stops (more than 100 meters between stops was considered excessive); user-friendly vehicles, preferably equipped with a low floor for level boarding; sufficient time to board, pay the fare and be seated; a relaxed and comfortable atmosphere aboard the vehicle; acceptable waiting areas and stations (protected from the climate and secure, with seats); considerate and polite drivers (Brog *et al.*, 1998; Ståhl, 1998).

Older people's stated preference for travel during evenings and on weekends, coupled with their general preference for avoiding night driving is at odds with most public transport services, which are reduced or suppressed during off-peak times (Kerschner and Aizenberg, 1999). Increasingly, these and other problems confronting older passengers are being addressed by social and transport planners, product manufacturers and transport operators.

Two promising approaches are being adopted in Europe. The first is to make conventional public transport more attractive and more user-friendly. The second is to introduce additional services specifically designed to satisfy the requirements of older and disabled persons.

Conventional bus services for older passengers

Buses are the form of public transport most commonly used by older people. As previously noted, to be attractive to older people, conventional bus services must be accessible and easy to use. Buses must take people where they want to go, they must operate at times when people want to travel and they must be scheduled so that travellers do not face long waits or be required to engage in significant pre-planning.

The design of buses varies greatly among countries. Buses with high floors (70-100 cm), high entrance steps (30-40 cm from the road and up to 35 cm internally), inadequate handrails and stanchions and poor seating, will be unattractive for people of any age and impossible to use for some. A bus step of 30 cm in height without a handrail excludes about 40% of the elderly population from boarding the vehicle (Mitchell, 1988). Since the early 1980s, European urban buses have been designed with floor heights of about 50 cm with a single 20 cm internal step at the entrance, and have been much easier to use. This may be one reason why transit usage is higher in Europe than in the United States. Low-floor buses and trams, described in Chapter 5, are easier to use and also accessible to wheelchairs, scooters, shopping trolleys and baby strollers. Their introduction has produced small but measurable increases in ridership, particularly by elderly people and people with baby strollers.

A comfortable bus ride on a route that matches people's travel requirements is only part of a complete transport system. It should be supported by suitable infrastructure (see Chapter 4), appropriate fare and ticketing arrangements (see below), clear information (see below) and well-trained staff. The bus driver can facilitate passenger access by manoeuvring the bus close to the kerb at stops (elderly people can often only stride a gap of about 30-40 cm). Enforcement of parking restrictions enables bus drivers to gain the needed access to facilitate boarding and disembarking. A driver's friendly and positive attitude is comforting to all passengers, particularly to those who are elderly and slower to board, pay their fares and find a seat. In addition, the provision of accurate information at bus stops about bus arrival/departure times can lessen older people's anxieties about using public transport.

Since conventional bus services are designed to serve the populace at large, they are sensitive to the wish of many passengers to minimise travel time. Stops are apt to be spaced further apart than older passengers would like. Routes tend to be direct and there is inevitably pressure on passengers to board and alight quickly. During peak travel times, buses may be crowded and no seats may be

available for some older passengers. For those able to manage these conditions, conventional services can be quick and convenient. For those who cannot, the following variants are designed to avoid these conditions in exchange for accepting longer travel time and probably a less direct route.

Service routes

The concept of a "service route" was first developed in Sweden to meet the travel needs of older and disabled users (Forsberg and Ståhl, 1991). Its main objective is to minimise walking distance to and from bus stops; to offer a readily accessible vehicle (no interior steps, comfortable seats, provision of handrails and handholds, etc.); to remove the pressure of time on passengers boarding and alighting and to avoid crowding; to ensure a friendly, welcome ride with specially trained drivers.

Typically, mid-sized buses with low floors and wheelchair ramps and spaces are used. They operate along scheduled routes between residential areas and sites with social and leisure facilities. Upon request, passengers can board or disembark at intervening locations. If asked, the driver helps passengers to board and waits for them to be safely seated before starting. Other countries, including Australia, Canada, Norway and the United States, have since adopted this concept.

In Sweden, service routes have proved so popular that some passengers eligible for Dial-a-Ride paratransit (see below) choose to use service routes for some or all of their journeys. This reduces the cost to the community. Service routes have replaced some lightly used conventional bus services.

"Flex-route" services

Flex-route services are a combination of fixed-route service and demand-responsive, kerb-to-kerb service. The features of the service developed in Gothenburg, Sweden, include:

- Use of small, low-floor buses.
- Advance booking required, up to 15 minutes before the trip. Bookings are coded into a computer to calculate the route and preliminary pick-up times. Then, 15 minutes before the last scheduled pick-up time, the computer calls all passengers to confirm or change the initial pick-up times.
- The route operates between two end nodes with fixed departure times. The route between the end nodes is adapted to the requests for pick-up and drop-off.
- Pick-up is at the door for passengers eligible for special transport services and entails only a short walking distance for other users.
- Flex-routes have about ten times as many stops as conventional bus or tram services.
- The fare is the same as for regular public transport and allows transferring to other public transport services within the fare zone.

Versions of the Swedish model are presently being tested and developed around the world. The degree of flexibility, the timeliness of response, the hours of operation and the range of services offered vary.

Community transport

Community organisations often provide transport services for older people. Typically, they link neighbourhoods and shopping areas, senior citizens' centres, medical services, etc. Services may be subcontracted to transit operators or to private companies (taxi companies, for example).

Better co-ordination between community organisations and transit systems could lead to expanded community services. In particular, transit vehicles that are under-utilised during off-peak times (for example, school buses during the period from late morning until early afternoon) could be made available to community organisations at reduced rates or even as a community service.

Ticketing

Fare vending machines can pose problems for older people. The complexity of the task, an inability to read the instructions and handling money or credit cards can cause difficulties. Since the introduction of automatic teller machines, banks have found that older people and others still require help from human tellers.

Paying cash for a fare while boarding adds to the time-pressured tasks. Smart cards, particularly contactless cards, and/or pre-purchased tickets mailed to a customer's residence may be better options for older passengers.

Evaluation of alternative transit services

Despite the increasing proliferation of special transit schemes for older passengers, they have rarely been evaluated for their effectiveness (Forsberg and Ståhl, 1991; Ståhl, 1998; Renolen and Hammer, 1995; Karash and Thatcher, 1998; COST 322, 1995; Oxley, 1998; Ling and Mannion, 1995). Some positive effects include: increased use of services following the introduction of more responsive services and/or low-floor vehicles; savings of funds when specialised public transit services have replaced paratransit services; and prompt return of investment outlays as a consequence of increased patronage.

Paratransit

Paratransit includes an extensive range of public and private transport services that provide demand-responsive shared rides on a kerb-to-kerb or door-to-door basis, often referred to as "Dial-a-Ride". Typically, small minibuses, taxis or private cars are used. Paratransit is particularly appropriate for areas where demand is low, either because of low population density (rural areas) or because the clientele is restricted to a small minority of the population. The availability of paratransit services varies among OECD Member countries.

Where available, some paratransit services are restricted to disabled people eligible for special transport services. In this case, vehicles are specially adapted with ramps or lifts for wheelchair users, and drivers able to assist passengers boarding and exiting the vehicle are available.

Two common problems associated with paratransit service are their restricted availability, owing to high operating costs, and the fact that their availability is often further restricted by eligibility requirements.

Taxis and car schemes

Taxi schemes provide door-to-door transport at lower cost than paratransit services and enable older people to remain mobile at lower cost to the community. Throughout Scandinavia, and in some other parts of Europe and North America, taxis are regarded as part of the family of local transport services for elderly and disabled people (Trudel, 1992). People who qualify for concessionary bus fares but are unable to use conventional public transport services are usually issued vouchers or a card to allow them to use taxis at reduced cost, often for about the same price as a full bus fare. The taxi scheme is often rationed to a budget limit or number of journeys over a given time.

A variant of taxi services is the voluntary driver car scheme. Under these arrangements, a car-owning volunteer drives passengers to certain destinations such as hospitals, day centres and food shops. The driver is paid generously for expenses but is not salaried. A hybrid scheme known as the Independent Transport Network (ITN) is operating in Portland, Maine (United States) (Freund, 2000). It is a form of taxi service operated by a pool of paid and volunteer drivers. The ITN offers shared or exclusive journeys at prices that reflect the exclusivity of the service and passengers' flexibility to time their journeys to match the availability of cars and drivers.

Information

Like all travellers, older people need information on the available alternatives to the car. First, they need to be made aware of a service's existence and of its operating hours and cost. They need to know how to use and access the service (route, location of stops, timetable and how to make a reservation, if required). There is great potential for an area transport broker able to supply this information to all, but particularly to elderly people and to those who, for whatever reason, have had to stop driving.

Information for public transport services

Information should be provided at transfer points and inside public transport vehicles to enable people to plan their journeys easily and regularly check on their progress. This information should be supplied both visually and audibly. Summaries of findings from recent studies (Hunter-Zaworski and Bricheux, 1999; Golledge *et al.*, 1996) include the following recommendations:

- Signs need to be clear, legible and easily visible. Text should be printed in large, high-contrast print. The use of symbols on signage is important to accommodate those older people with impaired cognitive ability. It is also important that signs be used consistently throughout the transport system. When new signs are introduced, public education may be required. Excellent guidelines for transit facility signage are available (KRW Inc., 1996).
- Information should also be made available audibly and can be delivered live (*e.g.* by a driver) or by a recorded message. It is important that the message be clear, simple, audible and comprehensible.
- Real-time information can help older people to reduce their waiting time. On average, an older person can stand for 15 minutes before needing to rest (Chen *et al.*, 1998*a*). Advance knowledge of a vehicle's expected arrival time can allow an older person to be seated in a waiting area without fear of missing his/her ride. If real-time information is available at home, older people can plan their trips to reduce waiting time at the station or stop. Research indicates that older people prefer live interaction with telephone operators to recorded messages when seeking transport information (Chen *et al.*, 1998*b*).
- Real-time visual and audio information should also be included at transit stops and on the vehicles themselves, to announce the next stop and prompt older persons to prepare to alight (GOTIC, 1997). Global positioning systems (GPS) technology makes it possible to track a vehicle's location as it progresses along its route (Koppa *et al.*, 1998).

New technologies can help all passengers by providing information and facilitating use of transport services. In many cases, technology will be particularly helpful in facilitating travel for older and disabled passengers (Table 7.1).

Technology can further facilitate use of public transport in the following ways:

- Use of smart cards for fare payment can reduce the number of actions a passenger needs to complete (usually under time pressure) when boarding a bus.
- Displaying the name of the next stop inside the bus gives passengers confidence and provides them with advance warning and time to prepare to alight.
- In the near future, it should be possible to receive and display real-time transit information on a hand-held unit or mobile telephone and at home. This should reduce waiting times at bus stops and increase the perceived safety and security of passengers by providing information on the location and operation of the service.

It is important that all such devices be designed with consideration of older people's dexterity and visual and hearing abilities in mind, as well as their potentially limited familiarity with the newest technology.

Table 7.1. **Bus passenger impairments, problems and technological solutions**

Impairment	Problem	Technological solution
Cannot stand for long, sensitive to cold.	Unable to stand while waiting at bus stops.	Display waiting time at home, at bus stop and on hand-held unit.
Unfamiliar with area.	Do not know bus service details.	Telephone information service.
Poor vision.	Cannot read service number. Cannot see community bus in time to hail it.	Service display at bus stop. Audio announcement by bus. Hand-held device for communication between bus and passenger.
Lack of manual dexterity, cannot do things quickly.	Difficulty in paying cash fare upon boarding.	Smart payment card.
Poor vision and/or unfamiliar with area.	Cannot identify destination stop.	Display name of next stop in bus, audio announcements.
Impaired hearing.	Unable to hear announcements.	Induction loop in bus. Visual presentation of information.
No vision.	Difficulty in finding bus stop, knowing which stop for which service.	Talking signs, stops that announce services from them.

Source: Suen and Mitchell, 1998.

Conclusions and key points

- An important way of maintaining older people's mobility is to make available alternative means of transport to the car so that older people who do not drive and older drivers who no longer can or wish to drive can continue to travel.
- In Europe, older people walk and use local buses, particularly if they live in reasonably large towns. In most European countries, 30-50% of all older people's journeys are made wholly on foot. Safe, convenient and comfortable walking is the key to local mobility. In contrast, older Americans only make about 6% of their journeys on foot and 2% by public transport.
- No single form of transport can provides mobility for all people under all circumstances. Many options are available, including conventional and special bus services, taxis, Dial-a-Ride, wheelchair, scooter, which need, however, to be developed with a view to their user friendliness for older people.
- Powered wheelchairs and scooters are special types of vehicles used to provide local mobility to those with disabilities. They offer tremendous mobility advantages for disabled people, but the physical infrastructure is often unsuitable for their widespread use.
- In Europe, conventional public transport is being made more attractive and user-friendly, and additional services are being introduced, particularly to satisfy the needs of older and disabled persons.
- Paratransit is particularly appropriate for areas where demand is low, either because of low population density (rural areas) or because the clientele is restricted to a small minority of the population.
- Taxi schemes provide door-to-door transport at lower cost than paratransit services and enable older people to remain mobile at lower cost to the community. In many areas, taxis are regarded as part of the family of local transport services for older and disabled people.
- Older people need information on available alternatives. They need to be aware of a service's existence and of its operating hours and cost, and on how to use and access the service. An area transport broker could supply this information to all, but particularly to older people and to those who have had to stop driving.
- New technologies can be used to help all passengers by providing information and facilitating use of transport services. In many cases, technology will be particularly helpful for older and disabled passengers.

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Chapter 8

LAND USE

Introduction

Mobility and transport needs are strongly affected by land-use patterns. Given that ageing is often accompanied by a range of mobility restrictions, land-use planning that aims to reduce the amount of travel needed to access services, facilities and social networks is of particular benefit to older people.

In this context, land use is much more than the location and density of residential development, together with the permitted mix of uses (residential, retail, services, employment, health, leisure, etc.). It also includes: the distance to shopping, health care, leisure and other services; the detailed local road layout (which, together with residential density helps to determine the feasibility of efficient, useable public transport); and the network of paths or sidewalks for pedestrians, powered wheelchairs, scooters and bicycles, including safe road crossings to encourage use of these transport modes, where applicable.

In current land-use planning practices and especially for new developments, marketing concerns often outweigh considerations of functionality for future generations. While compact communities with locally available facilities and services benefit older people specifically, this pattern is of general benefit to society and supports environmental sustainability policies.

Location and scale of facilities

As people age, the distance they can conveniently travel diminishes, owing to various factors, including slower driving and walking speeds and increased use of slower modes of travel. For older people, essential services need to be located within a decreased travel radius.

However, current development trends in some OECD Member countries favour the construction of centralised complexes with a collection of services (supermarkets, banks, family services, medical offices, hospitals, leisure centres, etc.) which are often distant from residential areas. For example, large retail outlets are usually constructed on a major route at the edge of town where land costs are lower. This choice of location ensures convenient access by car and ample customer parking, but is often inaccessible by other modes of transport.

Such complexes offer a number of advantages, but they inevitably entail longer journeys by clients and customers. Although careful location of such facilities to take advantage of public transport networks can help, these complexes can be difficult for older people to access. Countries such as Denmark have passed legislation prohibiting the construction of such complexes far from city centres.

Ageing in place

At present, many older people have spent their lives either in central urban areas or in inner suburbs and will "age in place" in these areas. Most of the necessary facilities and frequent public transport services are likely to be nearby and available.

In contrast, middle-aged people are living in lower-density suburbs, where car ownership and use is essential for daily living (Wachs, 1978). If they remain there as they age, they are likely to encounter reduced options for mobility, particularly if they are obliged to stop driving.

Studies have shown that older people change residence less often than younger people (SCP, 1999). On average, those between 50 and 80 years of age move only once; whereas younger adults move three or more times on average, usually to a more spacious and better home. When older people do move, it is usually to a smaller home in their neighbourhood in order to maintain their social circle. Such changes in residence often occur after the loss of a spouse, or owing to failing health or financial difficulties.

Encouraging ageing people living in low-density suburbs or rural areas to relocate to areas well served by a variety of mobility options well before the onset of old age is an efficient, cost-effective strategy. Residential alternatives can be found in many cities with an appropriate public transport infrastructure and where essential destinations can be reached by either public transport or walking. Another option is relocation to retirement communities with sufficient density to be able to offer acceptable levels of health care and public transport.

Voluntary relocation and consequent ageing in place offer easier access to mobility options and give potentially unsafe older drivers less need to drive. Moreover, if reliable, secure public transport is readily available, government budgets earmarked for alternative transport (*e.g.* subsidised taxis, community buses) can be better directed to those unable to relocate or to use public transport.

At the same time, care should be taken to ensure that relocation policies do not disrupt established social patterns. Further, using public transport is a learned activity and many older people may need assistance and training.

Survey results indicate that older people in England prefer living in central areas of large towns and make more journeys on foot or by bus (CBS, 1999; DETR, 1999). This illustrates the impact of location and land-use patterns on the viability of mobility options other than the car (Table 8.1).

Table 8.1. **Travel by older people: number and percentage of journeys by transport mode, Great Britain, 1997-99**

	London boroughs	Metropolitan built-up areas	Other urban over 250 000 population	Urban areas 25 000 to 250 000	Urban areas 3 000 to 25 000	Rural areas
	All people aged 60-69					
Walk	311 (33.6)	284 (30.2)	309 (31.6)	275 (27.0)	2 293 (29.6)	243 (25.6)
Local bus	129 (13.9)	120 (12.8)	92 (9.4)	49 (4.8)	36 (3.6)	– (–)
All modes	926 (100)	941 (100)	978 (100)	1 019 (100)	988 (100)	950 (100)
	All people aged 70+					
Walk	252 (37.1)	184 (30.8)	271 (37.0)	248 (35.1)	256 (36.2)	180 (29.6)
Local bus	141 (20.8)	149 (25.0)	74 (10.1)	70 (9.9)	49 (6.9)	– (–)
All modes	679 (100)	597 (100)	733 (100)	707 (100)	707 (100)	608 (100)

Source: British National Travel Survey, 1997-99.

In sum, if middle-aged people can be encouraged to relocate to areas well served by public transport and thereafter age in place, transport options are likely to increase rather than decrease, even for those who ultimately must cease driving.

It remains, however, that many of today's middle-aged people will prefer to age in place and to remain in suburbs or remote rural areas, despite the potential difficulties for access and travel. This reluctance to change location underlines the need to develop sound land-use practices as soon as possible to better manage the mobility needs of older people by 2030.

National policies on land use

Most European national governments have policies to encourage the development of more sustainable communities. Policies concentrate on locating development where it can be served by public transport, reusing previously developed land, developing higher-density residential areas, encouraging mixed-use developments and discouraging developments that require dependence on the car.

For example, the national government of the Netherlands has implemented land-use policies as a means to influence travel behaviour and limit car use. The aim is to ensure that businesses and services very likely to generate demand for transport are located in places that are, or can be made easily, accessible to public transport.

Further afield, Singapore provides an exemplary model of integrating land-use planning and managing transport needs in its development as a "Tropical City of Excellence". Achieving this vision includes integrating transport and land-use planning, expanding the road network and maximising its capacity, managing demand for road use and providing quality public transport choices.

Detailed design issues

Chapter 4 addressed key infrastructure features needed to provide older people with adequate mobility, and many of these can be achieved through improved land-use planning. For example, the ease with which people can travel as pedestrians or in wheelchairs depends on the detailed design of land-use developments. Where provision for pedestrians or powered wheelchairs is satisfactory, a substantial proportion of journeys of up to 4 km can be made using these two means.

For public transport, the layout of a development needs to be based on a road network that allows buses reasonably direct routes through the development. In this way, quick journeys can be made by bus; this can be attractive to passengers and efficient for transit operators. Likely points of departure for bus trips should be close to the bus route and linked to bus stops by high-quality paths. Pathways leading to the bus stops should be direct and include safe crossing places at roads carrying significant traffic. Stops should be located in developments with neighbourhood centres and local shops. The network of pedestrian and cycle paths that serve the shopping centre can then also serve the bus stops, particularly if provision for cycle parking is made.

There are various guidelines on the layout and design of new developments, including means to reduce dependence upon the private car (IHT, 1999; DETR, 1999). In the Netherlands, a guide on pedestrian facilities was developed, based on the assumption that these are fundamental needs rather than optional "add-ons" to a road network. The issue is not whether pedestrian facilities should exist, but rather what is the best level of quality that can be provided.

Traffic management

Land-use planning can also lead to improved, safer traffic management in and around residential and other developments, for example by diverting higher-speed through traffic to suitable roads and by minimising traffic and traffic speed in residential and shopping areas. The Dutch Traffic Safety Institute (SWOV) has introduced a road network hierarchy with three classes:

- A*ccess roads* (residential streets) that give direct access to properties alongside a road or street.
- D*istributor roads* that provide short links between neighbourhoods, urban districts and traffic corridors.
- T*raffic corridors* that accommodate higher-speed, high-volume, long-distance traffic.

To achieve the highest level of safety, the three types of roads should adhere to three safety principles:

- F*unctional road use*: prevention of unintended use of the infrastructure.

- H*omogenous road use*: prevention of great differences in mass, speed, direction and volumes at moderate to high speeds.
- P*redictable road use*: prevention of uncertain behaviour.

These design principles for land-use planning can be used in all OECD Member countries to lead to safer traffic management and to encourage a range of transport options in appropriate environments.

Planning processes

Land-use policies can enhance older people's lifestyle options by improving their mobility. Land-use planning is an essential ingredient in any programme targeting the safe mobility of older people. In improving land-use planning and practices, the following issues need to be considered:

- Land-use and transport planning are multidisciplinary exercises, requiring input not just from planners in the public and private sectors, but also from local citizens and potential transport customers.
- Planning that considers only mobility is inadequate. The lifestyles of older people and their interaction with the broader society must also be taken into account.
- The implementation of land-use policies requires research and development, legislation and regulation, enforcement, taxes, subsidies or investments and public participation and negotiation.
- The co-operation of planning authorities on the macro (national), meso (regional, district) and local levels is crucial to the success of land-use planning, and responsibilities, competencies and tasks at each level need to be defined.
- Explicit, quantitative goals are required to ensure that desired results are attained.
- The different working methods and cultures of the various professions and others involved in the planning process must be recognised to ensure an integrated and widely accepted outcome.

Conclusions and key points

- In most developed countries, older people live in suburban settings and age in place.
- Ageing in place is essential if the costs of an ageing population are to be contained. Given the current and expected geographical dispersion of older people, however, ageing in place will rely heavily on the availability of appropriate mobility options for access to services and facilities.
- Shopping, financial, medical and other services are often grouped in suburban centres, requiring trips beyond walking or cycling distance from the home. When car use is no longer an option, public transport is needed but is frequently inadequate. The mobility and independence of the most vulnerable groups, including older people, is thereby compromised.
- Appropriate land-use planning policies and especially residential development patterns have great potential to curb the dispersion of future cohorts of older people. They can also allow services and facilities to be located closer to older people's places of residence, thereby reducing travel needs.
- Land-use planning needs to take full account of quality-of-life issues and trips required for daily living. Compact communities with locally available facilities are best suited to the needs of older people.
- At regional and local levels, better integration of transport and land-use planning can lead to communities that are more comfortable to live in. Patterns of land-use development that are suitable for ageing populations are similar to those needed for environmental sustainability.
- Average travel speeds and distances decline with age. Essential destinations need to be located within the travel radius.
- With increasing age, difficulties in reaching destinations that pose minor problems for younger people may become insurmountable for older people.

- Guidelines that take account of the needs and limitations of older people are required for strategic land-use planning at the local, regional and national levels.
- The transport network should reflect desired land-use outcomes by distinguishing roads primarily used for access to residential areas and services from those primarily used for through traffic. Residential areas should restrict heavy and fast vehicles, except those used for public transport.
- Although new developments offer greater opportunities for adapting to the needs of older people, urban redevelopment projects can also be practicable and economically feasible. Communities need to consider retrofitting developments to improve the mobility of older people ageing in place.
- Good land-use planning requires participation of the general public (including older people) as well as a range of professionals.
- It is recommended that task teams be formed to co-ordinate research on the implications of an ageing society for future land-use patterns. Specifically the following aspects should be investigated and reported upon:
  - Identify locations of present and future older populations.
  - Compile an inventory of current daily needs of older people.
  - Develop means to improve the transport modes that encourage sustainability.
  - Develop easy-to-use techniques for local land-use planning projects.
  - Identify different types of physical and perceived barriers to older people's mobility and develop countermeasures and options to overcome them.
  - Determine the extent to which financial measures (taxation, subsidies, compensation) affect modal choice, particularly the car.
  - Develop education programmes for planners and national, regional and local authorities.

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Chapter 9

EDUCATION, PUBLICITY AND TRAINING

Introduction

As governments address the safety and mobility needs of older adults, it is important to ensure that all decision makers and stakeholders are well informed of these requirements and have access to information on the measures needed to promote them.

Education, publicity and training (EPT) are important tools for sharing and disseminating this information. EPT efforts endeavour to raise public awareness of the mobility requirements and safety problems of older people, to support the planning and implementation of measures promoting older people's mobility and safety and to change the road safety habits of both older people and other road users.

EPT efforts include campaigns, educational projects and materials that can be integrated into a broader package of travel safety and mobility measures. EPT projects have greater impact when they are co-ordinated and linked with other initiatives.

This chapter presents the main challenges affecting older people's mobility and safety that need to be addressed to increase the awareness, knowledge and preparedness of relevant groups. In presenting these issues, the chapter's structure reflects the road safety marketing model of a 1993 OECD Working Group report entitled, "The Marketing of Traffic Safety" (OECD, 1993). This model emphasises the need to analyse fully the customer and the operating environments before implementing any programme. Accordingly, this chapter covers the following topics: situation assessment, general goals and objectives of publicity and education, target groups, strategies and approaches of publicity and education and methods and best practices.

Assessing the situation

As Chapter 3 noted, researchers have heightened awareness of the mobility challenges facing ageing populations. Research has clearly demonstrated that certain groups of older people face significantly higher risks of experiencing personal physical injury in crashes. Moreover, certain groups may also risk causing accidents to others in differing degrees.

Despite competent research and statistical data on the travel behaviour of older road users, existing prejudices and stereotypes remain prevalent. To a large extent, the view of older drivers held by decision makers, implementing agencies and the general public remains uninformed. Restricting older people's access to the road, particularly as drivers, is still viewed by many as the solution to the problem. Moreover, media coverage focusing on accidents involving older people reinforces these misconceptions.

Education, publicity, and training directed at improving the general public's recognition, awareness and understanding of older people's mobility and safety not only influence road safety habits, but also society's willingness to improve the situation. Marketing efforts aimed at dispelling preconceived notions about older road users are particularly important (Milton, 1999; Uutela and Ruth, 1994).

To date, the mobility requirements of older people have not found their way into the public consciousness and are not high on the political agenda of most OECD Member countries. Moreover, many transport planners fail to recognise the importance of mobility for older people. Institutions of

higher learning and training programmes for public officials and transport professionals rarely include courses on planning for the mobility of older people.

Decision makers often cite cost as a barrier to adapting systems and services to improve mobility and safety. Although almost half of the current population is not part of the 20-55 year old age group, most roadway networks and transport systems continue to be designed for younger road users. With the ageing of the population, this divergence will increase. In view of the growing numbers of older people in OECD Member countries, there has been some progress in motor vehicle and infrastructure design and in addressing licensing systems for ageing populations (Kanouse, 1988; European Conference of Ministers of Transport, 1998; Tielen, 2000).

Little precise information is available on the social costs that accrue when older people lose some or all of their mobility or on how this compares to the costs of accidents that might occur if more older people continued to drive (Burkhardt, 1996). Better information might well influence the attitudes of decision makers and the public at large and their support for the continued mobility of older adults.

In addition, older people must assume some responsibility for their mobility and safety. Training programmes and services that facilitate their awareness, assessment and recognition of their own abilities and limitations and that foster their use, adaptation and incorporation of appropriate transport options are particularly important. Special consideration is needed to address older people's fear or distrust of assessments that they think might hamper their mobility and/or result in forfeiture of their driving licence (OECD, 1985). The design and implementation of tailored training programmes and services to address these attitudes and concerns require careful reflection and planning.

Older drivers need information on the implications of ceasing to drive, on the physical and cognitive changes experienced as part of the ageing process, and on the choice of safer vehicles. In particular, it is important to inform older drivers of the following (Burkhardt, 1996; ERSF, 1997):

- How and where to seek and access mobility alternatives to the car (transport options available, booking procedures, schedules, routing, fares and where to get help on travel needs).
- The potential for declining sensory and cognitive abilities and problems in coping in traffic (such as driving at night, handling complex traffic situations, negotiating turns, etc.). At the same time, information must be available to provide reassurance that with care and planning, drivers can continue to drive safely well into old age.
- Problems relating to eyesight and hearing, restricted movement, dementia and mental impairment and the effects of other illnesses on mobility.
- The effects of alcohol, drugs and prescribed medication on driving ability (including the dangers of side effects, combined usage effects, use with alcohol and fatigue).
- Special features to consider when choosing a car, such as seat positioning, powered mirrors, driver and passenger restraints, power assistance and applications of new technology.

Family members, care providers, and social service agencies that work with older people also need assessment and referral information. Family members are prime targets for educational campaigns, as they are usually the first to notice the need for intervention when an older person's skills deteriorate. Often, family members do not know what to do or where to seek help. They may have difficulty deciding the best course of action and convincing an older person that the time may have come to stop driving. The family may also fear the negative impact on their relationship with the older person and with other relatives. An independent, objective process to address these situations is often welcome.

Information dissemination is the most common method of informing older drivers and their families about matters concerning their mobility. In some countries, handbooks and self-directed material are included in courses provided for older drivers. A handbook entitled, "When You are Concerned – A Handbook for Those Worried about the Safety of An Ageing Driver", covers important questions often faced by older drivers' family members. Among other topics, it offers tips for assessing when it is time to act, finding help, how to help the driver to cope with the change and transport tips for continued mobility after ceasing to drive (NYSOFA, 2000; Allstate Insurance Company, 1998).

The following are issues that family members often encounter (Burkhardt, 2000; Rabbitt *et al.*, 1996; Carp, 1988):

- Older people prefer to remain independent and not to depend on the availability of others. The ability to drive gives an older person a sense of control over his/her life.
- Driving has important practical and recreational benefits for the older driver and can affect his/her self-esteem and sense of health and well-being. It is thus a difficult decision to cease driving voluntarily.
- Revocation of a driving licence usually has a dramatic effect on an older person's lifestyle and mobility and may also have a considerable impact on the lives of the affected person's family and friends.
- Driving cessation and the process of learning to use other means of transport has more than social and psychological impacts for older people and their closest family members. The diminished capacity of some older people to process educational and training materials also has implications for the nature and delivery of the measures undertaken.

A recommended process to raise awareness of the mobility problems of older people and take appropriate action can be stated as (Sonkin *et al.*, 1999):

Awareness of the need for change → *Data collection and analysis* → *Necessary measures*

The process stresses that recognition and definition of the underlying needs necessarily precede collecting data and implementing subsequent measures.

A major area for EPT programmes concerns the differences that may be expected in emerging cohorts of older people. Possible differences in their mobility and safety needs have been outlined in previous chapters, as have the difficulties for making firm predictions. Those involved in the design and delivery of EPT programmes will need to monitor developing trends closely in order to design effective programmes up to the year 2030 and beyond.

Goals and objectives

Improving perceptions and information regarding the safe mobility of older people requires short-term measures to raise awareness of topical issues as well as long-term efforts to change social attitudes. EPT seek to:

- Ensure that public debate and decision making are based on valid information in order to dispel misconceptions and prejudices regarding older people's safety and mobility needs.
- Create a balanced representation of older road users, their abilities as well as their limitations.
- Provide older people, their families and friends with information and corrective strategies to maintain safe mobility, while making them aware of alternative transport options.
- Address others with a particular stake in the safety and mobility of older people, such as doctors, therapists, other care providers, social service agencies, law enforcement authorities, vehicle manufacturers, highway engineers and lawmakers.

Target groups

Older people

The key objectives of transport safety education for older people concern their mobility and their ability to travel independently and safely for as long as possible. Educational efforts address all modes of transport. To increase its effectiveness, the material must address the needs of each target group. In addition, road safety education for older people should be linked with the creation of better societal conditions that directly contribute to their safer mobility.

For educational and training purposes, road-user groups can be targeted, using various approaches and offering programmes tailored to older pedestrians, cyclists, motorists and public transport users.

Segmentation by region or locality is another useful way of efficiently targeting specific sub-groups. Gender differences and travel patterns should also be taken into account in designing information.

As a target group, older drivers need to be made aware of alternative transport options earlier, rather than later, in the ageing process, in anticipation of the day when they must cease driving. Educational efforts to improve the mobility and safety of older pedestrians, cyclists and transit users includes "user-friendly" information on transport services and guidance on safe routes and secure means of transport. Efforts directed at other road users include improving the visibility of pedestrian crossing zones, reducing red-light running and non-conformance with traffic signs and signals and reducing the number of incidences caused by aggressive drivers (Kanouse, 1988).

The family and the social network

"Social facilitators" (people who communicate and convey information to older people) play an important role in the dissemination of educational material. The most important facilitators are family members and friends who have regular, social contact with older people. These people are both a target group and conveyors of programme information.

Facilitators also need support and information if they are to assist older people. In one study, families stressed the importance of general support from the family doctor, but felt that doctors often avoid offering support for decisions about whether an older person should cease driving (Malfetti, 1985). Yet an older person is more likely to heed advice from his/her doctor than from the family.

An EPT programme endeavours to provide families with information on services available to older people, to develop operating models for their use and to support them in adopting these models. The media for delivering the information range from printed handbooks to family discussions, from Internet Web sites to newspaper and radio campaigns and from personal counselling to driving tests and courses.

Public officials and governmental authorities

National, regional and local public officials and governmental authorities constitute another important target group, as these entities typically control the resources necessary for improving older people's safe mobility. The marketing and dissemination of successful municipal pilot projects is an effective means of demonstrating the advantages of addressing older people's mobility and safety issues. In addition, public opinion and the will of voters can significantly shape and influence political action. With the growing number of older people in OECD Member countries, a critical mass of older constituents can form a powerful lobbying group to advocate government funding and services to support needed mobility and safety improvements. EPT can help raise awareness of the problems and requirements associated with the improved mobility of older people and of the resulting costs and advantages to be gained.

Other public and governmental officials include researchers, planners and public health and safety professionals. Police officers, health care and social services providers and transport and planning officials have an important responsibility for providing services to older people and promoting their safe mobility. Service providers need to be well informed of the problems experienced by older people and should be provided with information and training options to assist their ageing clients.

The role of doctors and licensing authorities is particularly important when a person is considering ceasing to drive. Doctors require information and training so that, in addition to assessing a person's health, they can also clearly explain the implications for driving and the alternative mobility options, as appropriate.

The private sector, not-for-profit associations and other organisations

Targeting the private sector, not-for-profit organisations and advocacy groups in the social welfare and healthcare sectors is becoming increasingly important. In many countries, the public sector is overburdened and resources are scarce. Governments are creating innovative public-private

partnerships and working with non-governmental organisations to leverage limited funds. Balance and co-ordination can be achieved through these collaborative efforts, trans-sectoral co-operation and development. Advocacy groups for older people and pensioners' organisations provide a vital link and important source of information to ageing populations.

With a growing customer base of older consumers, private enterprises can create a market for products, services and marketing materials oriented towards older people's special mobility and safety needs. These services range from clear product specifications to large-print timetables and signs.

Market research and heightened awareness of older persons' mobility and safety needs will highlight a number of potential target groups for information and training. Consumer response and customer behaviour will reveal the wishes and needs of older clients, thus facilitating communication of EPT messages.

Transport personnel

To increase awareness of older travellers' needs, sensitivity training and information programmes for transport personnel, including management, operations and front-line staff, need to be expanded. Transport services personnel do not always fully understand the range of issues associated with older people's mobility and may restrict their concerns to specific issues (for example, a licensing official's decision about whether to renew an older driver's licence). Older people's mobility limitations arising from locomotive, sensory or cognitive impairments are also often regarded as beyond the scope of transport personnel's job responsibilities.

Strategies and approaches

Global outreach

The status and welfare of the ageing population is a topical issue that concerns every OECD Member country. International co-operation has the potential to create opportunities for improving the mobility of older people by raising global awareness.

The United Nations' International Year of Older Persons in 1999 illustrates how an international organisation can raise its member countries' awareness of the importance of addressing the needs of an ageing population. The campaignunited various theme-related national projects across different sectors of society, integrating them under this broad initiative.

By launching similar campaigns, OECD Member countries can raise awareness of this issue and offer ideas and support for promoting older people's mobility and safety. Opportunities for collaboration among countries also exist through information exchanges on general approaches, action strategies, pilot projects and best practices.

National programmes

National objectives are crucial for improving the mobility and safety of older people. In addition to recognising problems at national level, it is important to ensure that decision makers, researchers and planners in different administrative fields are knowledgeable about the mobility requirements of older people and the measures to be taken to promote their safety. An earlier report recommended the following types of national programmes (ECMT/CM, 1991):

- Information campaigns that draw the attention of older people to traffic problems and risks by means of straightforward, factual and unambiguous messages.
- Information for all road users on the difficulties experienced by older people in traffic.
- Information for medical and health service personnel to develop awareness of their obligation to inform older people of the psychological and physiological changes that may occur as part of ageing and that may affect behaviour in traffic.

- Development of principles and methods for testing the capabilities of older drivers and encouraging them to take training courses to improve their theoretical and practical ability.

Creating a vision detailing future goals and priorities is a powerful tool for raising awareness. Sweden's "Vision Zero" for road safety offers an example of a comprehensive approach to transportation and safety, which will be of specific but not exclusive value to older road users. Similarly, the Netherlands has implemented a concept called "Sustainable Traffic Safety". Such objectives require the support of a national programme leading to the implementation of concrete actions and programmes. National support provides a framework for these objectives, guidelines and the division of work and ensures co-ordination between the authorities and other organisations.

Regional and local efforts

As previously noted, many safety and mobility issues that concern older people are best addressed with the assistance and support of families and close social networks. Community support increases the effectiveness of programmes and services. Communication and education projects that are practical, user-friendly and adapted to regional and local culture are best able to address local road safety problems and practices.

To encourage older people to continue making independent mobility choices, marketing material and information on available regional and local transport services should be provided in large-size print, as the illegibility of travel signage, transit timetables and other types of printed material can be a problem for older travellers.

Methods and best practices

Publicity as a tool for raising awareness

High visibility and extensive media coverage are necessary to change public attitudes regarding the mobility and safety of older people. Public debate and discussion in the media should be stimulated through regular dissemination of findings from research and studies. Authorities, organisations and associations must actively strive to publicise information about their activities in a manner that is likely to attract media interest.

The mass media offer the best channel for reaching all target groups simultaneously. Local media also play an important role, particularly in terms of getting localised messages to older people and their facilitators. Improved public visibility of issues affecting older people sends a signal to politicians about their social importance and may thus influence the political process.

Material in the electronic mass media must be supported by more detailed information in other media. An information campaign may, for example, use the broadcast media to heighten awareness of an issue and inform the public about the existence of specific sources of information. Print media (magazines, books, and booklets) can convey more detailed information in a form that facilitates greater depth of understanding and is easier to retrieve.

Assessing safety campaigns

In the past, extensive media campaigns have been used to raise public awareness. Some have been particularly successful in initiating or accelerating cultural change. In the 1980s, the United States launched a major campaign to reduce cigarette smoking. This raised public awareness of the health consequences of smoking and sparked major legislative changes to create smoke-free environments. A campaign to educate the public about older people's safety and mobility might be similarly effective. One expert, commenting on the need for such an effort, stated, "It may be quite important when it comes to the special needs of older drivers, because unlike many problems involving public safety, the facts have not been widely aired and debated in public forums. Thus there is ample room for awareness to grow" (Kanouse, 1988).

The following list offers points that can help to design a successful mass media campaign directed at older people's mobility and safety needs (Kanouse, 1988):

- Information will have the most influence when it addresses the audience's specific needs.
- Audiences seldom change their behaviour in response to information they already have.
- Information campaigns work best if they take advantage of the audience's existing motivation, that is, if they give people information that helps them accomplish what they already want to do.
- People are likely to respond more favourably to information that empowers them than to information that makes them feel powerless.
- Communication will have more influence on behaviour if it contains information that is relevant to decisions.
- People are more likely to use information if it is provided to them in a way that takes into account how and when they will use it.
- Information can have an especially strong effect on behaviour when it induces a change of mind or leads people to reframe how they think about alternatives.
- Large-scale educational efforts are most likely to reach people when they are presented on a sustained basis through multiple channels and are reinforced at community level (repetitive messages, targeting carefully identified audiences through appropriate channels).

Although a given media campaign promoting safety may change the behaviour of only a few people, social modelling can greatly multiply this effect. Moreover, a sustained campaign of educational messages can eventually change the tide of public opinion.

Developing campaigns

Developing a public awareness campaign on older people's safety and mobility needs requires careful analysis of public opinion and an understanding of the public's reasons for its beliefs and behaviour. Further, it requires establishing what is commonly thought and the context of beliefs and/or behaviour to be influenced. Finally, it requires considering how to tailor approaches to different segments of society (Milton, 1999).

The marketing approach to road safety provides new ideas and methods for planning campaigns and for communicating information. The main focus is on "customer interaction", that is, on the promotion of a two-way exchange between the producers and consumers of information (OECD, 1993).

Customer interaction is especially important for initiatives aimed at improving the mobility and safety of the ageing population because it is vital for older people to be seen as a valuable asset to the community. It is important that their strengths are emphasised when planning information campaigns and education projects.

In developing campaigns for educating older people, it should be recalled that many are avid consumers of the traditional media, particularly television. Although television programming has not given much attention to shows tailored to the issues confronting older adults, there are indications that this is changing. In the near future, "media for older people" may become a reality (Kanouse, 1998).

Best practices

Norway offers one of the few reported and evaluated information campaigns on mobility and safety issues concerning older people. The evaluation indicated that the design of the campaign was the most important factor in reaching the public. Further, it was noted that better results were achieved by marketing specific measures than by launching a general campaign and that the use of informal channels (friends and acquaintances) as conduits to disseminate information was particularly effective.

Information along with medical examination

Many OECD Member countries require older people to undergo a medical examination in order to renew their driving licence. These examinations focus mainly on physical characteristics, thereby potentially emphasising reduced capacities. By linking the medical examination to the provision of educational material, greater emphasis can be placed on maximising the abilities of older drivers, while addressing their limitations.

In Finland, the National Transport Authority distributes a guidebook entitled "Driving for All Ages" to all motorists at age 70. The guide contains scientific findings and news on topics concerning older drivers. The same material is also supplied to doctors who conduct assessments, and the distribution coincides with regional information campaigns.

Handbooks and working models for practitioners

Some handbooks that serve as both self-education materials for older road users and as resources for organisations aim to improve the safety of older road users in their areas. For example, "Ouderen op de Weg" is a handbook from the Netherlands that addresses all older road users and provides a resource on ideas and methods. In particular, it provides details on the BROEM scheme, a voluntary driver assessment programme for people over 50 on driving style, eyesight and response times that also provides a refresher course on traffic rules (ERSF, 1997).

Conclusions and key points

- Publicity and education can promote the mobility and safety of older people by ensuring that research results are used in public debate and decision making in order to dispel misconceptions and prejudices about older people's safety risks and mobility needs; by providing accurate information to professionals who develop policy that directly affects older people's mobility and safety (health care and social service professionals, law enforcement officers, vehicle manufacturers, highway engineers, land-use planners, lawmakers, etc.); and by providing older people and their caregivers with the information and options required to remain safely mobile.
- Policy makers, the general public and transport providers, as well as older people, need to know that good mobility is not only beneficial for older people but also less costly overall for society.
- Many older drivers consider alternative transport means only after they are required to stop driving. A powerful marketing strategy is needed to encourage ageing drivers to assess their future transport needs and to consider transport options well before they cease driving.
- Older people need information about how their medical condition and medication affect their driving and their use of other transport modes.
- Mechanisms need to be promoted which encourage discussion and negotiation between representatives of older people and their transport providers so as to ensure sufficient mobility.
- Publicity and education need to change older people's self-perception, including the tendency to ignore age-related problems, to treat offers of assistance as ageism and to decline help from others because it is felt to impose a debt of gratitude.
- Professionals and family members need to be informed about the advantages of mobility for older people, including its beneficial effect upon self-esteem, sense of independence and health; and the reluctance of older people to be dependent and to have to comply with others' schedules. They also need to be made aware of the financial implications of an older person's immobility, for themselves, their families and society at large.
- Publicity and education efforts to involve the non-governmental sector need to be intensified, especially to involve older people's organisations and their networks.
- Decision makers should be provided with better evaluations of the effectiveness of safety and mobility measures and their costs and benefits to society.

- Older people represent a heterogeneous group in terms of their characteristics and abilities. Accordingly, more specially tailored measures are needed for the various sub-groups of older adults. There is also a need to take into account national, regional and local differences.
- A long-term approach should be taken to improving public awareness of older people's mobility and safety issues. Planning efforts should take into account the different life situations and information needs of older people, their families and friends. Campaigns linked to practical measures are most effective.

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Chapter 10

CONCLUSIONS

Introduction

In most OECD Member countries, older people comprise the fastest growing segment of the population, and in many, one in every four persons will be aged 65 or over in 2030. Over the next three decades, maturation of the "baby boom" generation (born between 1946 and 1964), increased longevity and declining birth rates will markedly transform the developed world's demographics. By 2050, it is expected that in most OECD Member countries the population of those persons over 80 years of age will have tripled.

As baby boomers age, providing for their continuing, safe mobility requires planning and a rethinking of strategies, policies and provision of services to support their continued health and well-being into and beyond retirement.

This volume has explored the travel patterns, transport and mobility implications and evolving needs of ageing populations to the year 2030. It has attempted to provide clear and objective information to enable strategists, policy makers, regulators and the general public to achieve a balanced view of older people's safety and mobility needs. Moreover, it has sought to dispel many myths and misconceptions about the safety of older road users by presenting the latest data and research findings. On this basis, the following conclusions highlight strategies and policy and research recommendations for providing safe and continuing mobility for older people.

Policy recommendations

Over the next 30 years, a significant increase in the population aged 65 or more will place new and growing demands on transport systems in OECD Member countries. On the whole, older people who drive will prefer to continue doing so as long as possible, but will also expect to have access to alternate transport modes, especially as they approach 80 years of age. Future transport systems and services will play a crucial role in supporting independent, healthy ageing.

The material presented in this volume gives rise to a wide range of policy issues. The issues discussed range from the reasonably specific (for example, vehicle design specifications that allow easier access) to broad recommendations (for example, improved land-use planning to inhibit or mitigate the urban sprawl that characterises many metropolitan cities). The study has raised two essential questions.

The first of these is: *What policy issues flowing from the analysis of the mobility needs and safety problems of an ageing society have the highest priority?*

The major policy priorities identified are:

- Support and funding to enable lifelong mobility.
- Support for older people to continue driving safely.
- Provision of suitable transport alternative to the private car.
- Safer vehicles for older people.
- Development of safer roads and infrastructure.

- Appropriate land-use practices.
- Involvement of older people in policy development.
- Educational campaigns to promote maximum mobility and safety for older people.

The second important question is: H*ow can the decision makers responsible for each issue be identified and made aware of the recommended policy options*?

It is essential that national governments recognise the urgency of these emerging issues. They must exert strong leadership if policy initiatives are to be embraced by communities in individual OECD Member countries. However, this is not to ignore the important roles that regional and local governments, other agencies and community groups need to play. In addition to requiring strong central leadership, successful implementation will also require partnerships involving all key players. In order to achieve cost-effectiveness in implementing best practice measures, exchange of information across OECD Member countries should be promoted.

The following sections discuss in turn the priority issues listed above.

Support and funding to enable lifelong mobility

Mobility is essential to organising and carrying out one's daily activities. It fosters independence, freedom of movement, social activity and choice. The ability to travel is as important to older people as to other age groups. Government support – particularly in the form of funding, best practices and technology transfer – is needed if lifelong mobility for individuals is to become a reality.

First, national governments need to recognise and then demonstrate the cost savings to be achieved through the support of lifelong mobility. The savings will come in particular from lower health and social service costs if older people continue to pursue active lives and enjoy access to a variety of services and facilities. There will also be less tangible and quantifiable benefits, including continued independence and a range of quality-of-life issues.

In all likelihood, continued mobility and access to services will be best achieved in conjunction with successful ageing-in-place strategies. Pilot projects at community level are needed to demonstrate the feasibility of such strategies, which imply as well the provision of appropriate transport and the availability of required services and facilities.

Governments face substantial challenges from both their own departments and related agencies for developing integrated approaches to support lifelong safe mobility and for raising the level of attention to the coming needs of an ageing population if these issues are to achieve budget parity with other national priorities. In particular, there is the challenge of responding to the diverse needs of individual communities. However difficult to manage, this is essential if workable and acceptable solutions are to emerge.

As part of their response, governments need to identify lead agencies (new or existing) or groups to take charge of this issue, with clear objectives and time frames for performance across the whole of government.

The sooner governments respond, the better. By 2030, it is unlikely that there will be sufficient public funds to support the wide range of changes needed, given the expected mushrooming of pension and health programmes, the declining ratio of workers to non-workers and the diminishing tax base. Accordingly, it is crucial to take action at a time when the public purse can still finance these needed programmes and services.

Support for older people to continue driving safely

As the number of older people in OECD Member countries increases over the next 30 years, most will have driving licences and access to cars and will prefer driving as their primary means of transport. Governments should support this, but the policy objective of extending the driving years of older drivers will require proactive measures from all levels of government, health and social service

providers, caregivers, families, transport planners, licensing bureaux, enforcement agencies and businesses.

This study indicates that mandatory age-based testing is ineffective. Rather, a licence management alternative that targets those drivers considered to be at heightened risk should be preferred, with a more thorough assessment tailored to individual cases. For this to work, a community-based referral system is needed, involving doctors and health professionals, police, community workers, friends and families of older drivers and older drivers themselves.

At the same time, however, policies for the driver assessment and rehabilitation approaches that target those afflicted with significant functional impairment shown to affect safety need to be defined more clearly and supported. Media campaigns will need to relay information to the public and raise general awareness, particularly to counter the misconceptions that create a distorted image of older road users.

Key elements of improved policy and practice include:

- Expansion of programmes to encourage older drivers' self-assessment, including development, distribution and promotion of supporting materials and tools.
- Improved means for referring to licensing authorities those older drivers who appear to be at increased risk owing to functional impairments.
- Provision by government agencies of assessment tools and information to medical and other health practitioners, enforcement agencies and others involved with driving assessment.
- Collaboration between government agencies and relevant health and related professional associations to provide in-service education programmes about driver impairment, assessment and rehabilitation.
- Inclusion of relevant materials about driver impairment, assessment and rehabilitation in tertiary pre-service courses in relevant professional areas.
- Increase in professional education programmes for health and related professionals provided by government and relevant professional and medical associations in order to better balance new levels of resources and the increased population of older adults.
- When required, involvement of driver assessment and rehabilitation specialists in licensing activities.
- Counselling and training for older people and their caregivers in accessing alternative transport arrangements and alternatives to transport.

Provision of suitable transport alternatives to the private car

Relative to the current situation, the health of older people may well have improved considerably by 2030. Nevertheless, a sizeable proportion of the older population will have certain levels of disability. What transport options will be most suited to the expected diversity of their functional abilities? How can older people best be encouraged to use the appropriate mobility options?

Transport services must be designed to suit older users if they are to serve as viable alternatives to the private car. Changes to the physical infrastructure to support ease of use of alternative transport options need to be identified and implemented. Those that are more cost-effective in terms of operational and/or economic efficiency should be implemented. Public-private partnerships offer opportunities to leverage public funds to provide improved transit services.

The mobility solutions developed in the immediate future will evolve and will reflect the cultural context and different settlement patterns of individual countries and regions. They will need to be more innovative in their operation than at present, and the range of services should become more extensive.

A concurrent challenge is to develop mobility management programmes for functionally limited older people that support their transition to user-friendly transport options over time. Effective

introduction of such an approach would benefit substantially from comprehensive demonstration projects and the sharing of information and experience.

Safer vehicles for older people

New technologies can make a significant contribution to improving the safety and use of roads, streets and vehicles by older drivers and passengers, pedestrians, cyclists and public transit riders. Unless there are marked improvements in vehicle safety features, there will be a significant increase in fatalities for older drivers and pedestrians, more than for other age groups. Vehicle manufacturers must be mandated or encouraged to increase substantially the protection of vehicle occupants against crashes and to design vehicles with less aggressive external characteristics in order to protect pedestrians. Vehicles also need to be designed to be easier for older people to drive. Particular attention needs to be given to evaluating new technology to ensure that older people can use it readily.

Development of safer roads and infrastructure

Governments are urged to continue to make road safer and easier for older people to use. In particular, policies are needed to:

- Provide safer roads for pedestrians, cyclists and users of powered wheelchairs and scooters. Pedestrian safety can be improved by providing safer roads and roadside environments. Improved pedestrian safety will also rely upon policy initiatives that address personal security concerns. Without a change in current realities and perceptions, encouragement of pedestrian activity will not succeed.
- Improve the overall road environment. From the viewpoint of older drivers, this will facilitate or reduce their need to make complex decisions and perform time-related tasks or will give them more advance notice. Improvements will also result in a road system that is more forgiving of errors made by all drivers. Technology has an important role to play in improving the intrinsic safety of the road system, and it will be necessary to keep abreast of developments in this area. Further, road geometrics, signage, and advisory systems will need to be consistent across different jurisdictions and nations so as to be more predictable to users.
- Provide user-friendly and convenient private and public transport. Provision of low-floor buses and trams and ready access from the kerbside are examples of key policy responses in the public transport field.

Appropriate land-use practices

There is an urgent need for governments to improve land-use planning if ageing in place is to be a major strategy for managing the mobility and safety needs of older people. In particular, development of local services and facilities appropriate to an ageing community and supported by adequate transport services is vital. New practices arising from improved land-use planning include the requirement that proposed road and pedestrian networks meet road safety standards while providing efficient public transport routing.

- Where sidewalks and safe road crossings are lacking, consideration should be given to retrofitting these where appropriate.
- Measures that improve the environmental sustainability of communities are similar to those needed to enable older people to maintain their independent mobility.
- Where cycle routes are introduced for more sustainable transport, these should provide the infrastructure needed for powered wheelchairs, scooters and other unlicensed low-speed alternatives to the car.

Provision of an adequate policy framework and practical guidelines for implementation for regional and local planning commissions and for transport authorities would be beneficial. They could be very usefully supported by a number of demonstration projects in partnership with the private sector.

Involvement of older people in policy development

Formulating effective policy development to address safe mobility for an ageing society has to involve older people and their caregivers in a comprehensive and meaningful way. As no one solution will satisfy their diverse needs, expectations, preferences and lifestyles, flexible policy approaches are called for. As older people, baby boomers will be better educated and more politically involved, and they are expected to continue to seek actively to meet their needs. By their sheer numbers, this group will be a formidable political and social force able to compel decision makers to respond to their demands for services.

Directly involving ageing populations in developing relevant processes and achieving beneficial outcomes will be a challenge for local, regional and national governments. Families, businesses and professional organisations must also be involved in meeting the mobility and safety needs of older people. Failure to respond to this challenge across all levels of government in an integrated and coherent way is likely to result in misguided and rejected programmes and policy.

A policy issue that illustrates the need to involve older people in such deliberations relates to the acceptable balance between mobility and safety. Research indicates that the greatest safety risk to older road users is their potential to be injured or killed in a crash due to their fragility. As the principal group at risk, older people clearly need to be involved in formulating policy responses to the mobility risks they routinely face.

Educational campaigns to promote maximum mobility and safety for older people

As governments address the safety and mobility needs of older people, it is important to ensure that all decision makers and stakeholders are well informed about requirements and have access to information on measures to be taken. It is suggested that a series of community awareness programmes be conducted over the next five to ten years, in order to inform all segments of the community and policy makers that older drivers do not represent a major risk to other road users, to make it known that, by remaining mobile, older people in particular (and society overall) will benefit substantially and finally to persuade all age groups to support the transport options developed for older people.

In particular, educational campaigns to promote the idea that older people can most easily meet their transport needs by driving will create sizeable political and policy challenges. In addition, it is important to convince designers of alternative transport modes that they need to be practical for all users and not just for the disadvantaged or disabled.

Policy development will also need to address the practical details of educational campaigns that promote existing (and new) transport options. For example, regular information and guidance will need to be provided about availability of services, schedules, location of stops, etc., in an easily understood and readily accessible manner, to support the perception, and the reality, that alternative transport systems are safe and user-friendly.

An early priority is to educate key decision makers in all areas relevant to older people, especially, but not only, those involved in transport. Whatever the accuracy of current perceptions of older road users, it is unlikely that they will apply to emerging cohorts of older people. Any decision based on them may lead to distorted or ineffective policy. Further, informational materials will be needed to help the media to depict older adults' mobility correctly and dispel inaccurate notions and misinformation.

Another significant and emerging area is the need is to inform people about the importance of preparing for their future mobility needs before they reach retirement age. This will enable them to make informed decisions while they have a wide range of options available. Governments may assist in this respect by offering incentives to people to encourage them to reside closer to transport services and other facilities and to land developers to design accessible communities. In some places, loss of driving is so debilitating that social workers have established self-help groups to assist older people who have stopped driving. This highlights the importance of having well-located, convenient transport services to maintain older people's mobility and sense of well-being.

Research and development recommendations

There is a pressing need for co-ordinated research and development among OECD Member countries if the safe mobility of older people is to be facilitated to 2030 and beyond. While Member countries may make separate efforts to address this challenge, collaboration to conduct research and share best practices and relevant information offers great potential.

The eight research and development recommendations highlighted in the report are:

- Improve older peoples' crash avoidance/survivability.
- Improve assessment and rehabilitation of older drivers.
- Determine, demonstrate and promote the societal benefits of road improvements.
- Determine, demonstrate and promote the societal benefits of ensuring the continued, safe mobility of older people.
- Provide transport options in an efficient and cost-effective way.
- Support health improvements for older adults.
- Enhance land-use planning and sustainable communities.
- Encourage cross-national co-operation in the development of data and information sources.

Improve older people's crash avoidance/survivability

Automobile manufacturers, supported by motor vehicle regulators in Member countries, should work together to achieve motor vehicle safety standards that better protect frail, older road users as vehicle occupants, pedestrians and bicyclists.

Improve assessment and rehabilitation of older drivers

In order to promote safe use of motor vehicles, national governments, working with universities and other research and development groups, should develop programmes to identify the functional limitations that preclude safe driving. Such programmes should also aim to identify the functional limitations that can be rehabilitated and to describe effective rehabilitation options.

Equally important is the need to work with health and social service programme developers to identify and demonstrate programmes that will reduce the likelihood of people becoming functionally impaired as they age.

Determine, demonstrate and promote the societal benefits of road improvements

National governments, working with universities and other groups, should develop a programme of research and development to determine the road improvements that enable older people to drive, walk and use alternative transport options well into old age. Guidelines to improve roads for older people developed in the United States and in Australia need to be evaluated in a series of demonstration projects so that the most beneficial aspects can be identified and applied in other Member countries.

Since many measures of varying cost-effectiveness have been taken to improve the road system, a co-ordinated set of demonstrations across co-operating OECD Member countries should be undertaken to identify those with the best cost-benefit value. The value of these standards for design or rehabilitation ("black spots") needs to be established to determine where funds can be most efficiently spent.

Determine, demonstrate and promote the societal benefits of ensuring the continued, safe mobility of older people

International organisations should work together to foster co-operation among their members to conduct research and demonstration programmes for improving the safe mobility of older people.

Particular attention should be given to activities that are initially costly and require time to prove their effectiveness. Examples include the development of sustainable communities, which are needed to allow people to successfully age in place, and the development of road improvement programmes and driver assessment and rehabilitation programmes.

Provide transport options in an efficient and cost-effective way

National and regional governments, working with universities, transport providers and other advocacy groups, should conduct co-ordinated demonstration projects using tailored approaches aimed at providing transport to those with differing types of impairment. Organisations should disseminate the results to assist other countries as they develop best practices for transport options.

Support health improvements for older adults

National and regional governments, in collaboration with universities, medical institutions and stakeholder groups, should co-ordinate research and conduct demonstration projects to explore whether the functional limitations that negatively affect older people's mobility can be reduced. Particular attention should focus on health, fitness and wellness programmes that help to reduce frailty. Frailty may make it difficult for the elderly to walk and use transport options, including driving, thereby reducing mobility. Older, frail people are more likely to be injured or to die in a crash. There is also a need for in-depth studies of the relationship between quality of life, welfare and health costs and the degree of mobility older people have in different OECD Member countries.

Enhance land-use planning and sustainable communities

National and regional governments, working with universities and appropriate interest groups, should conduct co-ordinated research and demonstration projects to improve land-use planning with a view to ageing in place. Particular attention should be given to finding ways to locate residential areas close to the goods, services and facilities needed by older people. To improve land-use planning, comprehensive cohort studies of travel patterns are needed. In addition, preferences in terms of retirement housing need to be studied, knowledge needs to be gained about the "new old" in different social and cultural contexts and analyses made of mobility solutions (public and private) in different countries for older people.

Encourage cross-national co-operation in the development of data and information sources

National and regional governments, working with universities and appropriate interest groups, should design a standardised, personal transport survey which Member countries can adopt and administer to identify changes in transport patterns over time and enable cross-national comparisons.

There is also the need to design a system to record annual driver licensing numbers and crash and injury numbers for all road and other transport modes to be used by OECD Member countries to monitor possible shifts in transport safety.

Finally, there is a need to design and conduct regularly a health survey across all Member countries to track the expected continuation of improvement or identify specific areas of deterioration in older people's health and well-being.

Key issues

Safety issues

Older drivers tend to be safer than is commonly believed. They have fewer reported crashes per capita or per number of licensed drivers. While they do have more casualties in crashes and more injuries per distance travelled, this is mainly attributable to their frailty and consequent vulnerability to

injury. Drivers over 75 years of age are three times more likely to die in a crash than one 20 years old in a comparable accident, and drivers over 80 are five to six times more likely to perish.

Older pedestrians (over 65) also have higher fatality rates than younger ones. They account for almost half of pedestrian fatalities in many OECD European countries and for one-fifth of pedestrian fatalities in the United States. Potential ramifications of older people's increased driving include increased occupant fatalities and decreased pedestrian fatalities.

Mobility issues

In most OECD Member countries, older people tend to age in place. Most make their housing decisions much earlier in life, frequently when they have fewer financial resources and therefore live in the suburbs of large cities where housing costs are lower. As such areas generally offer limited public transport services, residents depend on the private car. While such patterns are most prevalent in North America, they are seen as an intensifying trend in many other OECD Member countries.

Older people who suffer from limitations related to health must often cease walking or using public transport before they are forced to cease driving. Approximately one-third of women over 80 years of age cannot use walking as a means of transport, but many with a licence can still drive. Today, many older people who do not drive rely on their children to provide or assist with transport. With declining birth rates, fewer older people will have care-giving children to help them, and those that do may not live near them. In future, older people who cannot drive may be less mobile, unless more transport options and services are provided.

In order to estimate future transport activities and needs, the driving and travel patterns of the baby boom generation, currently aged 35-55, were studied. Most baby boomers have a licence and access to a private car. Licensing trends suggest that people who obtain a licence at a young age maintain it and generally drive longer into old age. For example, in the United States, 55% of men and 23% of women over 85 years of age who have a licence still drive (Eberhard, 1996). Those who drive tend to walk less and use public transport less, except for work trips or trips to central business districts. In Europe and Japan, more people currently rely on walking and public transport, but this pattern needs to be closely observed for any changes.

In preparing estimates of future car use, fluctuations in the economic conditions of OECD Member countries should be monitored, given that a country's gross domestic product is a major factor in private vehicle ownership.

Land use and mobility

Well-planned communities facilitate ageing in place, enabling older people to access services and facilities by walking or using transport options. While many older European cities offer conveniently located neighbourhood services, many metropolitan North American cities do not. Moreover, new residential communities are increasingly developed in outlying areas, often with relatively few public transport services.

The majority of older people reside in areas where they lived prior to retirement. As baby boomers age, they will tend to relocate to areas where public transport options and walking is less feasible. There is a need to improve the provision of necessary goods and services to these areas. Whether older people can be encouraged to move to more suitable areas where user-friendly, sustainable transport alternatives to the private car can be more easily provided needs to be determined.

Fatalities and serious injuries among older drivers may well increase substantially as population levels and the amount of driving by older people increase. Estimates to 2030 from the United States indicate that the number of older people killed on roads could more than triple, given expected demographic and exposure trends. A key issue is how to make vehicles and roads safer and hence more effective in protecting older people from the threatened injury and fatality levels.

Socio-economic issues

As more people continue to drive well into old age, those residing in outlying areas may have fewer public transport services and mobility alternatives available when driving is no longer possible. Furthermore, more resources and a larger share of countries' gross domestic product will be needed to provide retirement pensions and health care, leaving fewer funds to meet the mobility needs of older people who do not or cannot drive.

Moreover, in most OECD Member countries, the fertility rate has fallen below the 2.1 ratio required to sustain the population. This phenomenon has serious fiscal ramifications for ageing populations. With fewer people in the workforce, less tax revenue will be generated. Thus, the funds that have supported retirement pensions and health care programmes are expected to decline over time. In recognition of this anticipated funding gap, some countries have taken proactive steps. For example, the United States has deferred the eligibility for social security benefits from age 65 to 67 for later members of the baby boom generation. It is essential that governments anticipate this funding shortfall and plan accordingly to ensure the provision of appropriate transport services and mobility options to serve this large share of the population in the 21st century.

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ANNEX

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OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16
PRINTED IN FRANCE
(77 2001 05 1 P) ISBN 92-64-19668-8 – No. 52187 2001