International Transport Forum

Pedestrian Safety, Urban Space and Health

Research Report

OECD

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Please cite this publication as:
ITF (2012), *Pedestrian Safety, Urban Space and Health*, OECD Publishing.
http://dx.doi.org/10.1787/9789282103654-en

ISBN 978-92-821-0364-7 (print)
ISBN 978-92-821-0365-4 (PDF)

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FOREWORD

This report was prepared by a research working group of the International Transport Forum, composed of experts from 19 countries (including town and transport planners, sociologists, engineers, psychologists, architects and geographers) together with experts from the World Health Organization.

The information on which the report is based was obtained through a survey of all ITF member countries, collecting information on mobility data, institutional arrangements and measures to improve the walking environment. Experts from the working group also reviewed current research including the detailed report of the COST358 project "Pedestrian Quality Needs", published in 2011.

This report assembles the most significant information on the importance of walking to the future development of our cities and opens with the main key messages. Chapter 1 discusses walking in the context of the key challenges of the 21st century; Chapter 2 highlights that walking is often a neglected transport mode, despite its important role in mobility; Chapter 3 describes patterns of walking in ITF/OECD countries; Chapter 4 discusses the benefits of walking for health and well being; Chapter 5 presents statistics on pedestrian accidents and crashes and issues associated with pedestrian safety and personal security; Chapter 6 outlines the key elements and planning principles for promoting walking; Chapter 7 addresses the need for a walking strategy, including the role that governments and stakeholders can play in promoting environments conducive to walking; and Chapter 8 presents the conclusions and recommendations of the report.

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Walking has great potential to contribute to high level government agendas for more sustainable development and should therefore take a central position in urban transport policies. Ensuring that walking is an attractive alternative and complement to motorised transport is a core response to the challenges of climate change, fossil fuel dependence, pollution, maintaining mobility for an ageing population, health and managing the explosion in motorisation expected in low-income and middle-income countries. Because trends established today will determine the future of cities for many decades, actions are needed now for the sustainable cities of tomorrow.

1. Walking is the most fundamental form of mobility. It is inexpensive, emission-free, uses human power not fossil fuel, offers important health-benefits, is equally accessible for all - except those with substantially impaired mobility - regardless of income, and for many citizens is a source of great pleasure. Yet walking presents challenges to society's least robust individuals.
2. The vitality of a city is closely linked to people being out and about on foot for many purposes. Beyond walking for access to goods and services, these other activities in the urban space are collectively termed "sojourning". Walking and sojourning are at the heart of urban life and contribute to liveable, attractive, prosperous and sustainable cities.
3. Walking is however the neglected transport mode and despite being at the start and end of all trips is rarely captured in government statistics on mobility and is often neglected in planning and policy development.
4. Public institutions representing specifically the interests of pedestrians – including the socially disadvantaged members of society who rely heavily on walking – are rare.
5. Walking and public transport are interdependent elements of sustainable urban mobility. Walking is facilitated by a well-connected network with pedestrian-friendly infrastructure and well-designed urban space.
6. Pedestrians are amongst the road users most vulnerable to traffic injury. It has become highly challenging, especially for older and young people, to cope with the complex, sometimes hostile, traffic conditions that characterise today's cities and towns.
7. Pedestrians suffer severe trauma from falls in public spaces and in traffic collisions while crossing streets. The magnitude of the consequences of falls is known to be underestimated. Older people have an elevated risk of severe injury and death from both falls and traffic collisions.
8. Low motorised traffic speeds reduce the frequency and severity of crashes, especially those involving pedestrians. Reducing speed also contributes to smoother traffic flow and enhances in many ways the liveability and sustainability of cities.

9. Motorisation has contributed to urban sprawl, and cities have evolved to accommodate car use, with many negative impacts on life and social cohesion. Changes are required now to manage the preponderant role of motorised traffic in industrialised countries. This is also urgent in low- and middle-income countries, which are now moving rapidly towards much higher levels of motorisation.

RECOMMENDATIONS

National governments and transport and health ministers can do much to support and encourage walking, even when it is considered to be mainly a local policy issue. A clear vision and political support at a national level, backed by a systematic approach to understanding and defining infrastructure quality for pedestrians, is an important complement to and support for initiatives taken by local authorities. To achieve sustainable mobility, governments are invited in particular to consider the following recommendations:

1. Integrate mobility management and urban planning and take better account of the needs of pedestrians from the earliest stages of urban development projects and transport investments, with the object of creating seamless, high-quality networks for pedestrian activity.
2. Establish clear administrative responsibilities among relevant government departments at all levels for co-ordinating walking programmes and initiatives. The purpose of such arrangements is to stimulate and support actions in government and private sector organisations in an integrated way. This might take the form of a national committee or an interministerial co-ordinator supported by a national pedestrian observatory.
3. Improve knowledge about walking to adequately inform government policy development in relation to this fundamental aspect of mobility. This requires a standardized methodology for, measuring, reporting and monitoring pedestrian mobility and injuries (from traffic crashes and falls). Standardization would help to make the measurement of growth in walking and sojourning a core indicator of urban sustainability and liveability. Efforts should also be directed at the development of international comparisons of mobility and safety statistics to agreed definitions. At a national level, such information could be collected by a national pedestrian observatory.
4. Incorporate public transport services as an integrated part of the development of new urban areas and the regeneration of existing areas, through planning guidance and financial support for public transport services. This can support a long-term shift towards higher-density, mixed-use, walking and transit-oriented urban form and a reduction in the growth of urban sprawl.
5. Encourage the responsible authorities to give higher priority and more space to non-motorised traffic and public transport in city centres. This includes a number of key actions: providing easy, safe, well-maintained and secure pedestrian access to public transport and to all city centre destinations; development of car-free areas; parking policies to discourage over-use of cars in city centres; and regulations to prevent parking on pavements and crossings, which undermines the quality of walking and, in severe cases, renders walking impracticable.

6. Develop national pedestrian planning guidance for local administrations. Plans should be required to give consideration to the impact of projects on pedestrians, and cyclists, as part of project appraisals and environmental impact assessments. Plans should also consider the development and setting of targets for future levels of walking, as well as addressing needs for financial support. Public participation through, for example, pedestrian associations should be solicited in developing urban transport plans. Safety should receive specific attention in national planning guidance, with recommendations for implementation at the local authority level.
7. Encourage employers to implement a broad range of incentives for employees to include active transport in commuting trips. Government agencies should demonstrate leadership in this area.
8. Adopt a safe system approach for the design of the walking environment so that it is organised in such a way that specific risk groups are not exposed to avoidable risks.
9. Implement traffic-calming policies and generalise 30 km/h zones in city centres, residential areas and other high pedestrian activity areas. This should be based on a functional classification of urban spaces, streets and road networks, supported by appropriate infrastructure design criteria to create low-risk and amenable urban environments for non-motorised road users. To be fully effective, best-practice education, communication and enforcement programmes are needed. The development of intelligent speed adaptation systems is also recommended.
10. Encourage the introduction of high-quality education programmes in schools and local community centres, to teach safe road user behaviour and promote the benefits of walking through a range of effective forms of communication. Adult retraining initiatives are also indicated. School mobility plans should be developed aiming to produce a safe and supportive environment in which children can walk to school.
11. Conduct a critical review of current traffic codes to strengthen the legal and financial protection of pedestrians in case of a crash, and give higher priority to more vulnerable road users in order to provide safer, more equitable conditions among all road users.
12. Develop a research strategy to understand better mobility trends and individual behaviours in a changing society. This should include evaluating the effectiveness of measures to reduce dependence on private car travel, achieve higher-density urban forms, protect the environment, improve health and achieve more efficient and sustainable use of energy.

ISBN 978-92-821-0364-7
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CHAPTER 1. INTRODUCTION: WALKING AND THE CHALLENGES OF THE 21ST CENTURY

"The pedestrian is entitled to live in a healthy environment and to freely enjoy the amenities offered by public open areas in conditions that safeguard his physical and psychological well-being."

From the Charter for pedestrians' rights, adopted by the European Parliament in 1988.

There is a rapidly-growing realisation within society that greatly improved provision for walking is needed if we are to meet a number of key challenges facing tomorrow's world. More and more, we are coming to understand that large cities and other urban areas are struggling to cope with a number of significant trends. They include:

- Increasing levels of traffic congestion and the insatiable demands of motorised transport for more road space.
- The cost of building and maintaining the infrastructure required to support our road-transport system and the urban sprawl it engenders.
- Poor air quality in cities and towns and the advance of global-warming and (potentially irreversible) climate change.
- Major declines in health caused by the combination of sedentary lifestyles and an over-reliance on the private car to make even the most local journeys.
- The degradation of public open areas that inhibits the walking and sojourning that are vital to the quality of urban life.

By any assessment, the prospects for a sustainable future and for liveable cities and towns for future generations is concerning, if not alarming.

Recognising that walking and also being out and about on foot for many purposes in addition to walking itself (the concept called sojourning) form the heart of urban life, this report seeks to identify key opportunities to redress these trends. Making better provision for walking is crucial to solving many of these problems. It can also help to create the kinds of cities and towns suited to prosperous and satisfying lives.

While an obvious sense of urgency exists to improve the way our societies cater for walking in the future, the socially valuable activity of sojourning, though more challenging to define, seems to be highly-valued by both residents and visitors to towns and cities.

Its capacity to build and maintain a sense of community and local amenity is fundamental. By improving the provision for walking, we are more likely to raise the aesthetic quality and 'liveability' of urban centres which, in turn, leads to more attractive and prosperous places to live, visit and conduct business. Once commenced, the process of improvement is self-reinforcing.

1.1. Why the need for a publication devoted to a strategy for better provision for walking?

What purpose does a publication dedicated to walking serve? Why is the OECD at the beginning of the 21st century turning towards something that, until now, was taken for granted by many, regarded as a matter of course, as natural as breathing and entirely free? Surely, it is difficult to imagine walking being a subject of policy and planning?

1.1.1. Walking as a cornerstone of liveable and sustainable cities

Historically, walking has been an essential element of city life. Today, however, the key role that walking plays is being eroded in many urban settings. It is commonly restricted by obstacles and hostile conditions, and consequently the health and safety of those who continue to choose to walk are threatened through an increased risk of death or disability from road trauma. Though walking constitutes a physical need, it is suppressed in "unfriendly" conditions and replaced by motorised transport with its attendant increases in traffic-related pollution, noise and congestion, and the downgrading of open public space. One of the main reasons for these problems is inadequate planning. Enhancing walking in planned ways needs to become a specific policy objective. Present day policies, however, indirectly inhibit walking by supporting the use of private motorised transport, even for very short distances. Though difficult to quantify, a substantial number of walking trips never take place because of the failure to integrate walking into today's transport policies. Consequently residents now walk much less than they did in the past.

Is it desirable to accept a reduction in trips, especially on foot, as compatible with the vision of the sustainable city of tomorrow? The aim of this publication on better provision for walking is to take an important first step towards improving the quality of life, safety, personal security, and the social environment within our cities and, by so doing, to reduce the attendant levels of noise and environmental pollution. Future progress in promoting walking will play a key part in ultimately deciding the fate of the 21st century city. After all, wherever residents and visitors walk, cities are alive and thriving.

The primary aim of this report, then, is to emphasise the importance of walking and the vital need for policies to promote walking at all levels of planning including national, urban and local. A further important aim that can help in realising the report's primary aim is to define best-practice promotion and future provision for walking across all relevant sectoral interests. As time passes, there will be a need to update our knowledge on what constitutes "best-practice".

1.1.2. Walking concerns all, including the most vulnerable

Many citizens, such as elderly people, have restricted mobility due to physical disabilities. As populations age, the size of this problem will grow. Providing those with mobility impairments with a dignified place to walk and enjoy simply being on the street allows them to remain purposefully engaged in society, and makes a therapeutic contribution to their condition. Walking also provides a valuable contribution to learning, especially for children, who can find it difficult to cope with the complex urban environment. In this context the city itself can be viewed as the "book" providing education on history, architecture, town planning and society.

1.1.3. System-based approach

Cities can be viewed as complex systems comprising many elements which influence one another and/or which depend on each other to fulfil their respective functions. Until now, measures for walking have, as a rule, been ad hoc and addressed site specific problems (usually of safety) as they have come to attention. This process has made the development of comprehensive solutions difficult because of our failure to adopt a system-based approach. Broad-based strategic goals and policies, with longer-term horizons, are needed to create and support a humane and sustainable city. In the framework of a broader strategy for walking, inter-sectoral policies will deliver better results than separate policies within sectors.

1.2. The identity of walking

There is much to be done to create the best possible conditions for walking. Providing more space is not enough. Walking warrants open spaces that inspire, sensitise and encourage communication among inhabitants of cities, towns and suburbs. In general, traffic codes tend to prioritise motorised traffic over the needs of pedestrians, leading to deficiencies for pedestrians in the design and operation of the physical environment. Cities where priority will be given to walking have before them an important task of re-planning the road network in order to ensure not only direct connection, but also uninterrupted walking by pedestrians and compliance by drivers with lower travel speeds.

This report is concerned equally with walking and sojourning in the public space. Both functions can be achieved, alongside mobility, to ensure pleasure, access to activities, quality of space and contact between friends and neighbours. The pedestrian is a lively presence in the public space, encouraged to stay when various activities, trades and places of work are easily accessible on foot.

1.3. Vitality and liveability of the city

Although the transport function of walking is important, equally important is the presence of people on the street; it indicates that the air is clean, the noise levels are not intrusive, and public space is comfortable, attractive and safe. It is a prerequisite for the prosperity of commerce and other activities and, of course, to attract visitors and investment. Research has shown that pedestrians are the best consumers, perhaps because walking secures convenient and direct access to land uses on either side of the road. As such an increase in the number of pedestrians may prove to be a significant boom to the local economy of an area.

The integration of comfortable routes for walking, both in terms of safety and general enjoyment, decreases the number of tasks for which people use their motor vehicle. For example, a safe walking route between residences and local schools may encourage more children to walk to school, having the two-fold effect of decreasing parent's motor-vehicle use and promoting friendships between children.

Avoiding the use of a motor-vehicle for short distance trips also helps decrease local air pollution, as well as decrease consumption of fossil fuels. In addition, the preservation of local eco-systems for the purposes of creating pleasurable routes for walking ensures conservation of natural resources

The term "*sojourning"*, is a term used to describe the experience of simply *being* in a public place, purely for the enjoyment that being there offers, or to participate in the activities of everyday life (e.g., trading and vending, waiting for others or public transport, playing, or meeting friends, family or other members of one's community).

It does not necessarily involve movement, other than travelling to or from the chosen place. It refers to the enjoyment or other advantage derived from spending time in a public space, either alone or with others.

The exclusive use of transport and town planning terminology undermines the notion of sustainability, vitality and liveability of public space. A city whose residents strongly believe in its social value and in the quality of living collectively, can be made more sustainable. Such an attitude encourages people to enjoy its open, social spaces, as well as the contact with the city itself and its residents.

A number of cities have replaced freeways with parklands, rivers and open spaces that are aesthetically pleasing and focused on people rather than vehicles. As a consequence property and land values increase when surrounded by aesthetically pleasing environments (Cervero, 2009). Environments that integrate urban areas for pedestrians with high quality public transport services encourage alternative transport use and support economic development. Consequently, there is a positive association between cities with high public transport use and cities with high levels of Gross Domestic Product per capita.

1.4. Economic dimension of a strategy for walking

A strategy for walking requires the adoption of number of measures, described in this report, which range from low cost education campaigns to major infrastructure reorganisation.

A quantitative assessment of the costs and benefits of a strategy promoting walking is a very complex exercise. This is largely because a strategy for walking offers a wide range of direct and indirect benefits, including health, pollution, noise and quality of life. While some effects can be relatively easily quantified and assessed within a cost benefit analysis framework, others are much more difficult[2] to assess, such as a better quality of life and these benefits also largely vary based on the local conditions. A recent study undertaken for the government of New South Wales in Australia has developed an approach for the economic appraisals of significant spending proposals to develop strategies for walking (PricewaterhouseCoopers, 2011). Generally, the benefits identified and quantified within a cost benefit appraisal framework for this study included:

- Health cost savings – an increase in physical activity may have strong personal benefits, in particular impacts on morbidity and mortality as well as other ailments related to inactivity. It is also likely that improved health outcomes will reduce health care costs to society. It has also been argued that improved health can result in increased productivity and reduced absenteeism in the workplace.

- Congestion savings – as a shift from motor vehicles to walking will reduce road congestion.

- Vehicle operating cost savings – individuals may save on the costs of maintaining a vehicle, including fuel, depreciation and tyres.

- Changes in the level of road and pedestrian safety – safety is especially important when separated pathways or roadway safety and awareness initiatives are implemented as there are reduced opportunities for vehicle-pedestrian accidents.

- Environmental pollution savings - through a reduction in GHG emissions, air pollution and water pollution.

- Noise reduction –a transfer to walking as a mode of transport reduces vehicular noise, especially in residential areas where the sensitivity to and corresponding costs of noise are high.

There are also a number of community benefits that reflect the local and social characteristics of walking [Tolley (2003) and Litman (2010)], which are more easily assessed on a qualitative basis due to their difficultly to quantify or existence outside of the bounds of a cost benefit analysis framework.

These benefits include:

- Liveability – the quality of the local environment and the degree that walking improves the local environment by reducing vehicle traffic and speeds.

- Economic development – effects on commercial activity and shifts in consumer expenditures towards more local businesses.

- Social equity – distribution of resources and opportunities, and the degree to which walking helps to increase the mobility and accessibility of disadvantaged people.

These benefits have to be weighed against the costs of a strategy for walking, including:

- The capital costs, including design, construction, land acquisition and implementation costs.

- The recurrent costs, including operating and maintenance costs.

This report does not address this complex issue. However, the economic benefits derivable from a health perspective are illustrated in Chapter 4.

1.5. The objectives of a strategy for walking

It is anticipated that successful implementation of a strategy for walking will achieve several objectives:

- Creation of better safety conditions at the street level for vulnerable users (especially children, elderly people and the mobility impaired).

- Increases in the use of public transport in place of private vehicles. This will reduce the numbers of vehicles on the road, hence decreasing congestion and the potential for conflicts between pedestrians and other road users.

- Reductions in the number of trips made by car in those cities that are well served by networks supporting public transport, cycling and walking.

- Reductions in the number of short distance trips made by motorcycle.

- Reductions in the rate of urban sprawl.

- Improvements to population health as a result of improved air quality and reduced noise levels including; enhanced mental performance and concentration levels, decreased feelings of tension and stress levels.

- An aesthetically better urban environment.

In summary, this report aims to encourage the implementation of policies that encourage walking and to provide "best practice" options to bring those policies to reality. The liveability and viability of our cities in the future will depend critically on how successfully these policies are defined and translated into practice.

ISBN 978-92-821-0364-7
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CHAPTER 2. WALKING: THE NEGLECTED TRANSPORT MODE

Despite figuring at the beginning and end of all trips, this chapter highlights that walking is rarely captured in government statistics on mobility and is often neglected in planning and policy development.

2.1. Forgotten in data

Data are a neglected key factor in promoting and acknowledging pedestrians in planning. There is an abundance of data on motorised traffic but a shortage of data on pedestrians. Information about walking and sojourning at the *location level* are key performance measures and are necessary to understand the correlation between urban- and street design, walking and sojourning, and to evaluate the impact of pedestrian infrastructure improvements. Reliable methods for collecting data on pedestrian volumes as well as path modelling both on the individual and crowd level are missing.

While many ITF/OECD countries collect mobility data about the *population* on a national scale, the emphasis is usually on motorised travel, and thus not all countries record pedestrian mobility. Even if pedestrian mobility is recorded, there is a tendency for under estimation. Pedestrian trips are typically quite short and people tend to forget many of these short trips when reporting their daily travel behaviour.

In most travel surveys a pedestrian trip is recorded as a trip that occurs when the whole trip is completed on foot. However, trips taken by other transport modes can also include elements of walking. For example, a simple trip using public transport has at least three elements or stages: 1) walking from home to the bus stop on foot, 2) the bus ride, and 3) walking from the bus stop to the destination by foot. The design of many national travel surveys is such that travel involving multiple modes is recorded in terms of the 'main' or 'primary' transport mode only. For example, persons using more than one mode of transport over the course of a journey may be asked to only report on the mode of travel used for the longest distance covered on the journey. If a stage level perspective were taken for all multi-modal trips, the picture would therefore be different. For example, in Switzerland 28% of all trips are pedestrian trips (made entirely on foot), while 45% of all stages are pedestrian stages. This example from Switzerland illustrates that the real *proportion of walking* is much higher than the statistics suggest.

The majority of pedestrian trips are quite short. The design of many travel surveys neglects short trips, like walking the dog, walking to the mail box to post a letter or visiting a neighbour. These short trips are often overlooked and forgotten by the respondent, and thus never reported. As a consequence, the total number of kilometres travelled may be substantially underestimated (Rietveld, 2001; Methorst, 2010).

Comparing national pedestrian mobility statistics can be challenging due to the variation in definitions surrounding pedestrian activity. Differences in the age range of the samples; the design of the surveys, as well as the scope of pedestrian activity that is captured, all can impact on the final pedestrian figures. These barriers make it difficult to make any international comparisons and generalisations about pedestrian activity.

Pedestrians are also not adequately represented in accident and crash statistics. The levels of under-reporting of injuries to pedestrians involved in traffic crashes and in falls are both of serious concerns.

According to the Vienna Convention a traffic accident[1] is a crash that occurs with at least one moving vehicle, and involves a death or injury. Cases where pedestrians fall or stumble due to poor road conditions are rarely reported as they are excluded from the international agreed definition of injury crashes. However, it is an important issue and some researchers have shown that up to 75% of pedestrian injuries can be due to falling.

While pedestrian deaths resulting from traffic collisions are well reported in most OECD countries, injuries are largely underreported because of a lack of systematic information exchange between hospitals and police. In addition the absence of an international agreed definition on traffic injuries makes it difficult to make any meaningful international comparisons.

2.2. Forgotten in cities

Historically, urban development of towns and cities has aimed to accommodate proximity travels. With the onset of population growth, towns and cities have increased in land mass, with the invention of motorised transport supporting longer distance trips. As a result, travelling by foot has decreased significantly as a mode of transport for individuals. Consequently, modern day societies have become considerably more reliant on motorised vehicles, leading to serious health, economic and environmental implications.

Cities were traditionally created as a safe and secure place against enemies and natural threats. Knowledge from history demonstrates how different cultures have previously attempted to utilise urban space as an asset, by shaping it to fit with the needs of the population. One particular obstacle associated with this task has, and continues to be, facilitating the movement of people in their everyday activities of life (e.g. travelling to school, work and recreational activities, as well as running errands). When populations lived under the transport constraints imposed by reliance on pedestrian and animal transport alone, urban settlements, hence cities and towns, were limited to a size accessible on foot. Proximity was necessary and acceptable as demonstrated in larger cities, where everyday life remained relatively restricted in terms of space. Hence, towns and cities were previously developed for less demanding modes of transport in contrast to modern day societies.

Structural facilities for pedestrians have been of significant importance since ancient times. During Roman times, pathways throughout towns were perceived to be safe and comfortable, despite animal-powered chariots posing potential danger to pedestrians. Since then, climate and health have become considerations in determining settlement of urban space and the means of transport people utilise. This has also been assisted by technological advances.

When looking at present day mobility data (which are limited in their ability to represent pedestrians), walking has not disappeared from the statistics, but the priority is demonstrably low, with the rate of pedestrian trips recorded being generally negligible, compared to other modes of transport. This trend may be influenced by several factors relating to the way societies are now structured.

The era of the private car has completely changed town design worldwide. Some urban settlements have been planned explicitly assuming private car use for transport (e.g. Los Angeles). This is also largely true for the suburbs that surround cities. In addition, general increases in economic growth, including personal income, have promoted car ownership. As a result, the convenient use of motor vehicles has flourished, at the expense of pedestrian movement. Along with this, home and work places have become separated by greater distances due to the availability of private cars. Despite some views that support the notion of liberalisation of locations, the loss of proximity has led to fewer walking trips, which has a series of implications.

In today's society, time is often considered more crucial than space, and therefore becomes a key factor influencing choice of transport mode. In addition, often there is distorted perception of time efficiency, with motorised traffic thought to be faster than non motorised, which is not necessarily true for door-to-door trips in urban areas, which are relatively short. Therefore, time needs to be taken into account when evaluating the potential for implementing different transport modes. Consideration of the space/time relationship in planning is therefore crucial to restoring a higher level of pedestrian walking mobility. At present, in order to cope with busy lifestyles, most trips are multi-modal journeys, where the means of transport chosen is the one that accommodates the longest section of a trip (i.e. mostly private car).

In summary, public space location and orientation, building location in relation to public space, legibility of urban environment, acceptable behaviour, personal security and safety are key areas that need to be considered, in order to fully integrate pedestrians into a comfortable urban space. Therefore, equal priority must be given to the needs associated with developing a pedestrian network, simultaneously with the needs of planning and building road and public transport networks.

2.3. Forgotten in the decision making process

Pedestrians are inadequately represented in urban policy making. Furthermore, institutions representing specifically the interests of pedestrians are rare.

Pedestrian advocacy is almost nonexistent

Most citizens are pedestrians at one point in time, but not all of them depend equally on walking to solve their transport needs. A large proportion of walkers, and in fact a large proportion of the population, comprises children and people with age- or mobility-related impairments.

These groups rely heavily on walking but are not well placed in making their needs known to decision makers and generally lack support from advocacy groups who are active in the transport sector.

Furthermore, in a world where interest groups and lobbyists are used to playing a role in driving solutions, institutions that solely represent the interests of pedestrians are rare. The role of pedestrian NGO's was acknowledged in the specific survey developed for this document (OECD/ITF, 2008a). Some are very active at either national or international levels in promoting walking, but very few are given a place at the tables where key decisions are made, standards set and policies formed.

Neglected technically and in legislation

Policy makers rely on mobility statistics, including data on personal travel behaviour, to formulate strategic transport policies and to improve the safety and efficiency of transport systems.

As previously mentioned, at present pedestrian mobility is clearly under-researched and under-represented in the transport statistics in most of OECD countries.

Under-representation is also a problem in current pedestrian fall and crash analysis and even in its legal status. Although pedestrians do not pose a significant risk to other road users, pedestrians are exposed to life-threatening risks. However, they have been overlooked in the development of current traffic codes, which have focused on facilitating the flow of motorised traffic.

Without national level institutional support or a co-ordinated policy

Another identified problem is the scarce presence of pedestrians in the agenda of national level administrations and the dispersed allocation of competences affecting them.

Even though pedestrian infrastructure is normally built by local administrators, walking is not simply a local matter. Best examples show that it is favourable to have unified leadership, and the provision of a legal, administrative and technical framework from national governments to effectively accommodate the needs of pedestrians. Otherwise actions in favour of pedestrians become isolated and, most of the time, inefficient, misguided or even infeasible due to existing legal regulations.

Currently responsibilities for accommodating the needs of pedestrians and promoting walking are spread across a wide range of organisations and ministries, including transport, safety, environment and health. As a result there is no clear institutional responsibility especially at national levels (OECD/ITF, 2008a). Accordingly, there is a lack of incentives for agencies to consider walking a priority. It is fairly difficult to encourage organisations to work together to benefit pedestrians and therefore a high priority needs to be placed on establishing the mechanisms to ensure that active, collaborative, and coordinated efforts towards pedestrian safety occur.

Not surprisingly in this context, no lead agencies for pedestrians at government level were identified in the survey undertaken by the Working Group (OECD/ITF, 2008a), although in a few European countries, such as the Netherlands, there are public officials in charge of pedestrian issues within the transport ministry. In terms of fostering innovation and creating new knowledge about pedestrians, there is still a small (although growing) number of institutions and countries establishing research programmes that aim to create sustainable transport options, including pedestrian mobility[2].

Finally, and equally importantly, in most OECD countries which responded to the survey undertaken for this report, walking is rarely supported by a national policy, with Switzerland and the United States being two notable exceptions with the establishment of a national strategy for walking (see boxes 1 and 2 in Chapter 7).

NOTES

1. Convention on Road Traffic, Vienna 8th November 1968.

2. The European Commission has funded several research projects on vulnerable road users, such as ADONIS, PROMISING, WALCYNG or, more recently, "New means to PROMote Pedestrian Traffic in cities – PROMPT" (http://prompt.vtt.fi/) and Cost Action 358 "Pedestrian Quality Needs – PQN project" (www.walkeurope.org/). The Walk21 Conferences are a consolidated initiative to promote walking.

ISBN 978-92-821-0364-7
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CHAPTER 3. WALKING PATTERNS IN ITF/OECD COUNTRIES

This chapter analyses existing data on pedestrian travel in OECD/ITF countries, and provides a picture of main trends regarding walking in ITF/OECD countries.

3.1. Introduction

How much people walk, how often and for what purpose varies between locations as well as between and within countries. This is because pedestrian travel habits are influenced by cultural and environmental factors, such as societal values and attitudes, weather conditions, infrastructure, geographic location and proximity, as well as individual differences, such as lifestyle, age, income, health, physical ability, and perceptions of risk.

Walking can be measured at a population level according to pedestrian mobility data or according to location based on the volume of pedestrians in traffic at certain locations. Thus, when measuring walking it is important to differentiate between pedestrians in traffic, pedestrians sojourning and pedestrian mobility. The focus in this section will be on pedestrian mobility.

There are many ways to measure pedestrian mobility at an individual or population level. *Passenger transport modal split* involves separating the number of trips as a pedestrian from other transport modes and can be described in terms of distance, duration and frequency (at the individual level).

3.2. The share of walking

The proportion of walking trips (entire trips on foot) varies among different countries. According to the United States National Household Travel Survey (2001), 8.6% of all trips in the United States were walking trips. In contrast, the Swiss 2005 Micro census on Travel Behaviour identified that 28% of all trips were completed by foot. The proportion of walking trips in the remaining OECD countries that provide data ranges between these two extremes (see figure 3.1). Cultural differences in attitudes towards walking compared to other transport modes may be one explanation for the variation between countries.

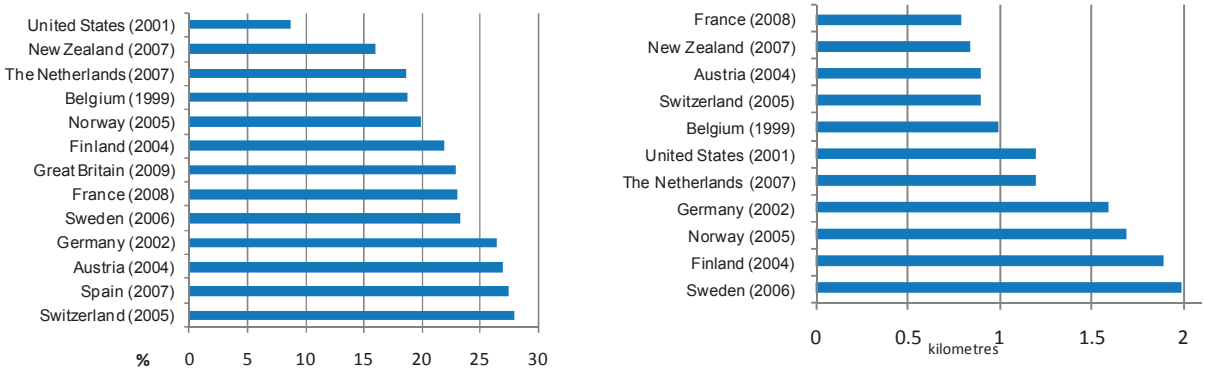
Statistically, the amount of *walking is a reflection of car use*. In general, where car use is lower, walking makes up a larger share of trips. For example, walking only accounts for 8.7% of trips made in the United States, while car use accounts for 86.5% of total trips. In contrast, in Switzerland the share of walking trips is more comparable to that of car trips (23% vs. 36%) (see figure 3.1).

On an individual level, mobility statistics suggest that vehicle ownership and possession of a driver's licence are substantial factors in determining how much people walk.

For example, the National Travel Survey in Finland (2005) found that people in households without a car will on average have one walking trip per day, while those in households with one or more cars average about half of that.

The Dutch Travel Survey (2007) found that people who did not own a vehicle of any type walked on average 720 metres per day compared to those people who owned vehicles, who walked on average 270 metres per day. Results from the Swiss Travel Survey (2005) showed that people without a driver's licence spent more time walking per week than those people with a licence, irrespective of age group.

Figure 3.1. **Share of walking and average length of a walking trip in various OECD countries**



Source: Various national travel surveys.

People who live in urban areas tend to walk more compared to people who live in rural areas. Data from the Netherlands (Rijkswaterstaat (2008) demonstrated that the number of walking trips made by Dutch citizens is higher at greater *levels of urbanisation*. Individuals living in very populated urban areas were found to have the highest average number of daily walking trips per person (0.66 trips), compared to individuals living in rural areas who had the fewest (0.49 trips). These findings also correspond with data from other OECD cities and regions.

3.3. Distance, duration and speed

In industrial countries *the majority of pedestrian trips are quite short (*see Figure 3.1). In Switzerland, for example, the Micro Census on Travel Behaviour (2005) determined that 60% of walking trips in Switzerland did not exceed 1 km, and only 10% of them exceeded 2 km. The average journey on foot in Sweden, as determined by the National Travel Survey (RES 2005-2006), is somewhat longer, at 2 km; however, when compared to the average journey by car (drivers 30 km, or passengers 41 km), bus (26 km), or bicycle (4 km), walking distances are still relatively short.

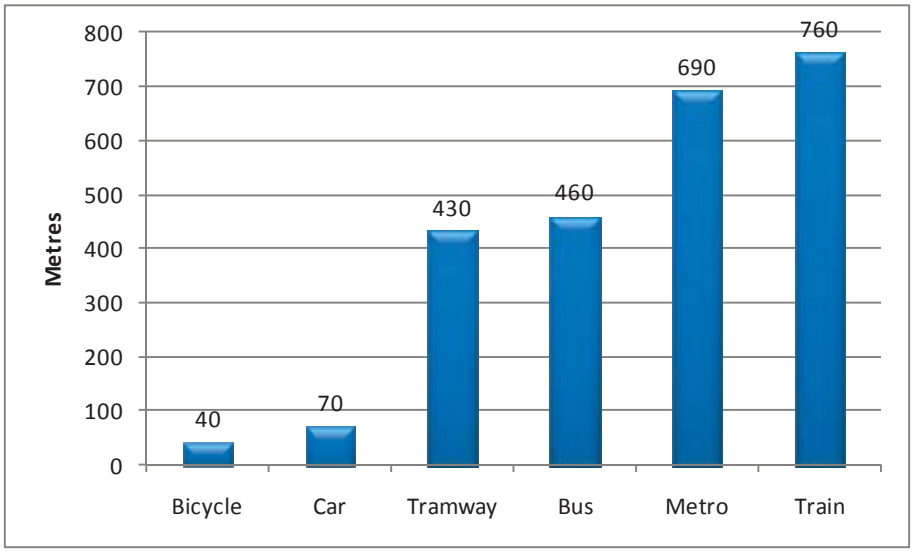
Overall, Germans appear to walk more than people from other countries. Germany has the highest proportion of walking trips, and the average distance of each pedestrian trip is relatively long.

In contrast, New Zealand has a relatively low proportion of walking trips and the average walking trip is short. Austria and Switzerland have distinctly different walking cultures.

Although people in these countries demonstrate a high proportion of walking compared to other transport modes, every walking trip is quite short. It is interesting to note that while people in United States tend to walk less than people in other counties, those who do walk tend to walk as far as pedestrians in other countries.

The proportion of walking trips referred to above only includes trips that were made entirely on foot. However, *walking is a key element in most multi-modal trips*. In the 2005 Norwegian National Travel Survey respondents were asked specifically about walking distances related to *all* of their trips. The results indicated that in one day Norwegian people, on average, walked 280 metres as part of longer journeys involving other transport modes. Furthermore, the results indicated when all transport modes are taken into account, on average about 110 metres was completed on foot. Distances for walking were found to be the longest for trips that involved public transport (see figure 3.2) (Vågane, 2006).

Figure 3.2. **Average length of a walking trip while using other transport modes Norway, 2005**



Source: Norwegian National Travel Survey 2005 (Vågane, 2006).

The *average trip duration* for pedestrian trips (made entirely by foot) also varies among OECD countries. The countries that report the average longest walking trips also report the longest duration of an average trip. However, there are international *differences in walking speed*. When the walking distance is compared with the walking duration the pedestrian trips show that people in OECD-countries walk at a *speed* of between 56 and 77 metres per minute. If these figures are reliable, it is interesting to note that people walking in Austria and Switzerland, who have the highest proportion of walking and the shortest trips, have the lowest average walking speed (56 metres per minute). One explanation might be that a greater proportion of walking trips in Austria and Switzerland take place in urban areas, where people potentially walk at a slower pace.

Another explanation for this finding is possibly due to the fact that a greater proportion of people are walking including older age groups who walk relatively slowly or on sloping paths.

According to a Danish article (Herrstedt and Lund, 2010) different countries use different standard values for pedestrian walking speed when planning. Several countries (including Norway, Finland, and Germany) use 72 metres per minute as the normal value. Danes use 60 metres per minute (or 1 metre per second). The United States has changed from 72 to 54 metres per minute (1.2 to 0.9 metre per second) in accordance with the weight increase in the population. What is most important is that traffic planners are aware that some groups of people walk slower than the average walking pace. This is particularly important when designing pedestrian crossings for the full range of users (see also section 6.3.4).

3.4. The purpose of walking

In general, trips for the purpose of leisure and recreation, shopping, personal business and education are the main reasons for walking trips in OECD countries. The proportion of people who walk to work is rather low, but there is variation among OECD countries.

The greatest proportion of people who walk to work live in Switzerland (36.8 %), and very few people walk to work in the United States (3.7%). Austria and Germany are exceptions because a large majority of walking trips are completed for the purposes of shopping.

3.5. Choice of transport mode

As mentioned, vehicle ownership and possession of a driver's licence are notable variables that influence how much people walk. It is not surprising that distance also seems to be a significant determinant in choosing the mode of transport. The proportion of trips by foot decreases with increasing travel length. Data from the Norwegian National Travel Survey (2005) show that when the travel length exceeds 900 metres, people tend to drive instead of walk. More specifically, for trips of up to about 300 metres, at least 75% of people walk all the way, but for trips longer than 2 km less than 25% walk the whole distance.

Results from the Swiss National Travel Survey (2005) showed that the length of journey/travel time was the most important factor in respondents' decisions to walk. In fact, this was the primary reason influencing all transport mode choice. The next most popular reason reported was how enjoyable the person found the transport mode. This finding is consistent across many OECD countries, where so much of the pedestrian activity is for leisure and recreational purposes. In addition, the lack of an alternative transport option was cited as being the second most influential factor in choosing motorised travel (both private and public).

Distances for walking were found to be longest for trips that involved public transport. Figure 3.2 illustrates for Norway the average walking length when combined with other transport modes.

3.6. Demographic differences

The objectives of walking differ according the demographic variables of the pedestrian, such as age and gender. According to the New Zealand Household Travel Survey (2003-2007), the main reason for walking for children and adults aged between five and 24 years is travelling to educational institutions.

In contrast, the main priority for people aged 25 to 34 years is getting to work, whereas for those aged 35 to 74 years, it is for recreation. For those adults aged 75 years and above, the dominant purpose for walking is shopping.

In general, women participate in more walking trips than men. For example, in Sweden women make 27% of their journeys on foot, while men make about 20% of their journeys on foot (RES, 2005-2006). It has also been found that overall women travel further on foot and spend more time walking than men (Finland, the Netherlands, and New Zealand). Youth and seniors tend to make a higher proportion of their trips on foot, as well as those with lower income levels. Young people walk more than other age groups. A travel behaviour survey among children aged 6 to12 years in Norway showed that more than half of the children walk or cycle to school (Fyhri and Hjorthol, 2006). However, the majority of children are driven by car to organised leisure activities. Data from New Zealand showed that the proportion of walking trips among children has declined and continues to decline. The proportion of walking trips for children was higher than the proportion that was receiving lifts in a vehicle in 1989-1990.

However, this pattern has now changed as data from the New Zealand Household Travel Survey 2003-2007 showed that 55% are car passengers and only 25% are walking. This is not a promising finding for walking patterns in the future population.

In Norway, parents who drove their children to school by car were asked to report their main reason for doing so (Fyhri and Hjorthol, 2006). The most frequent response was that the school was located along their route to work (60%), only a small proportion mentioned traffic safety (approximately 20%). In addition, there is a clear relationship between distance to school and mode of travel. When distances to school are above 3 km, cars are the preferred mode of travel. Seventy-five percent of children who lived less than 0.5 km away from the school walked to school, while this figure decreased to only 2% of the sample for children who lived more than 3 km away from the school.

Population projections in OECD countries indicate that the number of elderly people, particularly older age groups (80 years and over), will increase as a proportion of the total population. With an increase in the aged population, the number of people with disabilities will also increase, given the growing incidence of disability with ageing. Generally, people with mobility impairments tend to limit their travel. Elderly pedestrians are inhibited by complex traffic situations, especially during bad weather and at night, where the walking conditions are more difficult and safety becomes a concern. In the U.S., for example, elderly people (65+ years) make 17% of their walking trips at night, compared with young people aged 16-24 years and those aged 25-64 years, who make 33% and 28%, respectively, of their walking trips at night.

3.7. Changes over time

Overall, the distances and the proportion of walking trips seem to have been decreasing since the early 1980's until now. This can be seen in France and the U.K. (Wittink, 2001). This is partly explained by urban development or "sprawl" creating longer distances to travel as well as an increase in vehicle ownership. An analysis of journey modes was conducted in Norway in 1992, 1998, 2001 and 2005 to determine the proportion of trips completed by a pedestrian compared to the proportion of trips completed as a driver. The figures demonstrated a modest increase in walking in 2001, accompanied by a small drop in the proportion of car trips. In 2005 this trend was reversed and the number of trips made by car increased as the number of trips completed as a pedestrian decreased.

This modest increase in walking around the millennium could be explained by the economic recession that occurred at that time. A similar trend occurred in France in 2009.

Results from the marketing and opinion barometer (BVA) from the Public Transport Union (UTP) (Union des Transports Publics, 2009 and 2010) showed a decrease in the use of all transport modes except walking. Thirty-eight percent of individuals indicated that they increased their number of walking trips, while 9% reported a decrease. The same tendency was demonstrated in the latest national travel survey in Norway, which showed an increase in the proportion of walking from 20% in 2005 to 22% in 2009-10. This could be the start of a promising new trend for health and urban environment.

3.8. Distances covered by walking and time spent

Distance is not a measure of importance. Expressing pedestrian mobility in terms of distance travelled is a gross underestimation of walking because the distance travelled is usually much shorter compared to other transport modes, and therefore distance should not be used as a measure of importance. Once factors such as time spent travelling and the number of trips is considered, walking is a much more prominent mode of transport than measures of distance would suggest.

This point is further illustrated by results from the Finnish National Travel Survey (2004-2005). According to these results walking only represents 3% of the total daily distance travelled per person in Finland, however it accounts for more than 20% of the total daily time spent travelling per person, as well as the total daily number of trips per person. There is a tendency for travel behaviour surveys to underestimate the number of walking trips and to disregard walking when it is combined with other transport modes. Consequently, it is critical to formulate policies and develop infrastructure and safety measures that are based on a full understanding of pedestrian activity. This will ensure that proper priority and consideration is given to the needs of pedestrians.

ISBN 978-92-821-0364-7
Pedestrian Safety, Urban Space and Health

CHAPTER 4. WALKING, HEALTH AND WELL BEING

Walking has important benefits for improving the quality of life, social well-being and general health. This chapter highlights some of the evidence for direct benefits associated with physical activity and walking.

4.1. Introduction

Urban mobility through the transport system has an important impact on a population's quality of life. Depending on how it is organised, the transport system can either offer or restrict opportunities for people to access services, education, employment, and leisure activities. It can also play a key role in the economy. The reduction in people walking in urban areas and, more specifically, in medium sized towns and cities has had a detrimental impact on several aspects of the quality of urban life, notably through the use of public space and through congestion, and on overall population health. Furthermore, there have been serious adverse effects related to increased exposure to emissions of air pollutants, and noise from vehicles, as well as increases in traffic injuries mainly in countries still in the earlier stages of motorisation, more socially isolated people and less people who are physically active. The impacts on transport are distributed unequally throughout society, with socially disadvantaged populations experiencing the least benefits and the greatest disadvantages from the prevailing model of a motorised private transport system (Transport and Health Study Group, 2011).

Walking is an accessible physical activity for individuals of all ages that can be incorporated as part of everyday living that provides great health benefits for the population as a whole. This section aims to describe and highlight the direct and indirect health benefits of walking, as well as discuss possible negative effects. Although the review of existing research often pertains to overall physical activity, specific examples related to walking are included where possible.

4.2. Direct health benefits of physical activity and walking

Current evidence suggests that moderate intensity physical activity, including walking, is essential in maintaining good health, while a sedentary lifestyle contributes to reduced health outcomes at different levels (Cavill, Kahlmeier and Racioppi, 2006; U.S. Department of Health and Human Services, 2008; Wardburton 2010; World Health Organization, 2010).

Several studies have reviewed the effects of overall physical activity on health and disease, but only a few studies have done so specifically for walking. The following section considers the available research surrounding the benefits of physical activity on cardiovascular diseases, cancer, non-insulin dependent diabetes mellitus, musculoskeletal health, obesity, mental health, mortality, as well as overall health-related quality of life. Where possible, reference is made specifically to walking.

There is evidence that regular physical activity decreases the risk of cardiovascular disease mortality in general and coronary heart disease mortality specifically (Nocon *et al*., 2008; Hamer and Chida, 2008; Boone-Heinonen *et al*., 2009; Warburton *et al*., 2010).

Regular physical activity prevents or delays the development of high blood pressure and high cholesterol, while also reducing blood pressure in people with hypertension (Cavill et al., 2006; Warburton et al., 2010). Physical activity improves cardio-respiratory fitness with a direct dose-response relationship between fitness and intensity, frequency and duration of the activity (U.S. Department of Health and Human Services, 2008; Warburton et al, 2010). This applies also for children and youth (Jansen and Leblanc 2010; World Health Organization, 2010). A meta-analysis showed that regular brisk walking significantly reduces cardiovascular risk factors among previously sedentary adults (Murphy, Nevill, Murtagh and Holder, 2007; Hamer and Chida, 2008; Boone-Heinonen et al., 2009). A dose–response relationship exists, with benefits starting to be achieved, on average at approximately 3 hours per week walking at a moderate pace. Greater benefits can be achieved especially at an increased walking pace (Hamer and Chida, 2008; Boone-Heinonen et al., 2009).

Physical activity is associated with a reduction in the overall risk of cancer, colon cancer and breast cancer (Cavill *et al*., 2006; World Health Organization, 2010; Warburton *et al*., 2010). A study conducted among Chinese women found that both walking and cycling reduced the incidence of mortality from cancer (Matthews *et al*., 2007).

Regular physical activity has been found to lower the risk of developing non–insulin-dependent diabetes mellitus, type 2 diabetes. There is a 30% to 40% decreased risk for type 2 diabetes, as well as metabolic syndrome (a combination of risk factors that can lead to diabetes), in moderately active people compared to sedentary individuals (U.S. Department of Health and Human Services, 2008; Warburton *et al*., 2010).

Low levels of activity result in a higher ratio of kilocalories consumed to those expended, which contributes to increased trends of obesity across Europe and other world regions (Cavill *et al*., 2006). Physical activity may favourably affect body fat distribution. Normal-weight youth who have relatively high levels of physical activity tend to have less adiposity than youth with low levels. Among overweight and obese youth, interventions that increase the level of physical activity tend to show beneficial effects on health (World Health Organization, 2010; Jansen and Leblanc, 2010). Studies have shown that walking and cycling regularly to, from and during work can result in a 50% reduction in the risk of becoming obese (Gordon-Larsen, 2009). Sedentary adults who took up brisk walking experienced positive outcomes for their body mass index and percentage of body fat (Murphy *et al*., 2007).

Participation in physical activity throughout life can increase and maintain musculoskeletal health, while reducing the functional decline that usually occurs with age in sedentary people (Cavill *et al*., 2006; Warburton *et al*., 2010). Physically active adults are likely to have less risk of a hip or vertebral fracture. Increases in exercise training can minimise the decrease in spine and hip bone mineral density (U.S. Department of Health and Human Services, 2008; World Health Organization, 2010, Warburton *et al*., 2010). Physical activity practised in the range recommended for health does not cause joint damage or development of osteoarthritis and may actually be beneficial for many people with arthritis (U.S. Department of Health and Human Services, 2008). Moreover, exercise training interventions (including

aerobic and resistance) of older adults showed improvement in physiological and functional measures, and longer-term reduction in incidence of mobility disability (Paterson and Warburton 2010).

There is clear evidence that physical activity reduces the risk of depression and cognitive decline in both adults and older adults (U.S. Department of Health and Human Services, 2008; WHO, 2010). A relatively high level of physical activity is related to better cognitive function and reduced risk of developing dementia (Paterson and Warburton, 2010). A meta-analysis showed that subjects who performed a high level of physical activity were significantly protected (-38%) against cognitive decline during the follow-up (Sofi *et al*., 2011).

Furthermore, even analysis of low-to-moderate level exercise also showed a significant protection (-35%) against cognitive impairment (Sofi et al., 2011). In addition, there is some evidence that physical activity improves sleep (U.S. Department of Health and Human Services, 2008) and reduces the risk of depression and dementia by approximately 20% to 30% (U.S. Department of Health and Human Services, 2008).

Higher levels of regular physical activity are associated with lower mortality rates (U.S. Department of Health and Human Services, 1996; U.S. Department of Health and Human Services, 2008; Warburton *et al*., 2010). Even those who are moderately active on a regular basis have lower mortality rates than those who are less active (Nocon *et al*., 2008; Powell, Paluch and Blair, 2010). A study on walking reported a decrease in total mortality among men who walked 1–2 miles (1.6–3.2 km) per day (Hakim *et al*., 1999). Hamer and Chida reported in a meta-analysis of prospective cohort studies that the risk of all-cause mortality was 31% lower for the population of the highest walking category compared with those with the lowest (Hamer and Chida, 2008).

Physical activity appears to improve health-related quality of life by improving physical functioning, while also enhancing psychological well-being (Cavill *et al*., 2006), and seems to be associated with reduced sickness absence (Laaksone *et al*., 2009).

4.3. Indirect benefits of promoting walking

Walking can be a group activity that provides opportunities for social interaction and engagement, which is a significant factor contributing to improved mental health and well-being. Improving population health through promoting participation in physical activity such as walking and cycling reduces health costs and expenditure (Boesch *et al*., 2008). Other indirect benefits may include those resulting from the substitution of trips undertaken by car with trips undertaken on foot (particularly short distance urban trips, and trips where the combination of walking and use of public transport is possible). Replacing car use by public transport use also results in a reduction of negative environmental and health-related consequences (Dora and Phillips, 2000). Examples include air and noise pollution, which will be discussed in the following sections.

4.3.1. Air quality

Three-quarters of transport-related emissions are from road traffic (Woodcock, Banister, Edwards and Prentice, 2007). Road traffic contributes to a range of gaseous air pollutants and to suspended particulate matter (PM) of different sizes and compositions. In addition to carbon dioxide, tailpipe emissions comprise nitrogen oxides, hydrocarbons, ozone, benzene, lead and particulate matter (Woodcock *et al.,* 2007). In urban areas, motor vehicle tailpipe emissions of primary particles account for up to 30% of fine PM (less than 2.5 μm in aerodynamic diameter or PM2.5 (Krzyzanowski *et al.*, 2005).

A systematic review of transport-related air pollution effects on health identified evidence suggesting pollutants derived from transport have a serious negative impact on population health (Krzyzanowski *et al.,* Schneider, 2005). The findings imply an increase in total mortality, respiratory morbidity, allergic illnesses and symptoms, cardiopulmonary mortality, non-allergic respiratory disease, and myocardial infarction. Some studies also suggested an increased incidence of lung cancer among people with long-term exposure to transport-related air pollution (Krzyzanowski *et al.*, 2005). Initial estimates show that in Europe tens of thousands of deaths per year are attributable to transport-related air pollution, similar to the death toll from road trauma (Krzyzanowski, Kuna-Dibbert and Schneider, 2005).

Long-term decreases in air pollution are associated with reduced bronchial hyperactivity and respiratory and cardiovascular disease, and consequent gains in life expectancy (Woodcock et al., 2007; Krzyzanowski et al., 2005).

Nonetheless, pedestrians in general, are not exposed to more air pollution than drivers of private vehicles, or individuals inside buildings. Although walking and cycling may result in greater exposure to such air pollutants, several studies that have considered levels of inhalation and duration of exposure have shown that pedestrians consistently had the lowest exposure to pollutants (McNabola *et al.,* 2008). In fact, the in-vehicle air pollution levels have generally been found to be slightly higher than exposure levels experienced by cyclists and pedestrians (Kaur *et al.,* 2007). Furthermore, it has also been reported that the mean in-vehicle concentration of volatile organic compounds often exceeds concentrations typically found in residential indoor air (Geiss *et al.,* 2009). Car and bus travellers appear to have the highest exposure to vehicle emissions, particularly gasoline-powered vehicle emissions (Nieuwenhuijsen *et al.,* 2007).

4.3.2. Noise abatement

Existing evidence suggests excess environmental noise affects daily activities and has negative impacts on the overall health and well-being of the population. Road traffic is the major cause of human exposure to noise in Europe, except in areas close to airports and railways lines (Dora and Philips, 2000). In the early 1990s within the European Union countries, it was estimated that about 40% of the population was exposed to road traffic noise with an equivalent sound pressure level exceeding 55 dB(A) during the day, and 20% were exposed to levels exceeding 65 dB(A) (Berglund *et al.,* 1995). Since then, sound levels have steadily increased, as a result of the growth in road-based travel, as well as the higher travel speeds (Dora and Philips, 2000). A conservative estimate of the social costs of traffic noise in the EU22 (Europe with 22 countries) have been estimated at EUR 40 billion per year (0.4% of total GDP), with the bulk of these costs (about 90%) caused by passenger cars and lorries (den Boer and Schroten, 2007).

The World Health Organization (WHO) has compiled three reports reviewing the health impact of environmental noise, each providing a set of recommended guidelines (Guidelines for Community Noise (Berglund *et al*., 1995) and the Night Noise Guidelines for Europe (World Health Organization, 2009). It has not always been possible to evaluate the impact of road traffic noise on health, in isolation from other environmental noise. Overall, the main effects of noise on health include pain and hearing fatigue, hearing loss, annoyance, interference with social activities and communication, sleep disturbance and its consequences (including stress, fatigue), cardiovascular effects, hormonal responses, as well as degrading performance and development at school and work (Berglund *et al*., 1995). The most recent report (WHO, 2011) estimates that disability adjusted life years (DALYs) lost from environmental noise are 61 000 years for ischemic heart disease, 45 000 years for cognitive impairment of children, 903 000 years for sleep disturbance, 22 000 years for tinnitus and 654 000 years for annoyance in the European Union Member States and other western European countries. These results indicate that at least one million healthy life years are lost every year from traffic related noise in the western part of Europe.

Sleep disturbance and annoyance, mostly related to road traffic noise, comprise the main burden of environmental noise."

4.4. Other considerations concerning walking

4.4.1. Adverse effects resulting from physical activity or exercise

Most of the evidence on the adverse effects of exercise refers to moderate to vigorous levels of physical activity, which is not highly relevant to walking. In fact, Calson *et al*. (2006) reported an increased amount of walking was related to lower rates of injury compared with other activities, such as running and sports participation. Furthermore, the most consistently reported risk factor for musculoskeletal injuries, as well as sudden adverse cardiac events related to exercise and physical activity, is previous inactivity and low fitness levels (U.S. Department of Health and Human Services, 1996).

One of the serious risks associated with walking is traffic injury involving cars, due partly to the low visibility of pedestrians on the roads (U.S. Department of Health and Human Services, 1996). Findings show that increased rates of cycling and walking do not increase the number of road crashes proportionally (Jacobsen, 2004; Boesch *et al*., 2008). Jacobsen (2004) suggested that an increased presence of pedestrians and cyclists on the roads may subsequently improve the awareness of motorists, while also influencing policies to separate motorised from non-motorised transport in order to produce a more effective organisation of existing roads.

4.4.2. Falls

Falls are a prevalent public health problem; however, there is little information available on the contribution of falls to the total burden of disease, particularly on pedestrian falls in public area. A study estimated that in Europe 1.6 million pedestrians are injured due to falls on public roads per year, which represents almost 3,000 victims per 1 million inhabitants, and an unknown number of people die for the same reason (Kormer and Smolka, 2009). It has not been possible to estimate fatalities from falls among pedestrians on public roads due to lack of reliable information in mortality registers. According to a study on falls conducted by Kormer and Smolka (2009), the ratio of males and females is almost equal (52:48). Research has identified that falls occur mainly in urban areas, where 30% occur on footpaths and 29% on roads. Children (0-14years), followed by elderly people (65+ years) are especially prone to such injuries (see more information in chapter 5).

The quality of pavement, road maintenance, adequate lighting, and an appropriate parking policy to prevent vehicles from disturbing the flow of pedestrians, especially the most vulnerable, can contribute efficiency in preventing falls (see also chapters 5 and 6).

4.4.3. Limiting physical and mental conditions

There are a number of health conditions that require special attention when planning and promoting walking. Conditions such as asthma, blindness or vision impairment, deafness or impaired hearing, diabetes, epilepsy, spinal cord injuries or diseases that require wheelchair use, and some chronic diseases may restrict mobility. Some of these conditions occur more frequently among the elderly, and so affect a considerable proportion of the population. This is expected to increase globally over time, as life expectancy increases. The specific problems experienced by people with disabilities and conditions resulting in restricted mobility need to be tackled to enable such people to walk in safe conditions.

Box 4.1. **WHO Global Recommendations Promoting Physical Activity**

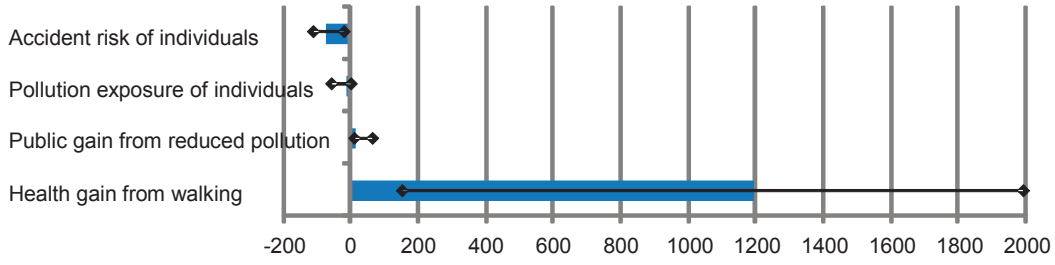
The World Health Organization Global Strategy on Diet, Physical Activity and Health elaborated the Global Recommendations on Physical Activity for Health for children and youth, adults and older adults (World Health Organization, 2010). Different types and amounts of physical activity are required for different health outcomes, which include:

- Children and young people aged 5–17 years old should accumulate at least 60 minutes of moderate to vigorous-intensity physical activity daily. Physical activity of amounts greater than 60 minutes daily will provide additional health benefits. Most of daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.
- Adults aged 18–64 years should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity. Aerobic activity should be performed in bouts of at least 10 minutes duration. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity. Muscle-strengthening activities involving major muscle groups should be practised two or more days a week.
- Adults aged 65 years and above should perform at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or at least 75 minutes of high-intensity aerobic physical activity, or an equivalent combination of moderate- and high-intensity activity. Aerobic activity should be performed in bouts of at least 10 minutes' duration. For additional health benefits, adults aged 65 years and over should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of high- intensity aerobic physical activity per week, or an equivalent combination of moderate- and high-intensity activity. Adults of this age group with poor mobility should perform physical activity to enhance balance and prevent falls on 3 or more days per week. Muscle-strengthening activities involving major muscle groups, should be practised 2 or more days a week. When adults of this age group cannot perform the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.

4.5. Economic benefits of walking

Studies undertaken to assess the economic benefits of walking and cycling, in particular the TAPAS project[1] and the HEAT programme, have shown that active mobility (walking or cycling) brings both physical and mental health benefits that largely outweigh possible increased exposure to pollution or safety risks. Rabl (2011) showed that replacing regular car trips by either regular cycling trips (e.g. commuting trips of 5 km each way) or regular walking trips (e.g. pedestrian commuting trips of 2.5 km each way) brings a net benefit of around EUR 1 000 for every person who decides to switch from using a private cars to adopting an active form of mobility (see Figure 4.1).

Figure 4.1. **Calculated economical benefits of one individual who switches from driving to walking**
Euros / year / person



Source: Rabl, A. (2011).

In 2011, the PEP Programme of the World Health Organization and the UNECE released a tool to assess the economic benefits of walking (see Box 4.2). This tool, which can be used at project level, will be very useful when comparing different urban development projects to demonstrate the net health benefits of policies promoting active mobility.

Box 4.2. **Health Economic Assessment Tool (HEAT) for Walking**

To demonstrate the return in investments in healthy transport modes, the World Health Organization and the United Nations Economic Commission for Europe (UNECE) developed — in the framework of the Transport, Health and Environment Pan-European Programme (THE PEP) —- a new Health Economic Assessment Tool (HEAT) for walking and cycling.

HEAT is designed to help transport and urban planners estimate the economic savings from population-based mortality reductions due to physical activity resulting from regular cycling and walking and is a basis for more informed investments in sustainable transport. Two different versions of HEAT exist respectively for cycling and walking.

The version for walking is designed to assess the benefits of regular walking for commuting or leisure time activities, at a moderate pace of 4.8 km/h, considered as a speed requiring energy efficient expenditure to produce health benefits.

The HEAT tool has been calibrated based on an in-depth review of 15 studies on the relationship between mortality risks and walking. These studies were combined to calculate an aggregated risk, weighted by sample size. The resulting relative risk estimate was 0.78 (95% confidence interval: 0.64-0.98) for a walking exposure of 29 minutes, seven days a week.

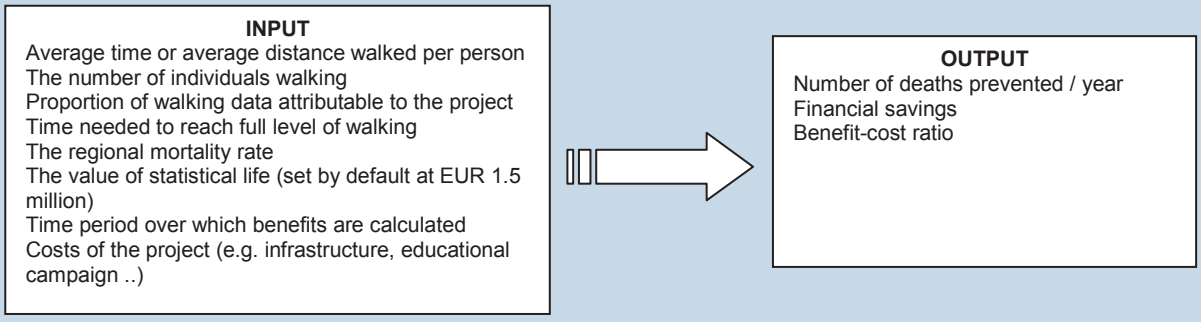
HEAT for Walking can be applied in many situations, for example:

To plan new walking infrastructure: it models the impact of different levels of walking, and attaches a monetary value to the estimated benefits when the new infrastructure is in place (this can be compared to the costs to produce a benefit–cost ratio (and help make the case for investment), or as an input into a more comprehensive cost benefit analysis);

To value the mortality benefits across a city or country resulting from current levels of walking (e.g. such as benefits from walking to a specific workplace);

To provide input into more comprehensive cost–benefit analyses, or prospective health impact assessments: for instance, to estimate the mortality benefits from achieving national targets to increase cycling or walking, or to illustrate potential cost consequences of a decline in current levels of cycling or walking.

HEAT is available on Internet2 and is relatively simple to use, as it requires only a limited number of input data variables.



HEAT for cycling has been used in several countries across the world, including Austria, England, the Czech Republic, Sweden and New Zealand. The new HEAT for walking is currently planned to be used in various cities in Europe, such as Coimbra (Portugal), Brighton-and-Hove (England), Pärnu (Estonia) and Kuopio (Finland). Results of these experiences will become available in 2012.

4.6. Conclusions

Current trends within developed societies, including the motorised model of transport, have negatively impacted on population health (for example, its contribution to road traffic injuries and the non-communicable diseases and obesity epidemic). In order to improve this situation, a raised awareness within society, as well as stakeholders and relevant policy-makers, is necessary, to start changing this model and the associated consequences. Initiatives to reduce private car use and promote public transport and active mobility, such as walking and cycling as part of everyday life, are essential in achieving such a goal. The benefits of being physically active, and in particular walking, are very important and largely outweigh the possible increased exposure to traffic accidents or pollution. Given the advantages discussed, it is clear that there is a pressing need to promote and encourage active mobility among individuals, not only to achieve sustainable transport, but also to improve overall population health.

NOTES

1. TAPAS (Transportation, air pollution and physical activities; an integrated health risk assessment programme of climate change and urban policies) is a research programme to quantify the health benefits of active mobility. Six cities were participating in the project in 2011: Barcelona, Basel, Copenhagen, Paris, Prague and Warsaw.

2. www.heatwalkingcycling.org/

ISBN 978-92-821-0364-7
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CHAPTER 5. SAFETY AND PERSONAL SECURITY: FACTS AND FEELINGS

This chapter assesses the extent of pedestrian safety in urban spaces. It addresses both non-traffic accidents (i.e. a pedestrian falling in a public space) and traffic crashes (a pedestrian hit by a vehicle). It also focuses on real or perceived insecurity and how it impacts on the decision to walk.

Walking presents challenges especially for the most vulnerable individuals. Pedestrian accidents include collisions with moving vehicles and accidents that involve no second object (falls, stumbling...). While there are data on traffic collisions that involve pedestrians, much less is known about the magnitude of pedestrian accidents that do not involve vehicles. Recent research, however, has shown that these types of accidents account for a significant share of pedestrian injuries.

5.1. Non traffic accidents: pedestrian falls and stumbling

Pedestrian falls account for up to 75% of pedestrian injuries

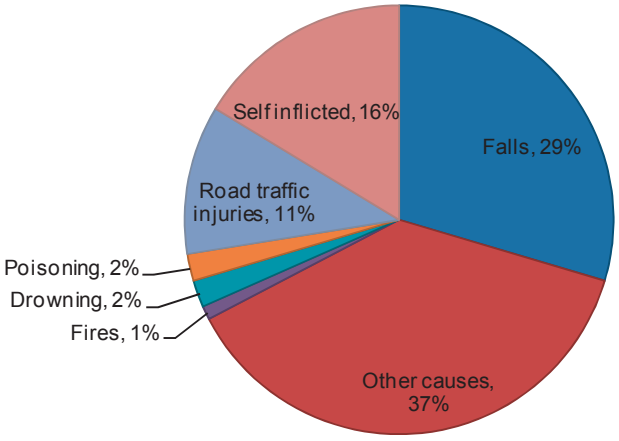
Falls are a leading cause of injury for people of all ages, but children under 14 years and older adults (over 65 years) are overrepresented (see Figure 5.1). The predominance of elderly people in hospital admissions from falls is a result of an increased likelihood of falling compared to younger age groups, and also due to their greater fragility resulting in greater likelihood of broken bones.

Falls often occur on stairs and inside buildings or homes; however they also occur while walking or jogging on footpaths, stepping off kerbs and crossing roadways. Nevertheless, few data exist on the magnitude and consequences of pedestrian falls, because these are largely unreported. The few available studies in OECD countries (Netherlands, Sweden, United States, Spain) show that up to one third of pedestrian fatalities and three quarters of injuries are due to falls in public spaces (Methorst *et al*., 2009; Larrsson, 2009; US DoT, 1999; and the Ministerio de Sanidad y Politica Social, 2006).

Pedestrian falls are mainly due to three factors. The first one being pavement and footpath conditions: changes in the pavement surface (even small differences in height) can easily lead to loss of balance, stumbles and falls. This is especially the case for older people. The second factor is weather conditions, particularly in countries with marked winter conditions, such as snow and ice which are particularly hazardous for pedestrians.

The final factors are related to the pedestrians themselves: people carrying loads, feeling tired, engaging in other activities at the same time as walking or being in too much of a hurry to reach their destination. Additional factors that may increase the likelihood of falls include reduced/limited vision and distraction from the walking task.

Figure 5.1. **Fatal injuries among older people (60+ years) by causes of death and gender**



Source: European Injury Database; Bauer and Steiner (2009).

Pedestrian falls have an important societal cost

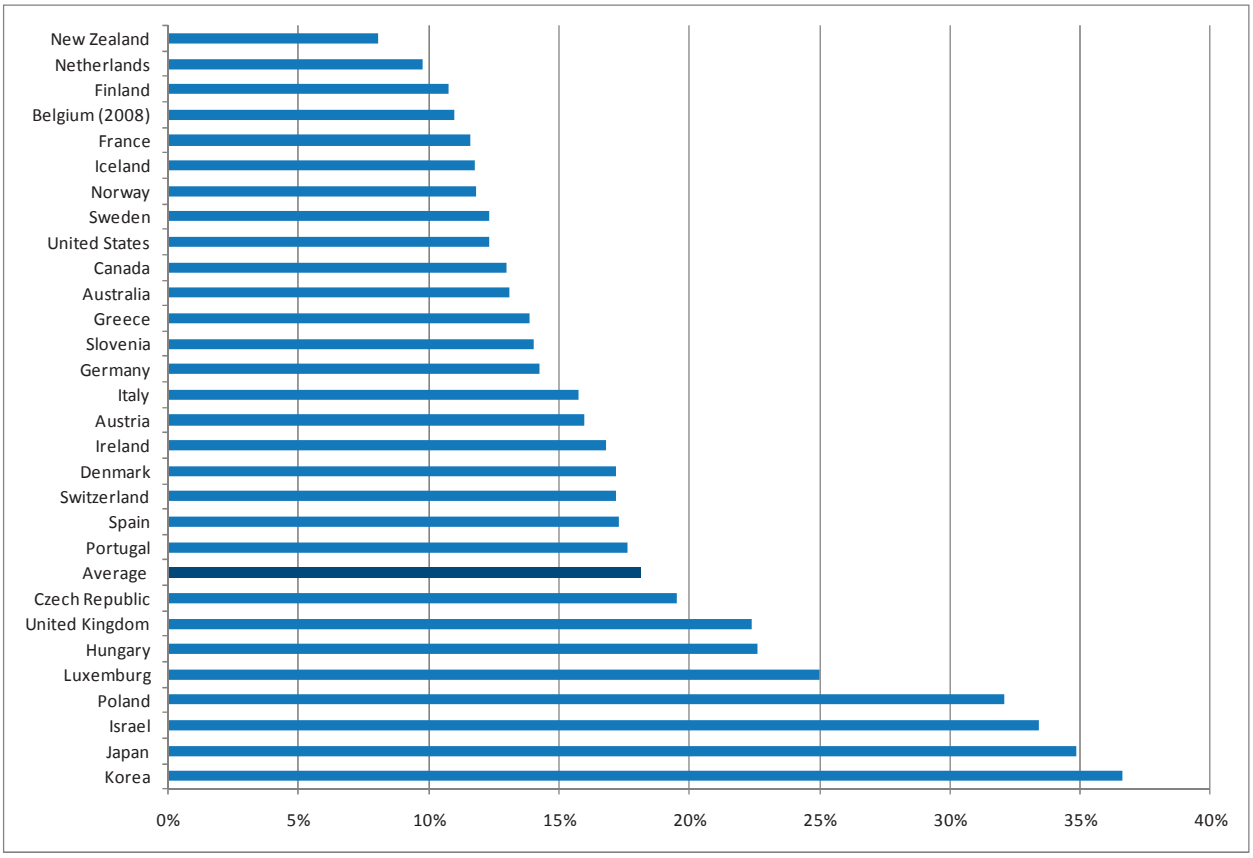
Few data exist on the societal cost of pedestrian falls although recent research estimated that falls represent 16% of total traffic crashes. This represents around EUR 1.4 billion per year in the Netherlands (Methorst *et al*., 2010), and NZD 1.7 billion (around 1.5% of GDP) in New Zealand (O'Dea and Wren, 2010). The high costs are due to the very high numbers of presentations and admissions to emergency departments of hospitals. In addition, older people with pedestrian injuries trigger a chain of health related consequences that result in high costs to the health system. Falls in public spaces need therefore to be recognised as a prevalent public health problem with significant human and economic consequences.

5.2. Traffic crashes involving pedestrians

More than 400,000 pedestrians are killed every year on the road.

More than 20 000 pedestrians die annually in OECD Member countries, and pedestrian fatalities range from between 8 and 37% of all road fatalities depending on country and year. The preponderance of pedestrian deaths in developing countries is more marked, where pedestrians represent up to 75% of traffic fatalities. Worldwide, the number of pedestrians killed every year on the road exceeds 400 000. In all countries, senior pedestrians (over 65 years of age) are the most at risk. In OECD countries, the 65+ age group represents 13-20% of the population but they comprise more than 50% of pedestrian fatalities.

Figure 5.2. **Pedestrian fatalities as a percentage of all road fatalities (29 OECD countries, 2009)**



Source: IRTAD.

A decrease in crashes does not necessarily mean safer conditions; it is sometimes also the consequence of a reduction in exposure or reduction in the number of pedestrians.

Since 1990, the number of pedestrian fatalities has decreased in all OECD countries, usually at a stronger rate than the overall number of all road fatalities, except in Italy and Japan. This decrease can obviously be linked to the important progress most countries have made in road safety, but it should also be seen as a result of a decrease in pedestrian mobility, especially among children.

Driver negligence and pedestrian behaviour are the main causes of collisions.

Canadian data show that in 2004-2006, one in three pedestrian fatalities involved the pedestrian being hit by a driver with at least one prior conviction related to speeding, drink-driving, failure to yield or ignoring traffic controls. Dangerous pedestrian behaviours can, and often do, result in pedestrian fatalities. Crossing the road at a signalled intersection when the green signal for pedestrian is not showing was the most frequent at-fault behaviour recorded in a Canadian survey, and accounted for about 13% of all pedestrian traffic deaths in Canada (Transport Canada, 2009).

Alcohol involvement - irrespective of road user type - is an important factor in fatal pedestrian crashes. In the United States, alcohol was a contributing factor in 49% of fatal pedestrian road crashes. Thirty-six percent of the pedestrians and 13% of the drivers involved in a pedestrian crash had a BAC of 0.8 g/l or higher. In France, 16% of fatal pedestrian crashes involved drunk drivers and 19% a drunk pedestrian.

According to a study of pedestrian collisions in Great Britain, contributory factors were assigned in 54% of the cases to pedestrians only, in 21% of crashes to the driver only and to both the pedestrian and the driver in the remaining 25% of cases. Failure to look out for other road users properly has been cited as the most common cause in all cases (Department for Transport, 2010).

Since pedestrian crashes principally occur in urban areas, pedestrian crossings require special attention.

The large majority of pedestrian injuries or fatalities occur in urban areas and, according to police reports 70-80% of crashes occur while crossing the road, including between 33% and 50% at a pedestrian crossing.

Crash scenarios are well documented and useful in adopting appropriate measures.

The concept of prototypical accident scenario has been used since the late 80s in French road safety research. A typical scenario can be defined as a type of the crash process corresponding to a series of crashes which are similar in terms of the chain of facts and causal relationships found throughout the various accident stages. This concept provides a means of combining and generalising the knowledge obtained from accident case studies, based on in-depth investigation methods or on detailed analyses of police reports (Brenac and Fleury, 2001).

Brenac *et al*. (2003) conducted an in-depth investigation to identify the various types of crash scenarios. These are described in Figure 5.3, which lists five scenarios under the heading of crash during crossing. The main factors involved in these scenarios are described in the report. To alleviate the problem action is required on speed and traffic management, parking policy and urban planning, in addition to pedestrian and driver education and training.

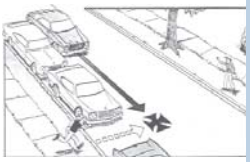
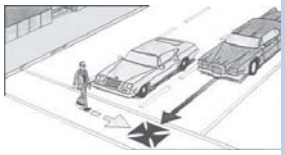
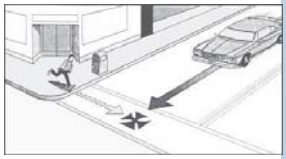
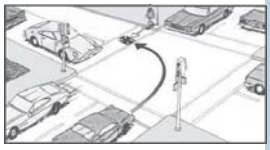
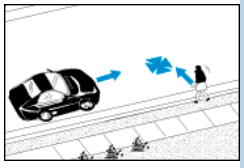
Higher speeds increase the probability and the consequences of a crash.

Pedestrian injury severity is directly and powerfully linked to vehicle impact speed. The faster a vehicle approaches, the longer the distance required to stop, and so avoid a collision. Clearly, in the event of a collision, the risk of a severe injury to a pedestrian is dependent upon the energy involved in the collision, which is a direct function of the vehicle speed at impact.

A number of researchers have attempted to define a mathematical relationship between the risk of a fatal injury for a pedestrian and the speed of vehicles involved in collision. The consensus of recent studies is that reducing the impact speed from 50km/h to 30km/h reduces the risk by a factor of 80% for a pedestrian being killed in a collision. Although few data exist on the relationship between impact speed and serious injuries, speed moderation in urban areas not only reduces the likelihood of a collision but, moreover, the severity of the injuries, which is a main goal of a Safe System approach.

Moderation of vehicle speeds in pedestrian environments remains one of the most effective measures that can be taken to safeguard pedestrians (see suggested measures in Chapter 6).

Figure 5.3. **Scenarios and factors for pedestrian crashes while crossing**

Type of problem	Name of scenario	Description	Factors influencing incidence of crashes
Detection	Dash obscured by parked vehicle	The pedestrian, initially hidden, generally by an immobile vehicle, undertakes his/her crossing when the vehicle arrives, often while running. 	Speed Vehicle parking Street width
	Pedestrian obscured by stopped vehicle	The pedestrian takes advantage of stationary vehicles in one traffic lane to commence crossing. 	Driver's experience Pedestrian's skills Parental education of children
Anticipation	Dash of non-obscured pedestrian	The pedestrian begins to cross, without paying attention to traffic, or dashes onto the road whereas the driver, who did not anticipate the pedestrian's action, did not slow down. 	Speed Street planning
	Turning "look but fail to see"	Vehicle turning left or right from main street into a side street when a pedestrian crosses. Most often the driver fails to see the pedestrian, or sees him/her too late 	Organisation of traffic lights Driver's experience
	Straight on "look but fail to see"	Vehicle travelling on a wide or a fast road in an urban area. A pedestrian, often young or elderly, misjudges car's speed or fails to see it, begins to cross, generally on a zebra crossing, often against a traffic light. Driver detects pedestrian too late or thinks that the pedestrian will stop crossing. 	Pedestrian abilities Driver experience.

Source: Brenac *et al*. (1997).

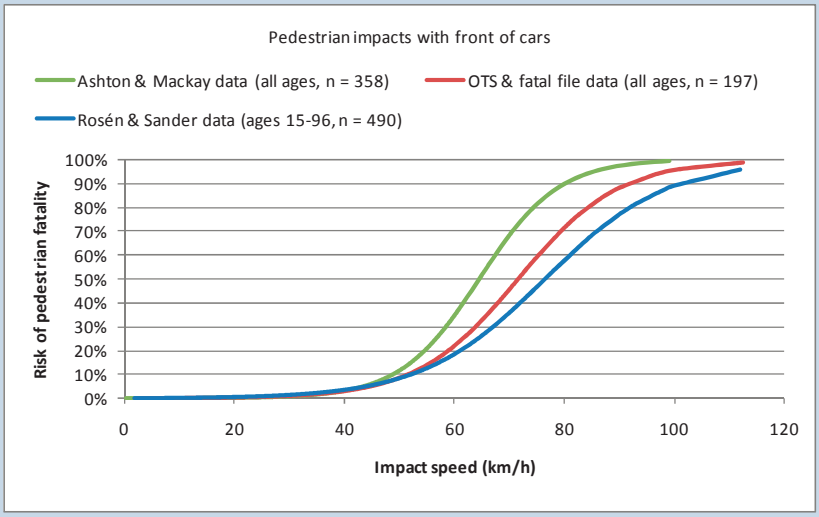
Box 5.1. **Impact speed and risk of fatal injury for pedestrians : review of recent research literature**

A recent study (Richards, 2010) based on three data sources has analysed the relationship between the impact speed in a collision and the risk of fatal injuries for pedestrians. These data sources are: pedestrian crash data collected by Ashton and Mackay in the UK in the 1970s, data and results from the recent German in-Depth Accident Study (Rosen and Sander, 2009) and recent crash data from the UK.

The three pedestrian data sets show a similar pattern in fatality risk. The risk increases slowly until impact speeds of around 50 km/h. Above this speed, risk increases rapidly and is multiplied by between 3.5 and 5.5 times from 50 km/h to 60 km/h. Although the risk of pedestrians being killed at 50 km/h is relatively low, approximately half of pedestrian fatalities occur at this impact speed or below.

The risk of fatality is generally higher for the dataset from the 70s, indicating that the risk of pedestrian fatality has reduced over the last 30 years, perhaps reflecting the improvements in car design (meaning that pedestrians are less likely to be fatally injured if they are hit at the same speed by a newer car with superior frontal protection) and in medical care (pedestrians can survive injuries now that would have been fatal in the 1970s).

Figure 5.4. **Risk of pedestrian fatality for different impact speeds**



5.3. Personal security

Insecurity, whether real or perceived, has a major impact on the choice to walk, especially for children and older people. Of particular concern is the observed decline in walking among children, in part motivated by the risk perceived by their parents.

Pedestrians are very sensitive to many factors affecting their perception of security including the legal framework concerning crime and vandalism, surveillance and police presence, social features of the area (sense of place, social ties and integration, solidarity, etc.), urban facilities (lighting, the design and location of street furniture and vegetation) and urban features (density, land uses distribution, street layout, etc.). Surveys and studies of opinions have shown that unsocial behaviour is systematically associated with a long-term effect on pedestrian behaviour and perception of public safety. Women, children and seniors are more sensitive to crime or fear of crime, and this can often lead to a decrease in their mobility and participation in social activities.

Thus, personal security issues appear to be fundamental in the construction and implementation of a pedestrian-friendly policy. Today, urban security, integrated into broader urban policies, is a shared target, being a prerequisite for public tranquillity and peaceful enjoyment of public spaces for pedestrians.

Social prevention and situational prevention are required.

Theories for addressing unsocial behaviour and fear of crime are now based on increasing natural surveillance. Most experts and practitioners now agree that a combination of both social prevention and situational prevention is required to achieve an optimally safe public place. Eliminating insecurity within a public domain often involves promoting vitality and facilitating the presence of as many people as possible in a given space. Public spaces are successful when they encourage a wide range of activities and instil various uses (Jacobs, 1961). Urban safety contributes to formalising the intuitive relationship of reciprocity between quality of life and pedestrian mobility.

In ITF/OECD countries, common ways to improve pedestrian personal security include enforcing appropriate crime and vandalism regulations, by providing increased or innovative lighting, increasing the number of security staff and installing video surveillance. Video surveillance is potentially one of the fastest spreading technologies amongst ITF/OECD member-countries. Video surveillance appears to work best when it is integrated as part of a package of safety measures, particularly in town centres. Camera systems should be fully integrated into police command and control strategies, and be used to assist decisions concerning the deployment of officers and how best to coordinate a response to incidents. Video surveillance is, however, controversial due to several legal issues related to protecting the integrity and privacy of people

Achieving urban safety and developing effective safety-related policies requires the input of various professionals in the community. The skills and experience of those in charge of public order and crime prevention, technical services, socio-educational organisations, public transport personnel, residents, architects, planners, urban designers and decision-makers are required.

ISBN 978-92-821-0364-7
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CHAPTER 6. KEY ELEMENTS AND PLANNING PRINCIPLES TO PROMOTE WALKING

Much can be done to support and encourage walking. This chapter reviews the spectrum of actions to be considered, including: the integration of mobility management and urban planning; the development of public transport services and urban space for non-motorised traffic; incentives to promote walking; speed management; education and communication; legislation and traffic codes; and new technologies.

6.1. Integration of mobility and urban planning

Walking is a mobility option that is highly dependent on distance and on the conditions of the environment, both of which can be strongly influenced by urban planning as well as design. This is why it is so important to integrate the needs of pedestrians into physical planning.

At the same time, walking as a mode of transport needs to be planned and designed with the same basic concepts as road layout (IHT, 2000). This is why a comprehensive and integrated approach to mobility and urban planning is crucial.

By reviewing the way that cities develop, some fundamental issues with regard to planning pedestrian spaces can be identified:

- Safe mobility has been a concern since long before the automobile era.
- Accessibility and proximity are both objectives and criteria for mobility planning.
- Energy-saving, even if it means only the physical energy, is a fundamental criterion for the choice of transport mode.
- Design according to climatic conditions is relevant for both walking and sojourning.

The evolution of these lessons can be discerned by examining the great variety of the world's urban settlements and the present impact of earlier planning decisions is *all* too evident. Nevertheless, different types of urban development promote certain types of mobility (see Box 6.1) and there is clear evidence that they can promote or inhibit transport choice (Transportation Research Board, 2005).

Urban development and city sizes can influence the selection of transport mode utilised, and in particular, walking trips (Orfeuil, 1997). Perceived acceptable walking distances can vary. For example, in larger, more densely designed cities, residents may be more willing to undertake longer walking distances in contrast to smaller, less densely designed cities.

The development of urban space within these cities also plays a role in the transport mode decision. The design of streets and availability of facilities impacts greatly on the choice to walk. Often within city centres, the availability of parking spaces for cars is limited, making driving less efficient.

Box 6.1. **Land use – mobility relationship: the case of "sprawl"**

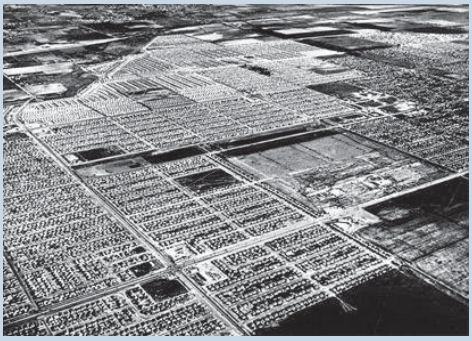
"Urban Sprawl" can be used to show how links work. The reasons for the development of urban sprawl are well known. The popularity of private cars makes living in low-density suburban areas more affordable or, simply, more profitable than inner city developments or urban renewal (Tira and Badiani, 2009).

Citizens appreciate low density because it provides privacy, space, leisure time and choice (Bruegmann, 2005). The residents also speak in a positive way about the liberalisation of locations. Difficulties with controlling, or an unwillingness to do so, are also powerful drivers of expansion in suburban areas.

In suburban areas, however, the means to access public transport stops can be compromised. Furthermore, workplaces are often located far from any public transport facilities and, therefore, trips to work are completed by car.

Limited mobility often prevails due to the perceived *loss of proximity*. People tend to walk less because there are no destinations within walking distance, whereas catchment areas where people frequently walk contain the most frequently used services (shops, schools and facilities). So the results of spatial-planning can lead to an environment where most people depend upon cars.

Figure 6.1. **Lakewood – Los Angeles County (United States)**



6.1.1. Learning from the past

It is difficult to achieve sustainable transport and improve walking when cities have been developed with a focus on the car. Minor cities established early in the 20th century were, for the most part, compact. Distances had to be kept short before the arrival of the car and public transport facilities were not economically viable due to cities' limited physical dimensions. The expansion toward medium-sized and larger cities was made possible through the development of rail, tram and bus transport networks. Until the mid-1950s, many low-density suburbs in British cities were still being laid out on the assumption of minority car ownership, with most residents travelling by bus (or in some cases until 1939, by newly extended tram routes). Well before the end of the 19th century, commuting by rail and tram had enabled cities to expand beyond comfortable walking distances.

This was followed by the development of the private car, which meant that distances could further increase with the continued expansion of the cities.

This situation contributed to the development of urban sprawl, with the car being the cheapest and most flexible transport mode to support city expansion. Public transport networks, on the other hand, provide a less flexible solution and their use in densely populated areas requires much organisation. As a result, the car was given priority over the construction of transport networks, as vehicles can be used for goods and passenger transport, while being a prerequisite for many activities. Public transport then became a secondary priority for government funding.

Nearly 150 years ago, Cerdà (1867) stated that, "urbanisation is a grouping of buildings connected together and which communicates so the inhabitants can meet, help and defend themselves" and "everything taken into consideration, urban life is made of two essential elements: human stays, human moves: that's all".

In the Athens' Charter (Article 60) the solution to mobility planning was seen as a separation of modes of transport. The primary measure proposed was a radical separation, in congested throughways, of pedestrians and light powered vehicles, with further steps recommending special traffic lanes and further separation measures for heavy goods vehicles.

Today, the central approach is that of integration. Indeed, this approach has grown out of the realisation that separation, despite the guidelines being quite clear, has led to more resources being dedicated to allocating space for cars, rather than to pedestrian (and cycling) facilities. Moreover, the strict separation of road user categories has resulted in increased numbers of high-risk crossing points at which different road user groups may conflict. The Buchanan report addresses these problems, but its perspective remains wedded to the concept of modal separation where vehicle flows are high. Where pedestrians and vehicles share the same streets or spaces, vehicle flow is envisaged as being kept by design within a limit called the environmental capacity. The report identifies the role of the road hierarchy and prescribes clear separation of functions, attempting primarily to solve mobility issues.

The more recent experiences of the Dutch "woonerf" and later of 30 km/h zones in France and other countries in Europe, show how vulnerable road users and cars can safely mix provided the space is designed so that drivers are guided by a self-explaining road layout.

Recent experiences such as "shared space", "home zones" and "liveable streets" have given impetus to this trend and, even if the results to date are controversial, they are worthy attempts to fully integrate pedestrians in a comfortable, low-risk urban space.

After a number of promising innovations and trials, many examples of best-practice can be identified where the integration of urban and mobility planning has been applied successfully (see box 6.2). In many countries, however, many of these developments are still in their infancy.

Higher levels of integration require several key issues to be addressed that will lead to better outcomes. These issues include planning and transport policies, the role of the transport network, urban structure, traffic management practices, especially speed management, parking strategies and public transport options. These transport options in turn are influenced by local public opinion, employment opportunities, social policies, town image and environmental concerns.

Box 6.2. **Land use – mobility integration in Freiburg**

For over three decades, the city of Freiburg im Breisgau – the regional capital of one of Germany's most popular tourist destinations and one of the country's fastest growing major cities – has pursued an environmentally friendly urban development policy in which transport plays an important role. This small European city has ahead a targeted policy to improve conditions for pedestrians, bicyclists and public transport. Carefully considered architectural elements connect the various city spaces.

The "global transport concept" (a transport infrastructure that is friendly to people, the environment and the city) is intended as an integral part of the development of the city, which now has 202 000 inhabitants. It includes reinforcing the city as regional capital, developing a 'quickest route to the city' campaign, preserving cityscape and urban spaces, and reducing pollution.

The concept was approved in 1969 and, since then, the city has developed many pioneering plans and measures, including establishing cycle lanes, banning traffic from the city centre, introducing Germany's first transferable flat-rate travel card, and building a city and suburban railway. Its objectives are:

- To reduce traffic in the city and give priority to local public transport, cyclists and pedestrians.
- To create a rational balance between all modes of transport.
- To create global traffic calming and concentrate private vehicles onto well constructed main arteries.

To control parking in public places.

Comparing figures for 1982 and 1999 for the three modes of transport – motor vehicles, local public transport and bicycles – demonstrates the positive effects of the concept. Local public transport increased from 11 to 18 per cent, and bicycle use from 15 to 26 per cent, while motor vehicle traffic decreased from 38 to 32 per cent, despite the increase in the issue of motor vehicle licenses. This result is in complete contrast to the trends observed across many other Central European cities.

Figure 6.2. **Freiburg (Germany)**

Source: www.skyskraperpage.com

6.1.2. The environmental concern

It is generally agreed that the increasing demand for private mobility and the related environmental and safety problems must be urgently tackled throughout Europe (Fleury, 1998; Busi *et al.,* 2000). Research has indicated that policies are required to establish calmer conditions on the road, with less pollution and noise, as well as increased safety (ICLEI, 2006; Verhoef and Ubbels, 2001). Furthermore, it is crucial to develop a common vision regarding land use and transport scenarios which will in turn help to drive decision-making.

The negative ecological impacts of sprawl have been known for some years, especially in the United States (Sierra Club, 1998). The impact can be widespread, and often goes unnoticed. Official EU documents often refer to this as the "ignored challenge" (EEA, 2006).

At the highest level, the political process is critical to shaping urban development and hence the safety of the road network (Fleury, 1998). Many European countries are now devoting considerable resources toward combining the planning of land use with transport functions, driven mainly by concerns about airborne emissions and other forms of pollution. In fact, environmental sustainability can often be used as a catalyst for change and may lead to fewer car trips, which can benefit road safety and promote pedestrian mobility.

The French example shows how the environmental concern can be the lever for a more rational traffic planning (see box 6.3).

Box 6.3. **Local transport plans**

The French Plan de Déplacements Urbain - PDU (Urban Mobility Plan), which exemplifies the environmental approach, is compulsory for towns with over 100,000 inhabitants (refer to the «Loi sur l'air et l'utilisation rationelle de l'énergie (Laure)» (no. 96-1236 of 30/12/1996), or Law on the air and streamlined use of energy, and the «*Circulaire MELTT»* (concerning PDU, issued the 24/3/1997). It clearly comes from an environmental concern and the sustainability culture, where energy saving and air quality are the two main goals.

Importantly, traffic circulation and road safety plans both aim to improve air quality. For example, inter-modal mobility improvements and the promotion of public transport are also concerned with solving environmental problems. Furthermore, the expansion of pedestrian areas and "car-free Sundays" arise from ecological issues relating to pollution and noise reduction, with safety improvements occurring as a valuable by-product of the schemes.

These acts and regulations, while clearly originating from an environmental concern, use mobility management plans to reach their goal.

6.1.3. Planning principles to promote walking

A key change is needed in urban planning to reintroduce some of the features of which history has proved valuable, namely, high density development and proximity. Indeed, higher density areas require shorter trips, which are not dependent on the car, and must be focused primarily within 500 metres of public transport stations. Relevant research shows high density areas and mixed land use favour walking, cycling and public transport use (Dunphy and Fisher, 1996). It is important that areas are designed structurally to incorporate public transport stops to create an integrated public transport system.

It is important to look at the mobility options for pedestrians when designing and planning urban environments.

- The first and main requirement is that town planning must take into account the importance of promoting pedestrian mobility with safety.

- A pedestrian network must be created in cities at the same time as the road network and with the same priority, and must connect between and within districts and city centres, to minimise the effects of geographical, topographical, and physical barriers to pedestrian mobility.

- A pedestrian network can be created by providing a set of continuous public spaces designed to join the main pedestrian generators (*i.e.* facilities, retail areas, offices, transit stations, etc) throughout the entire city, connecting as many streets and people's home as possible.

- The need for car use must be reduced through gradual but permanent restoration of the proximity of urban functions.

- The density of development around public transport stations should be increased when planning the networks, thereby generating capital gain for developers through an increase in land value, and bring about the use of part of the capital gains to develop better services and pedestrian facilities; this approach to increasing urban density, which requires either legislation to give the authority the power to impose a levy, or bargaining to persuade the developer to forego some of their gain voluntarily, can be strengthened through the introduction of taxation incentives (i.e., lower taxes for development that targets urban renewal more so than urban extension).

- Overall lower speed limits must be ensured. With the exception of motorways and other fast roads, where high speeds are desired and allowed, speed within residential areas should not be a threat for pedestrians, cyclists or other users of the residential streets. Residential areas cover approximately 70-80% of urban space and many cities have already applied policies for limiting the speed to 30 km/h (see box 6.4).

- The priority rules for pedestrians crossing a street are not always clear in many OECD countries. A new, clearer philosophy on safe conflict points between different road users should be developed and approved. The priority rules have been changed to improve pedestrian safety under Belgian law and are under consideration to be changed in France. It is recommended that other countries consider providing greater legal protection for non-motorised mobility.

- Transport services should be resourced through the application of transport-related taxes; trials of such an approach have already been conducted in several contexts.

- The use of car parking places should be closely managed and their number reduced where appropriate, while concurrently improving public transport facilities.

- When planning urban environments that are pedestrian friendly, it is essential to apply the 'right' design in the "right" place from the beginning to avoid costly redesigns.

- Pedestrians should be provided not only with pedestrian islands, but with a well-connected network of pathways and well-designed pavement areas.

Box 6.4. **Public Transport Planning in Barcelona**

In the urban mobility plan (PMU) for the city of Barcelona a decision has been incorporated which divides the street network with 25 % of Arterial streets, basically with maximum speed limit of 50 km/h.

Barcelona has defined the map for 30 km/h zones covering about 75% of the local street network and during recent years 15 of these zones have been installed within the city 300 km of local streets covering currently.

In the first application the zones have been defined by road markings (white 30 km/h sign on street wide red background).

For the public surface transport, an orthogonal bus grid network, with 9 express lines and light signal priority, is to be implemented.

The neighbouring city, Badalona, has defined the whole centre as a "shared space zone", using short one-way streets to regulate incoming traffic with limits of 10 and 20 km/h. Importantly, traffic circulation and road safety plans both aim to improve air quality.

In the United States, where sprawl started after the Second World War, alternative urban design concepts such as "New Urbanism", "Growth Management", "Smart Growth", "Transit-oriented Developments" (see figure 6.4.) and "Car-free cities" [1] have started to create new possibilities for supporting travel options and pedestrian activity through the integration of transport and land use planning. In 2005, the concept of Complete Streets emerged aiming at providing more transport choices; supporting existing communities through transit-oriented, mixed-use development and land recycling (that is, reuse of abandoned, vacant, or underused properties for redevelopment); and value communities by investing in healthy, safe, and walkable neighbourhood (see box 6.5).

Box 6.5. **Complete Streets Concept in the United States**

Transportation agencies and advocates in the United States are embracing the concept of creating Complete Streets. A Complete Street is designed and operated to enable safe access for all users. The term "all users" is key to this concept. In other words, the movement is focused on the quality of the travelling experience for people and not just the throughput of motor vehicles.

At the national level, Complete Street bills are currently under consideration in Congress. In March 2010, the US Department of Transportation released a Policy Statement on Bicycle and Pedestrian Accommodation which stated that "Every transportation agency, including the Department of Transportation, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems"

The Complete Street approach recognizes that transportation facilities are unique and should be adapted to the local community context.

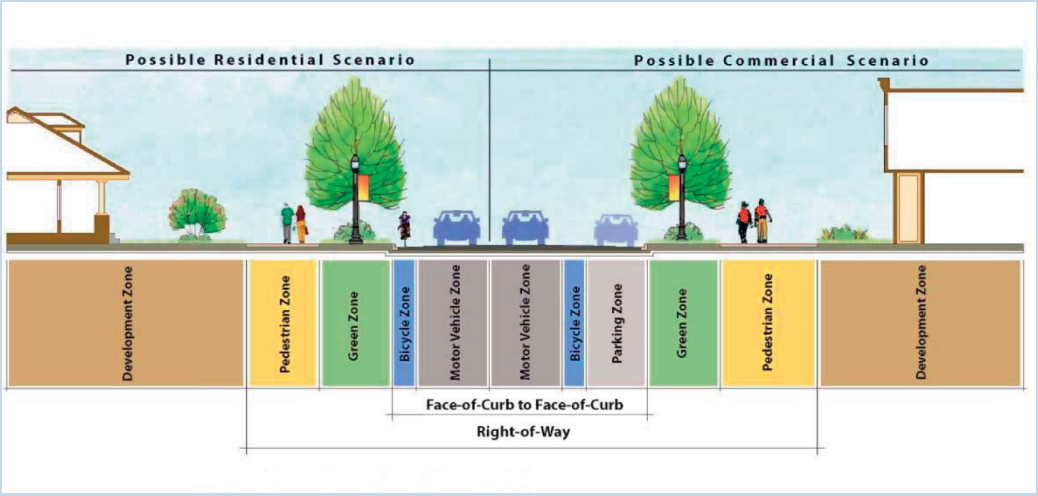
Appropriate facilities may include: bike lanes, special bus lanes, comfortable and accessible public transport stops, frequent and safe crossing opportunities, median islands, curb extensions, as well as narrower travel lanes.

Complete Streets can offer many benefits for the communities at large and especially pedestrians, including:

- Improved safety for all road users, in particular pedestrians: one study found that designing for pedestrian travel by installing raised medians and redesigning intersections and sidewalks reduced pedestrian risk by 28%.
- More walking and bicycling, with health and environment benefits. One study found that 43% of people with safe places to walk within 10 minutes of home met the recommended healthy activity levels, while just 27% of those without safe places to walk achieved healthy activity levels.
- Lowered transport costs for individuals with less spending on petrol.
- More liveable communities, spurred by a safe walking and bicycling environment.

Figure 6.3. illustrates how the complete street designed was implemented in an avenue in Charlotte, United States.

Figure 6.3. **Complete Street in Charlotte, United States**



Source: City of Charlotte, United States.

More information is available at: www.completestreets.org

Figure 6.4. **Transit Oriented Development (TOD) scheme; urban functions around a transport stop City of Ottawa**

Source: City of Ottawa, Transit oriented development Guidelines, City Council, 2007.

In most instances, the key primers for pedestrian-oriented urban land use are: linking urban development to transit provision, maximising metropolitan accessibility with public transport and designing land use and activities in close proximity to one another (Tira and Lombardi, 2009).

6.1.4. A strategic approach is needed

A strategic approach is needed to keep pedestrian mobility and pedestrian planning at the top of the political agenda.

As in the case of traffic safety [e.g. Urban Safety Management, see IHT (1992)], a ”strategy setting” and “sharing interests” approach should be applied[2]. This is an approach that looks at the urban environment from a high-level community safety and amenity viewpoint, targeting these two objectives as core strategies informing any plan of action. In addition to the favourable results that it generates, this type of strategy has been effective in keeping safety issues on the political agenda (DUMAS, 2001). It can also be vital in helping to gain financial support for the implementation of safety programmes and packages of safety measures. Local administrators should have a clear understanding of the historical context in which their city has developed as well as the consequences of their strategies for the future, with pedestrian mobility and safety among the top issues on the political agenda. The “sharing interests” strategy places emphasis on the achievement of common goals within different policy settings through combining efforts and resources (Tira, 2003). The forming of such coalitions could be especially successful in an alliance between environmental (OECD, 1997) and well-being policies (UNICEF, 1996).

Both strategies require, among others, long-range comprehensive action programmes, reliable organisational structures, monitoring of procedures and information transfer, as well as established roles and responsibilities for all personnel (DUMAS; 2001). Furthermore, in some cases where interest in pedestrian mobility is low or absent, complementary strategies that focus on noise reduction, pollution control or health outcomes can assist.

In summary, it is important that mobility is integrated as a key consideration in urban planning. The needs of pedestrians should be considered at the commencement of urban planning projects to regain “proximity” and to create a continuous, high quality network for safe and convenient pedestrian movement throughout the entire city.

6.2. Development of public transport services and urban areas

The reliance of the motor vehicle is greater in the suburbs than in the city centre, where public transport plays a greater role. In contrast, walking is more predominant in the city centres. The traffic system incorporates many modes of travel, both individual and collective, such as public transport, motorcycles and scooters, taxis, bicycles and, of course, walking. It is important to develop and implement policies regarding the transport system that consider pedestrians in order to enhance their experience.

In order to create a sustainable city, the number of people using public transport, cycling and walking should be dramatically increased (Laffel, 2006). While this publication is devoted to walking, it cannot be stressed enough that the propositions here not only focus on walking but also belong to a broader strategy for functional, productive, healthy and less-energy-consuming transport options. In order to achieve this, the number of cars in a city has to be reduced to free up public space.

Traffic planning for fewer cars is one of the big challenges of the 21st century and is a challenge that can be met if we focus on planning of alternate transport means rather than private vehicles.

6.2.1. Public transport

Walking is irrevocably connected to public transport; there is a direct relationship between walking in a city and the efficacy and reliability of its public transport networks. It is imperative that transport stops are accessible, safe and comfortable. Regrettably, large investments in public transport occur with inadequate consideration of pedestrian access to stations. This could be a result of a lack of communication between different authorities.

Public transport can differ according to the type of walking required by its users. For example, people who use the underground train system are disconnected from the urban environment, and hence their walking does not take the unrestrained, more carefree form found on city streets, where window-shopping and enjoyment of the surroundings and architecture can occur. Underground public transport is in many cases necessary for reasons of high mobility demand, develops without necessarily affecting the traffic above ground and is associated with minor side-effects on the upgrading of the urban environment.

This section presents the principles of traffic planning that emphasise the importance to the individual and to the society at large. The first principle and, perhaps, the most important, is that walking cannot be promoted independently of public transport. Residents who use public transport tend to walk more than those who use other transport modes. The more extensive and efficient the public transport system, the more people will be persuaded to use it and, in turn, the more likely that they will walk. Similarly, upgrading public transport means guaranteeing greater ease of movement, often through re-allocating road space previously used by the car. Therefore, improving public transport often leads to limitations in road capacity for cars.

Decades ago, many cities had plenty of space for developing roads for cars except, for example, the European medieval towns which had already developed in ways that precluded spacious roads for cars in the inner city. The current situation is very different. As a result, car use must be substituted with other means that are environmentally-friendly and consume less space and energy.

6.2.2. Principles of technical design for public transport

From an urban planning perspective, a widespread change in attitude is needed that values life, together with increased attention to sustainable transport.

To achieve this:

- Transport policies have to be directed by urban planning strategies.
- Data should be analysed about the trips of all citizens. In urban areas, many trips involve walking entirely or walking-based trips (e.g., public transport trips start and end with walking). Quality data must also be available.
- Accessibility to all in the whole area should be the declared aim. This includes giving access to all transport modes for people with limited mobility and accepting that public transport is a service for all during all hours.
- The maximum accepted traffic volume should be defined, not in terms of physical capacity but in terms of environmental capacity.

- Data on pedestrians and other sustainable transport modes, should be included in all road and street projects.

- Streets with a maximum speed of 50 km/h (or higher) and used by pedestrians should offer genuinely safe crossing opportunities for pedestrians, at least every 100 metres.

- Buses should have priority at all traffic lights; green wave progression should be provided for buses using bus detection systems.

- Local streets should not have more than two lanes.

- The maximum acceptable walking distance to a public transport stop should be 300-500 metres;

- In small and medium –sized cities there should be no more than one transfer needed to reach a destination by public transport.

6.2.3. Parking policy – Mobility management

It is well-accepted that managing parking is a very effective tool for managing traffic. Another important tool is the reduction of road capacity for cars.

This is indirectly achieved through the widening of footpaths and the creation of bicycle, bus and tram lanes. A central area, an area with environmental issues or an area well-served by public transport could be relieved of cars with the concurrent implementation of two policies; strengthening public transport accessibility and implementing restrictions for cars, particularly for parking. It is important that these restrictions not only be applied to an area itself, but also to all connecting arteries from the neighbouring zones. The creation of conditions for easier, safer and more pleasant walking can occur by widening footpaths and increasing the duration of the green signal for pedestrians at crossings (Langlois et al. 1997).

Under such a policy, car circulation will be affected. On the one hand, increasing pedestrian crossing times restricts road capacity and, on the other hand, widening the footpaths limits the number of traffic lanes or eliminates road-side parking. Where the road is very narrow, as is typical in the historic centres, the principal solution is to abolish parking, which supports public transport in areas served by train stations.

Parking policies also influence whether the car user will walk. If, for example, the parking facilities for the city were not located at its heart but, rather, its perimeter, as is the correct way, then the car user will, in fact, visit the centre on foot or by public transport, according to the spatial layout of the centre. It naturally follows that in centres rich in wide pavements, with restricted parking and few cars, walking will dominate. In residential areas, the farther away the parking facilities, the less the car is chosen. In the suburbs, one parks at one's home, but this is not true of the city centre where buildings are usually older and do not always have parking places provided. Parking planning usually provides privileges to residents of the centre, which conflicts with the prospect of centres being no longer dominated by cars.

6.2.4. Car sharing and car pooling

In recent years some cities have developed two solutions - car pooling and car sharing. Both solutions are based on the more intensive utilisation of fewer cars, thus relieving the road network of traffic and parked cars. Car pooling seeks to increase the occupancy of vehicles which today is well below 1.5, meaning that most private cars circulate with just their drivers. A series of incentives to achieve car pooling have been put into practice; they are commonly motivated by concerns about traffic organisation and infrastructure. Three examples of the former are a) specifying an area where entry is only allowed to cars carrying more than one person; b) permission to park at places of work granted to cars transporting more than one employee; c) provision of a specific lane in the arteries of entry into a city, exclusively for cars with more than one person. The enforcement of such policies is, of course, especially difficult and, moreover, their success depends on how efficiently the transport of employees from neighbouring areas is organised, either by companies with large numbers of employees or by a municipality.

Car sharing is an answer to the rising cost of owning a car. It offers the resident "collective ownership" of a fleet of different vehicles parked in specific places. Members of clubs/associations use one of the vehicles, when desired, on payment of flexible rental at low cost. It represents a solution for cities well equipped with public transport and bicycle lanes, cities where walking is pleasant and the collectively-owned car mainly offers the security of private mobility, only when really needed.

6.2.5. Urban tolls and walking

In recent decades, one method for reducing cars in city centres has been to introduce tolls on roads. Tolls have already been introduced in a few European cities with great success. According to many policy documents, it seems logical and equitable to ask car drivers to pay to compensate for the unwanted impacts of private car travel. Paying to park on the street also comes under the same rationale. While this measure is widespread in the centre of large cities, elsewhere, it has sometimes been met with serious opposition by those arguing that town centre is not a commodity, but a public space open to all, independently of their revenues. Another consequence is that simply reducing the traffic volume may increase vehicle speeds, which would have serious consequences for the pedestrian.

It should not be forgotten that the ultimate objective is to increase public space for sojourning and walking, and to build routes for the exclusive use of public transport and bicycles. This requires a major project of restructuring the road environment. In reality this undertaking will reduce traffic volume and the amount of space available for the car. However, financing will probably be difficult for a strategy of this scale, restructuring to improve road quality and decisively prioritise public transport, cycling and walking. The income from urban tolls may be sufficient to fund such improvements. Perhaps a unified policy with the clear aim of regenerating public space, using funds obtained from urban tolls, would be the most plausible. After all, a robust case can be made that reducing the traffic can help to reduce the impact it has on the whole of society, in terms of crashes, pollution, noise and urban aesthetics.

6.3. Urban space for non-motorised traffic and public transport

6.3.1. General principles

It is important to design urban space that considers pedestrians by promoting mobility, accessibility, safety and health. Different principles can be used to guide the design of urban environments. These principles include; Design for All, the 5 C's and the Sustainable Safety Principles (SWOV, 2006).

Design for All

Walking is an activity in which it is easy to partake, as it does not require any special education, licence or equipment. As social exclusion is unacceptable, society cannot afford to restrict or limit basic walking options. In accordance with this concept, the Design for All (D4A) principle is aimed at satisfying this fundamental human right.

The D4A principle considers the perspective of the users who have the most difficulty accessing and using the transport system. This subsequently caters for a greater proportion of public transport users and pedestrians (European Institute for Design and Ability, 2004). More specifically, the main groups of concern are children, elderly people, people with limited walking ability and those without driver's licence (Methorst, 2003).

The 5 Cs

In 1996 Gardner *et al.* published a report on the development of a pedestrian strategy for London. It was concluded that, in order to be pedestrian friendly, public space should comply with at least five requirements: it should be convivial, convenient, connected, conspicuous and comfortable.

- ***Convivial*** public space means that the design and facilities support a liveable environment for pedestrians. Being surrounded by others makes the public space safe and inviting for pedestrians.

- ***Convenient*** relates to whether or not the public space or facility accommodates pedestrian needs, such as the need to be both time efficient and the ability to provide a direct route to the pedestrians' destination. Convenience is a subjective term and can change over time. For example, infrastructure that was once viewed as being convenient and reducing travel time may not be meet today's standards of quality of life.

- ***Connected*** refers to connectivity of the infrastructure network that links trip origins to desired destinations, thus making it possible for persons to get where they want to go.

- ***Comfortable*** relates to the extent to which walking accommodates the competencies and abilities of all pedestrians. In objective terms comfort refers to the ability to use the facilities without straining one's self. In regards to subjective terms comfort is a state of mind, a feeling of usability without stress, uneasiness or pain.

- ***Conspicuous*** refers to the extent to which an object or facility is noticeable or eye-catching in regards to clear and legible routes, signs and information.

Sustainable safety principles

One of the most basic needs of pedestrians is safety, which can include the risk of falls as well as personal security. Traffic safety is not exactly the same as pedestrian safety and therefore there are safety principles that apply to pedestrians.

The original best available safety principles can be redefined with safety of pedestrians in mind as follows.

- **Functionality** concerns the usability of the public space for walking and sojourning. Pedestrians should be provided with a designated space, where they can walk and sojourn without being bothered or threatened by traffic or any other external dangers.

- **Homogeneity** of mass and/or speed and direction means that pedestrians should not be exposed to traffic that moves substantially faster than one can walk. For example, heavy vehicles should be separated from pedestrians. Furthermore, traffic speed should be very low at pedestrian crossings so that both the pedestrian and driver can take appropriate evasive action if required.

- **Predictability:** Pedestrian walkways should be self-explanatory, meaning that it should immediately be clear where one can walk and sojourn. Where the path leads should be easily identifiable enabling one to anticipate and cope with difficulties or threats. Individuals should also not be taken by surprise due to encountering vehicles.

- **Forgiveness:** Pedestrians need forgiving environments, which allow for mistakes in their walking direction or allow for mistakes by others in their environment. In traffic encounters mistakes made by the pedestrian or driver are less likely to result in collisions when vehicle speeds are low (i.e., 30 km/h or less). The risks of falling should be minimised, as should the risk of encountering moving traffic, or hard and sharp objects.

- **Awareness:** Drivers and riders of vehicles should be aware of the likely presence of pedestrians, and pedestrians should be aware of their responsibility to other road users as well as their rights;

The pedestrian environment should be designed and organised in such a way that specific risk groups are not exposed to risky situations that they cannot consistently handle.

6.3.2. Barrier-free design

Barrier-free design removes the physical barriers in the infrastructure and promotes mobility for all pedestrians, regardless of their level of functional ability. It is essential to cater for the mobility-impaired, but a barrier-free road and path network can benefit all pedestrians. Additional safety features for handicapped people are only necessary where there are safety concerns. The design intention should be to cater for all users (see D4A).

Barrier-free design requires well-defined footpaths that are sufficiently wide, free of obstacles and include safe street crossings. According to the current guidelines the urban space should incorporate the following features:

- **No steps**: Paths without steps are a basic condition for a barrier-free footpath network. Where for topographical reasons steps are helpful to those who can use them, an alternative path without steps should be offered, such as a ramp that includes minimal detours.

- **No obstacles**: Obstacles on footpaths are considerable barriers, for the visually-impaired as well as for people with impaired mobility and for those who use wheelchairs. The visually impaired rely on the kerb edges for orientation guidance and therefore kerbs should be kept free of obstacles.

- **Recognisability**: The visually-impaired are dependent on well recognisable path guidance cues. Therefore, optical (high-contrast), acoustic and tactile elements are necessary for basic orientation which can be used to provide advanced warning about dangerous places, road crossings and public transport stops. Guidance can be assisted by architectural edges (e.g. house walls or kerbs) or by special pavement treatments (e.g. textured paving, cobblestones, markings) that are tactile and clearly contrasted from the surrounding footpath layer. The edge of the road should be clearly distinguishable from the edge of the footpath and should include a tactile component. The visually-impaired can also benefit from acoustic and tactile features associated with traffic signals.

- **Path network**: A coherent path network of at least 2.5 metres in width is essential for barrier-free mobility, as this allows wheel chair users and pedestrians to interact without hindrance. Road junctions and street crossings should be easily visible and, where necessary, they should be equipped with traffic lights.

Accessibility

Most city centres include well-functioning pedestrian routes for walking and sojourning. The issue is whether or not pedestrians can easily access these areas. A well connected public transport system with defined routes leading the pedestrian directly and safely to their destination can assist with accessibility.

Comfort and Appearance

Pedestrian mobility is encouraged when designers consider the needs of pedestrians. It has been demonstrated that pedestrians who walk on less attractive pathways report walking greater distances than those who walk on well-designed footpaths.

According to the FHWA and ITE standards and guidelines, a minimum pavement width of 1.5 metres (5 feet) is recommended (Harkey and Zegeer, 2004), as this allows two people to pass comfortably or to walk side-by-side. Wider pavements should be installed near schools, at transit stops, in city centres, or anywhere where pedestrians are highly concentrated. However, for a barrier free design a minimum pavement width of 2.5 metres (8 feet) is recommended.

At intersections, pedestrian crossings should be elevated to the level of the pathways, to allow for a continuous footpath. In addition, pathways should be easily accessible to all pedestrians in accordance with D4A principles and with the infrastructure guidelines described above.

Footpaths should be regularly maintained to ensure they are not dangerous or slippery, in addition to free of obstacles. In countries with cold winters, it is important to clear and remove the snow, ice and salt or sand from the footpaths when necessary. In general, surfaces should be firm, stable, and slip-resistant in all circumstances. These considerations are particularly important for elderly people.

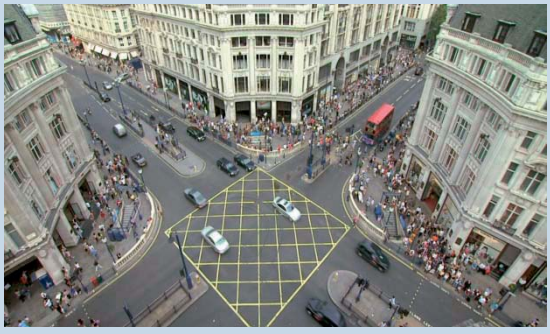
Box 6.6. **The transformation of Oxford Circus in London through a Diagonal Crossing Scheme.**

Oxford Street, in the centre of London, is a retail destination with over 200 million visitors each year. Prior to its transformation, including the introduction of the Diagonal Crossing Scheme, the environment was unpleasant for pedestrians: the footways were severely overcrowded due to high levels of shopping activities. The carriageway and footways were in poor condition; and there were significant delays along the busy public transport corridor; contributing to overcrowding around bus stops. The GBP 5 million project launched in November 2009 by Transport for London and the local highway authority in partnership with the private sector aimed at:

- Delivering an innovative Public Realm Enhancement scheme at Oxford Circus to reduce overcrowding and improve the pedestrian experience in the area.
- Improving the 200,000 pedestrian movements at Oxford Circus each day by increasing pedestrian flow capacity across the junction and by widening footways and pedestrian crossings.
- Transforming the pedestrian experience, revitalising retail and ensuring that by the 2012 Olympic Games, the West End maintains its position as a world class shopping district.
- Minimising the impact on traffic and bus journey times and reliability through the junction.

The concept of the Diagonal Crossing was to allow shoppers to cross diagonally and to almost double free pavement space and radically cut pedestrian congestion.

Although it is still too early to fully assess the impact of the project, preliminary ex-post evaluation has shown positive results in terms of reducing pedestrian congestion, collision rate and public transport journey time.



Before

After

Source: Transport for London.

6.3.3. Public Transport

Access

The efficiency of the local public transport is directly related to the number of people that use the transport system. Public transport routes should allow the connectivity between significant destinations so that they can be reached comfortably and safely. In built-up areas bus stops should be within 300-500 metres of pedestrian areas and railway stops should be within 1000 metres. All public transport stops should be accessible on a coherent path network. Clear marking and sign-posting will assist pedestrians to locate public transport stops easily.

Safe and barrier-free street crossings are necessary for access to waiting areas and should be clearly recognisable during both day and night. In addition, non-signalised crossings should be located behind the stopping bus or tram, to allow pedestrians to see, and be seen by oncoming traffic. Signalised crossings may need to be positioned at public transport stops to avoid passengers crossing at red lights after stepping out of the bus or tram.

Interchange Points

Every car trip, bicycle and motorbike ride begins and ends with a walk to and from the parking site. Therefore car parks and places for leaving motorcycles and bicycles should be accessible by safe footpaths and crossings.

6.3.4. Pedestrian crossings

Traffic Control

The purpose of an intelligent city-wide traffic control system should be to limit dangerous interactions between pedestrians and road traffic. Particular attention should be given to reducing both traffic volume (by re-routing traffic) and traffic speed, especially in areas with high pedestrian volumes such as schools. Pedestrian-friendly traffic lights are required, with average waiting times of no longer than 40 seconds. It is beneficial to forbid traffic from turning when the pedestrian light is green. Pedestrian traffic lights with push-buttons (like pelican crossings) should give right-of-way to pedestrians within a few seconds.

When designing a pedestrian crossing controlled by a traffic light, careful consideration should be given to the time allocated for pedestrians. Very often these are designed assuming a walking speed of 1.2 metre per second. This can be challenging for some pedestrians. A walking speed of 1 metre per second or less is preferred, as it allows pedestrians walking more slowly to cross at their own pace (e.g. young children, older adults or people with mobility impairments).

Visibility and Conspicuity

Although fewer pedestrians, in general, walk after dark, the risk of a vehicle colliding with a pedestrian at night is 5-7 times higher than during the day (Sullivan and Flannagan, 2007). Thus, the road pavement and crossings should be lit sufficiently to ensure adequate pedestrian visibility at night, and additional specialist lighting may be necessary if it is not already available from the existing infrastructure (see Figure 6.5).

Another source of danger for pedestrians is obscuration by parked cars, billboards or trees. To avoid visibility problems, kerb extensions should be built. Kerb extensions improve sight lines and prevent motorists from parking on or too close to a crosswalk. Kerb extensions have the added benefit of reducing the crossing distance for pedestrians.

Figure 6.5. **Light-band lamps**

Source: *Picture by Franz Luisi.*

Crossing width, number of lanes and crossing time

To increase pedestrian safety, the width of crossings can either be minimised, or crossings can be divided into sections. In this way pedestrians have less oncoming traffic to consider, making the task of selecting an appropriate gap easier. Minimising crossing width can occur with the help of kerb extensions, as described above. Kerb extensions significantly improve pedestrian crossings by reducing the pedestrian crossing distance, visually and physically narrowing the roadway and reducing the time that pedestrians spend on the carriageway.

Crossing islands, consisting of a raised island in the centre of the road, may be used to shorten crossing sections on wider roads, providing a refuge for pedestrians. Central crossing islands allow pedestrians to deal with one direction of traffic at a time, and enable them to stop part-way across the street to wait for an adequate gap in traffic before completing their crossing. It has been demonstrated that crossing islands radically decrease pedestrian road crossing crashes, due to fewer conflicts, reduced vehicle speeds approaching the island, greater crossing conspicuity and shorter exposure time for pedestrians (Stefan *et al.,* 2007).

Due to previous planning philosophies focused on vehicles some roads have multiple lanes making it difficult for pedestrians to cross because of their width. Furthermore, pedestrians on the roadway may be masked by cars in adjacent lanes. Reducing the number of lanes on a multi-lane roadway can reduce crossing distances for pedestrians and may reduce vehicle speeds. A reduction of the number of lanes is able to provide more space for pedestrians, bicyclists and parked cars, reduces crossing times and improves the social interaction and neighbourhood feel along the street.

6.3.5. Shared space

Shared Space is a philosophy of urban road design developed in the Netherlands, with the main benefits being a substantial improvement in the spatial quality of neighbourhoods. The concept replaces traffic regulations with informal social-minded rules. In particular, traffic signs and traffic lights are

removed to allow people to settle potential conflicts by eye contact. Traffic in these areas is regarded as a guest and the layout should clearly indicate that the primary function of the area is residential.

This approach is expected to result in lower driving speeds and improved road safety, although the latter has not yet been conclusively proven for each example in real use.

Several cities have experimented this concept and impact monitoring will be useful in fully assessing its benefits and possible undesired effects.

6.3.6. Conclusions

It is crucial for pedestrian mobility that urban areas are designed in a coherent manner, are barrier-free, safe and comfortable. It is important that urban areas contain continuous footpaths of adequate widths along main roads, and along residential roads or through-traffic calming zones. Junctions and street crossings should be clearly visible and should consider the special needs of vulnerable pedestrians who are mobility-impaired, elderly or young. If necessary, footpaths crossing vehicular traffic should be provided with suitable measures such as traffic lights. It is important to integrate the pedestrian network with other transport modes, such as public transport, cyclists and motorists.

6.4. Incentives to promote walking

There are numerous advantages associated with promoting walking within current societies, which surround the notion of sustainable living. These include benefits to the environment, society and general health. According to the International Charter for Walking (2006), the presence of pedestrians on streets provides a key indicator of a healthy, efficient, socially inclusive and sustainable community. Within developed societies throughout the world, however, people are facing a series of inter-related problems associated with poor health and the use of ineffective transport systems, with an increasing pressure on society to address these issues (International Charter for Walking, 2006). Knowledge of the current situation has fuelled the need for a change in walking culture within our societies. While promotion of walking requires concerted action in a number of domains including policy, infrastructure, education and promotion, the role that incentives can play in increasing pedestrian activity needs to be explored, understood and highlighted.

6.4.1. Incentives associated with increased pedestrian activity

There is a series of incentives associated with promoting walking that can, in turn, aid a change in current walking culture in more developed societies.

The workplace is an especially fertile area where incentives may play an influential role with walking promotion. The employer has an overall invested interest in their staff being active and healthy, leading to reduced sickness and work down-time, as well as improved productivity.

In this setting, a number of options are available to encourage greater levels of walking being incorporated into the daily lives of company staff. They include:

- Introduce reminder software programmes that can gently remind employees at the computer to stop and take a break, stretch, or take a walk at lunch-time.

- Sponsor employees to participate in sporting events like runs, walk-a-thons and triathlons; these events not only promote physical activity but teach goal-setting and self-monitoring, while offering a friendly and supportive environment to enhance physical activity and promote

behaviour change; participating in scheduled training sessions leading up to an event can also prevent relapses into sedentary behaviour from occurring as well as boost team confidence.

- Provide public transport tickets for staff at reduced prices in order to encourage active trips in preference to private motorised transport.
- Provide maps to employees that mark out safe and interesting routes to get to work by walking.
- Link "employee of the month" schemes to the value of making walking part of the work routine.

Box 6.7. **The 10 000 step challenge in Australia**

The 10 000 step challenge is one health promotion programme administered in Australia that encourages people to walk 10 000 steps a day; each person is required to wear a pedometer and participate as part of a team to reach a combined target number of steps based on a specific destination. The workplace challenge co-ordinator is responsible for setting the challenge and providing incentives, such as mouse pads and pens to reward teams that achieve their goals. Participants are also offered tips on how to achieve 10 000 steps a day such as parking further away from their workplace and walking to speak to a work colleague rather than emailing.

Within school settings also, the opportunity exists to encourage increased levels of walking by students and their parents in safe, local environments. Opportunities include:

- Promote "Walk to School Days" in which parents are actively encouraged to join their child in walking to school and to help break the reliance on motorised transport; a morning tea for parents and spot prizes for children could help build levels of participation.
- Introduce the idea of the "Walking School Bus" in which nominated parents chaperone a number of children to school via safe routes on a rotational basis. Children are motivated by the social aspects of the journey and participants can be rewarded by stickers and the like at school. In Australia, the collaborative efforts of Monash University Accident Research Centre (MUARC) and Alfred Health – Caulfield Community Health Service (CCHS) has resulted in the design of a star rating tool that can be used to promote, as well as assist the journey of children walking to and from school (Corben *et al.,* 2008).
- Introduce "fun walks" for charity in which children are supervised during longer walks in the neighbourhood and sponsors support them on a per-distance travelled basis.

6.4.2. Summary

In summary, there is a need to change the culture of walking. It will require a concerted and sustained approach within multiple settings. Carefully thought out incentives can play a strong supportive role – especially in environments where groups are managed and influenced by incentives that support the goals of those groups. In workplace settings, the employer is interested in having healthy and active employees while within schools, a key educational objective is to instil in young people the need to live healthy and active lives. Active promotion of incentive ideas to management in each of these settings is a most worthwhile endeavour.

6.5. Speed management

6.5.1. Vehicle speed: A major problem for pedestrians

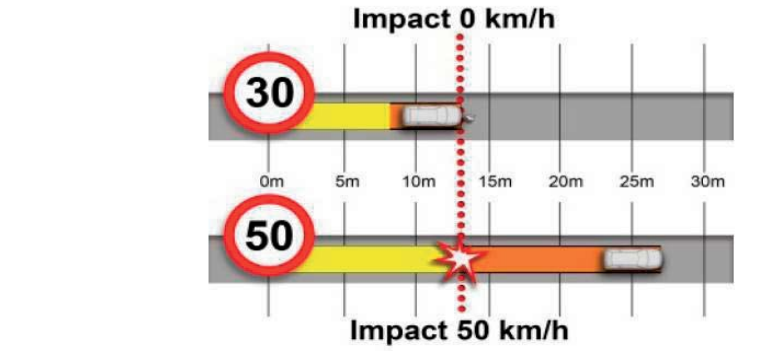
The impact of speed on pedestrian safety

It is well established that excessive speed (i.e. driving above the speed limit) or inappropriate speed (driving too fast for the prevailing conditions, but within the speed limit) is a determining factor of road safety.

Speed moderation is essential to reduce the occurrence and severity of pedestrian crashes

Naturally, when drivers drive at a slow speed, they are more able to attend to stimuli in the environment, for example, a pedestrian who intends to cross the road in front of the driver. At a slower speed the stopping distance becomes shorter (when the driver slows down from 50km/h to 30km/h it is divided by two – See Figure 6.6), and therefore this allows the driver to avoid a collision or to decrease the severity of injury in the event of a collision.

Figure 6.6. **Stopping distances at different travel speeds**



As discussed in section 5.2, it is generally agreed that the probability of pedestrian death rises sharply when the driver collides with the pedestrian at speeds in excess of 30 km/h. In addition, a pedestrian is 5 times more likely to be killed at an impact speed of 50 km/h than at 30 km/h.

The limits of physical resistance of a human cannot be ignored, and these limits need to be considered in the development of laws, regulations and the arrangement of infrastructure in order to ensure that 30 km/h zones are placed in urban areas. Several studies (for example, Webster and Mackie (1996), show a significant decrease in both the number of crashes and their severity following the introduction of 30km/h speed zones on a large scale.

Speed impact on every day quality of life in open public spaces

In addition to the many safety benefits, speed moderation can also bring a number of additional benefits, including a reduction in environmental pollution and noise (as a result of quieter and smoother driving, limiting thus the phases of braking and acceleration), driver aggression, surrounding stress, urban severance and loss of vitality of urban centres.

Consequently, lower speed in urban areas allows:

- A restoration of an interactive environment where drivers and pedestrians give-way to each other, to modify social relationships and to reintroduce respect and communication between roads users. For example, a driver will be more likely to give-way to a pedestrian who is about to cross.

- Equality between all road users by facilitating their interaction. At 30 km/h, cyclists can be integrated into the general traffic (the difference of speeds being small) and below 20 km/h, it is possible to allow the interaction of all the users in the same space (meeting zones or pedestrian areas could assist in these areas). At lower speeds, motorists are not excluded but are encouraged to circulate slowly, calmly and quietly.

- The creation of a more pleasant environment that promotes effective use of the streets by their inhabitants.

Although speed reduction is not looked upon favourably by some drivers, it is important to emphasise that speed reduction in urban areas does not increase travel times greatly and need not increase traffic congestion (OECD/ECMT, 2006).

6.5.2. Speed management measures

The implementation of speed reduction initiatives should act simultaneously on the road infrastructure, the road user and the vehicle.

It is possible to modify the infrastructure by arranging the roads and implementing appropriate speed limits. Compliance with speed limits can be achieved via education, communication, fines and penalties. In-vehicle technologies can also work to encourage speed limit compliance. However, although it is an important element of achieving a successful and walkable city, a speed management policy, alone, does not solve all pedestrian problems.

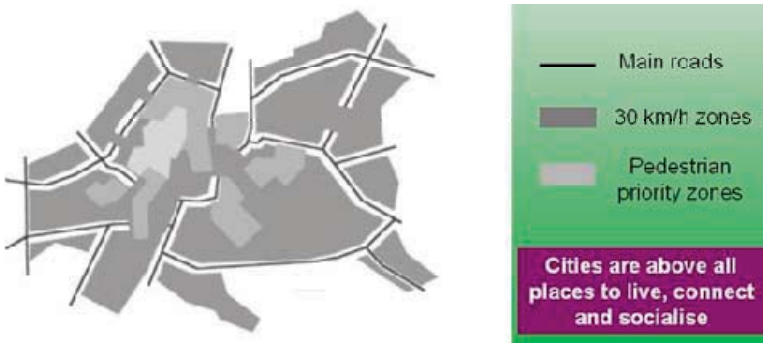
Road infrastructure measures

Road network hierarchy

Before designing a road network it is important to organise it into a hierarchy of roads (see figure 6.7), where each street differs according to its mobility functions as well as the number of road users.

In accordance with the road design approaches in several European countries, all streets are now designed as “slow speed zones” with the exception of main roads.

Figure 6.7. **Road network hierarchy and appropriate speeds**



The primary function of a "main road" is to provide a thoroughfare from one destination to the next. Main roads are for example large arteries and boulevards. Typically, main roads do not represent more than 20% of the urban road network. The posted speed limit on main roads should not exceed 50 km/h (this may be 70 km/h in some sections with high safety standards incorporated into the road and roadside infrastructure).

"Slow speed zones" comprise the majority of roads and streets. Slow speed zones are typically designated "30 km/h zones". However in some specific areas where pedestrian activity is very important and where priority is given to pedestrians, speed limits may be even more limited comprising of 20 km/h or 10 km/h speed zones. Slow speed zones can occur in areas such as "meeting zones", "residential areas", "woonerfs", and "pedestrian areas" (see figures 6.8, 6.9 and 6.10).

Figure 6.8., 6.9. and 6.10. **Woonerfs (Netherlands), Meeting zone (Switzerland) and pedestrian area (France)**

Generalized 30 km/h zones

The idea of assigning a 30 km/h speed zone to major parts of the urban road network is not new. This concept has been adopted for some time in certain European cities.

This has been the case in Freiburg-in-Brisgau, Germany, since 1990, as well as in Graz, Austria, since 1992, and Zurich in Switzerland, since 1999 (see figure 6.11.). More recently, it is also the case in The Hague, the Netherlands and in Stockholm, Sweden.

In France this concept has recently been adopted, for example in Lorient and in Paris, where "green districts" (based on zones 30) have been installed. In smaller communities like Lezennes where the inhabitants live close to Lille, the traffic has been diverted away from the town centre, which functions with a 30 km/h speed limit.

The implementation of 30 km/h zones in city centres and in all residential areas has proved to be highly effective. It is therefore crucial that this concept continues to be promoted so that *communities can reap the benefits for pedestrians, the users of the urban public space and, more generally, the residents of cities.*

Street and urban space design

The various techniques used to control speed including road and urban design features are well known. The techniques are managed by two principles: to convince and to enforce drivers to slow down.

Several countermeasures can be implemented to achieve this, including:

- Techniques used to structure the urban space, such as installing treatments in successive sequences or installing perceptual countermeasures; (low cost treatments designed to reduce drivers' travel speeds by altering their perception of speed, risk or comfort).
- Installing horizontal deflections, such as lane markings, traffic islands, road narrowing, and roundabouts.
- Installing vertical defections, such as roads humps, speed cushions, and raised junctions.
- Environmental components which underline or reinforce the urban appearance and character of the area, such as street furniture, vegetation, paving, treatment of frontages, architecture and street lighting.

Figure 6.11. **Examples of large-scale 30 km/h zones**

Graz in Austria (240 000 inhabitants)	 *Source:* Certu.	The entire town is limited to 30 km/h (except for arterial roads which are limited to 50km/h). The town implemented and piloted the zones in 1992, and the concept was adopted in 1994. There are virtually no changes in physical layout; speed management is primarily achieved via methods of communication. Following implementation of the speed zones, crashes were reduced by 30% and the numbers of seriously injured persons were reduced by 37%.

Zurich in Switzerland (340 000 inhabitants)	 *Source*: Catia Rennesson.	In 1999, Zurich introduced seventy 30km/h speed zones over the period of one year. Currently, all the districts have posted speed limits of 30km/h. The entrance to the speed zone is clearly marked, and speed reduction devices are found within the zones. Information and surveillance of speeds are the other keys to the success. The community quickly accepted and respected the new speed limits, which contributed to a 40% reduction in crashes.

Two approaches may be distinguished:

- A "*low cost approach"* that consists of implementing traffic calming devices that is efficient but not too expensive. For example: street narrowing by providing parking on alternate sides of the road, speed cushions, and installing priority lanes on the nearside at road junctions. This low cost approach makes it possible to treat wide areas and is often utilised in residential areas.

- A *"quality enhancement approach"* refers to an approach that considers the overall design of the urban environment. It is costly because it involves implementing speed reduction countermeasures in the town centres, the commercial areas or the historical districts. It aims to give pedestrians priority in these areas and sends a message to drivers that they are only a "guest" in the area. . Including these features from the beginning is a much more cost-effective strategy.

6.5.3. Road user behaviour

Educating the public and the policy makers about the problem of speeding

Education, training and information programmes should include information about why driver speed is a significant road safety issue. These programmes should include information about the efficacy of speed management measures and highlight the positive safety benefits of reducing speed.

Driver speed and its consequences concern the entire population, and therefore education programmes should target all age groups (from children to elderly people) as well as all roads users (including drivers and pedestrians). The educational message provided will differ according to the age of the individual, the type of road user and the culture of the country.

Licensed drivers form the largest target group, but they are very difficult to reach, and it is challenging to change driver behaviour. Countries generally rely on information campaigns, such as placing information on billboards by the side of the road or advertising the messages on television commercials (see figure 6.12). Information campaigns can be effective when used in combination with other speed reduction measures, but they have a minimal effect if applied as stand-alone measures. In summary, the production and dissemination of information should be a continuous activity.

Figure 6.12. **Public awareness campaigns accompanied the large-scale implementation of 30km/h zones in 1992 and since then are repeated on an annual basis (City of Graz)**

Speed displays (Figure 6.13.) that inform the driver of their current speed can serve to encourage self-regulation of speed and can be considered an educational tool. Car manufacturers can play an influential role in promoting appropriate road safety behaviour. It is important that advertisements for cars do not glamorise speed, as is often still the case. Governments should encourage manufacturers to replace the emphasis on speed with positive messages about the benefits of vehicle features including technologies that can improve driving comfort, functionality and, in turn, enhance road safety.

Figure 6.13. **Speed displays**

Speed control

Traditional methods of police enforcement have involved automated speed control devices, which include the use of fixed and mobile cameras, as well as the administration of penalties. Speed cameras and penalties are more effective at reducing driver speed when implemented together rather than alone.

Evidence from speed reduction efforts has shown that:

- Enforcement should include all road users (including foreign drivers) and all types of vehicles (*e.g.* motorcycles and trucks).
- In the case of automatic enforcement (as illustrated in Figure 6.14), better results are obtained when the vehicle owner, who is easier to identify than the driver, is legally responsible for the violation.
- The fact that speed enforcement can be random is a major determinant of a driver's subjective assessment of risk. An "anywhere anytime" enforcement programme (including mobile radars) could be expected to have more wide ranging effects, especially when implemented with an extensive publicity campaign.

- Communication about the importance of law enforcement and about the use of the money from the fines (*e.g.*, reinvestment in road safety initiatives) is important for gaining social acceptance.

- Retrospectively, automatic speed control devices are cost effective and can have a widespread safety impact that occurs not only just at the site of the speed camera. However, a successful large-scale automatic speed camera operation should be administered with the provision of adequate information to the media, the relevant interest groups and the general public.

In addition, point-to-point enforcement seems to be an effective means to reduce speed. Point-to-point speed cameras calculate the time it takes the vehicle to travel between two points and then determines the average speed on a section of road. This enforcement method has been implemented in certain European countries, and is being piloted in others. In London similar devices are being tested to control for speeding in 20 mph (32 km/h) speed zones.

Figure 6.14. **Automatic surveillance in Paris (France)**

Source: CERTU.

6.5.4. Vehicle technology

Drive assist and vehicle speed control technologies

A number of vehicles are manufactured to travel at speeds greater than 150km/h. If, at some stage, all vehicles had a maximum speed limit that was similar to the maximum posted speed limit this would not necessarily solve all the speed problems. For example, this would have little effect on speed in urban areas, which require complying with speed limits of 50 and 30 km/h.

A step forward in speed management in urban areas could occur as new technologies become progressively available. At present, Intelligent Speed Adaptation (ISA) applications are being actively researched and tested in many countries.

With ISA technology, the vehicle "knows" the local speed limit and is capable of using that information to either give feedback to the driver, or to automatically limit vehicle speed.

Two broad ISA categories are being assessed for possible wider deployment:

- Informative (advisory) ISA, which principally displays the speed limit and warns (via an audible or visual display) the drivers when they drive above the speed limit.

- Supportive (intervening) ISA provides information on the speed limit to the driver and is directly linked to the vehicle speed control system. Both systems can be set voluntarily (if the driver chooses to activate it) or can be made mandatory (when the system is activated all the time). Whatever system is chosen, the driver always has the ability to override it in emergency situations.

ISA can be based on navigation devices or on roadside posts. Until now, ISA has been based on navigation devices and has been considered as one of the best solutions for covering large areas, both nationally and internationally. It is also less expensive for the road authorities. The problem of updating the data is nevertheless crucial.

6.5.5. Conclusions

Lowering the traffic speed can result in a reduction of the frequency and severity of pedestrian collisions, which means that speed moderation is both highly effective and a cost effective means for improving pedestrian safety. Reducing speed can also contribute to better air quality, more efficient energy use, smoother traffic flow and, overall, enhances the liveability and sustainability of cities.

In urban areas, 30 km/h zones should be incorporated in to the majority of streets, with only a few main roads remaining at a posted speed limit of 50 km/h. Moreover in areas where pedestrian activity is important and where it is necessary to give priority to pedestrians, a reduction of the speed limit to 20 km/h or less should be considered. In order to effectively introduce lower speed limits into high pedestrian areas, the following designs could be considered; “meeting zones” “residential areas”, “woonerfs”, and “pedestrian areas”.

The choice of the speed limit should be based on the functionality of the streets and urban roads, and be supported by appropriate infrastructure design. This would then help to create low risk and enjoyable urban environments for all, especially for unprotected road users.

To be effective, road infrastructure measures should be supported by education and communication as well as speed enforcement programmes. Automatic speed cameras place the onus and responsibility on the driver to maintain the appropriate speed and can be effective enforcement devices. Furthermore, the installation of point-to-point speed cameras should also be encouraged on road sections as well as inside slow zones areas.

Finally, given the great potential benefits that new technologies can provide, the progressive implementation of speed reduction technology is encouraged in both new and existing vehicles. For example, all new cars could be equipped with manually adjustable speed limiters. The benefits of voluntary informative or supportive Intelligent Speed Adaptation (ISA) systems are becoming evident and further studies are required to investigate their efficacy and the scope for their widespread voluntary adoption ahead of any possible mandatory requirement to use them.

6.6. Education and communication

High quality education programmes in schools and within local communities are useful to promote the benefits of walking and encourage safe road user behaviour through a range of communication methods.

Communication on walking and education about walking are needed to increase the number of people who walk safely in urban space. The benefits of walking, whether they are for utilitarian or for recreational purposes, can be expressed in terms of improved environmental and personal health, reduced traffic congestion, enhanced quality of life, and can also benefit the economy.

6.6.1. Educating pedestrians

Elderly pedestrians

Elderly pedestrians are the most vulnerable age group for being involved in a crash due to their on-road exposure and frailty. Interventions that promote physical activity, that aim to balance training and exercise, are effective in lowering the risk of falls and fall-related injuries in selected groups of older people. Older pedestrians can be educated about the role of physical wellbeing and mobility in pedestrian safety, and the benefits of walking for general health. Informative campaigns are successful in teaching adults but are not necessarily useful for transferring knowledge into practice. Therefore, practical training interventions could address aspects of pedestrian behaviour and should be designed with the intent to modify behaviour in the road environment with lasting effects (Dunbar *et al*., 2004).

Educating children

The new focus on sustainable development and on reducing health problems such as obesity motivates countries to promote non-polluting and active travel modes. Walking and safe walking behaviour should therefore be promoted in childhood.

Get children back in the streets

Pedestrian mobility among children has decreased in a lot of countries in the past 20 years. Children now are autonomous as pedestrian from the first year of secondary school (between 11 and 12 years old) instead of 7-8 years old in the 1970's (Hillman *et al*., 1997) and their experiences of traffic are therefore often limited (Demetre, 1997). These elements could explain a new peak in pedestrian crashes that has increased in developed countries over the past 20 years that coincides with children becoming autonomous in their walking.

Many countries develop interventions with the aim of improving traffic safety by changing mobility patterns and reducing the use of motor vehicles. For example, "walking buses" to and from school have been developed all around the world (see figure 6.15). The walking school bus follows a pre-determined route to school in which a group of children gather at a scheduled meeting point and are supervised by adults as they walk to school together. This practice increases the number of children travelling to and from school by foot. Walking permits the children to become familiar with their environment and to feel they belong to a neighbourhood. It also plays a role in children's' socialisation, autonomy and visio-spatial awareness. For example, the project "La citta dei bambini", while promoting children from six to eleven years old to walk without an adult, recommends children be viewed as the reference standard against which the safety and mobility needs of all citizens are compared and judged. It is important to consider any fears expressed by families with respect to their children's safety and to create favourable environments to assist with rebuilding social acceptance around safe walking.

Figure 6.15. **Pedibus « Walk to school », in Sisteron, France**

Figure 6.16. **Leaflet of "I go to school alone" from School in Pesaro (blue), and Gabicce (pink), Italy**

Pedestrian education programmes – Content and methodology

Pedestrians require a range of fundamental skills in order to interact safely with traffic. Previous research has identified four core generic pedestrian skills that should be included in training programmes (Thomson *et al*., 1996). The core skills can be integrated into sequential and progressive modules (Tolmie *et al*., 2001).

Children must be able to: 1) perceive the dangers posed by topological features of the traffic environment, 2) develop attention to the more dynamic features of the environment, especially vehicle movements 3) relate information about vehicle movements to their own potential actions in judging whether gaps between vehicles are large enough to cross safely, 4) develop sensitivity to cues, signalling the intentions of other road users, and how this should inform and influence their own intended actions. Pedestrian education programmes should be developed, with formal content based on these skills. Furthermore, these skills are involved in all modes of travel.

Sequences of modules over a long period of time are more effective than administering single interventions. Practical training, where children learn from experiences in relevant contexts (as illustrated in figure 6.17), could be used from the age of four years and is far more effective than mere knowledge transfer (Thomson *et al*., 1996). Realistic settings, such as protected roadsides or realistic simulations, with several real modes of traffic should be encouraged. Furthermore, two forms of teaching methods

seem to be central for this kind of learning including: 1) peer collaboration which improves the contextual application of the skills learnt and 2) adult guidance which improves understanding of procedures (Thomson *et al*., 1998b).

Figure 6.17. **Children practice crossing in a simulated setting at College Gardens Elementary School, Rockville, Maryland, United States**

Educating pedestrians' partners

Simply being a pedestrian is not sufficient to teach effective safe pedestrian behaviour. Road safety education should be integrated into the education and training of all teachers and police officers who are involved with pedestrian education (Weber, 2005). It is also important to involve parents in actions and to make them aware of their own pedestrian behaviour, to increase their awareness of their child's abilities and to act as important role models for their children. Furthermore, parents could be involved as trainers to achieve low adult-child teaching ratios and to combine an effective training method with cost effectiveness. Nevertheless, parents, like all other educators, require training to help children to be educated properly (Thomson *et al*., 1998a). Professionals should be informed about ways to reintegrate pedestrians into the cities and should receive continuous training about how pedestrians can benefit from urban and road installations (Transport Québec, 2009). Reducing speed at pedestrian crossings should be encouraged and promoted. Drivers can also be educated about give way rules and the presence of appropriate signs, which can also improve driver compliance. Drivers could also be informed about the limitations of children and older adults' behaviour in traffic.

Figure 6.18. **1998 Media campaign from French Prévention Routière: "Don't depend on her to accelerate: slow down!", "Give back to pedestrians what belongs to pedestrians", "Depend on children to surprise you: slow down!"**

6.6.2. Communication tools and personnel

Walking should be promoted as a way of life, to enhance the value of walking as a transport mode for daily trips (employees, scholars), utilitarian trips (shopping) and leisure trips (culture, sports), in addition to encouraging inhabitants to discover their town as a pedestrian.

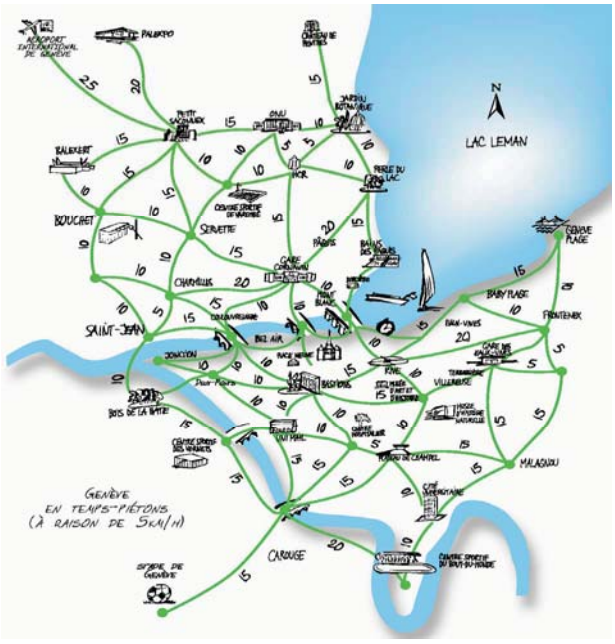
Key personnel, such as family doctors, school teachers, retailers and businesses have an influential role to play by promoting walking. Central administrations and public sector staff can play a key role in visibly reinforcing the need to undertake physical activities such as walking. For example, in Norway, the Working Environment Act directs Norwegian employers to encourage employees to be more physically active. Educational institutions can play a role as well by establishing transport plans for schools that encourage walking.

Media can be a useful communication tool as they have an important role in contributing to the diffusion of messages on walking. Blogs and websites displayed at key activity hubs can help inform walkers of issues of interest, allowing them to contribute to the forum of ideas and help to establish a pedestrian identity.

6.6.3. Communication in the cities

Pedestrians can benefit from knowing their approximate distance from a certain destination as well as the time it will take for them to walk there. Some cities (such as Geneva[3] as illustrated in Figure 6.19, Liège and Tempe) have constructed city maps with walking times and distances marked between principal locations within the city centre (COOPARCH -R.U. and CITEC Ingénieurs Conseils, 2004). Walking maps can be developed around a broad range of themes and topics, capitalising on the community interest in the environment, arts, education, tourism as well as activities for children and families. For example, maps can be produced that promote cultural heritage walks – taking in fine examples of architecture, cultural and historic sites, parks and museums.

Figure 6.19. **Walking map of Geneva, Switzerland**



Additional tools for promoting walking that are starting to receive attention include measures that assess the walkability of routes and the walkability of cities [Pedestrian and Bicycle Information Center (PBIC), 2007]. While of interest to individual citizens, their value may well lie ultimately in the leverage they can gain within key decision-making bodies to drive changes favourable to pedestrian mobility.

A pedestrian sign (as illustrated in Figure 6.20) may serve an educational purpose as well as provide directions and can display a lot more detail than is possible with a sign directed at motorists or bicyclists. The signs usually provide directions or display maps but they can also indicate off-street routes, and links with public transport or tourist areas (AIG London, 2006, Farrell, 2007).

Figure 6.20. **Urban way-finding sign in Washington Region (USA)**

Communication for pedestrians is not sufficient if there are no tools provided to encourage pedestrians to walk in a safe environment in the cities. Educational, awareness and behaviour change programmes are vital to the success of improving pedestrian safe mobility, particularly to increase the adoption of safe walking practices.

6.6.4. Conclusion

The increasing numbers of people who walk in urban areas require adequate communication and education about the walking environment to walk safely. The introduction of high quality education programmes both within schools and within local communities should be encouraged to learn and retrain safe road user behaviour across the life span. Employers of pedestrians in the cities should be involved and trained to take pedestrians needs into account and to promote safe walking. Effective forms of communication in cities and media should be developed to promote the benefits of walking and encourage safe road user behaviour.

6.7. Legislation and traffic codes

6.7.1. Need for a critical overview of the current national traffic rules

Although by the end of the 1950s the most progressive cities had begun to acknowledge pedestrians as legitimate participants in the traffic system, there are still many cities where systematic consideration of pedestrian needs, convenience and safety are largely overlooked. The fundamental principle that must guide traffic rules is that *all road users regardless of age, physical capacity and mode of transport have the right to travel safely*.

Considering what already exists in ITF/OECD legislation (ITF/OECD, 2008), it would be helpful if pedestrians were given more priority in the legislation regarding public space as we notice that there is a general lack, with some exceptions, of definitions for pedestrians. For example, words like pedestrian, footpath or pedestrian crossing are often missing. If they are present, the definitions are not well defined; for example, the term pedestrian is often defined as a lack of a vehicle. This definition does not allow for consideration of the pedestrian's needs and safety.

As pedestrians have to walk in allocated spaces it is important that these spaces are pedestrian friendly. In the future, with the ageing population, one can expect to see the emergence of mobility scooters on footpaths; which will give more independence to elderly people. To avoid putting the pedestrian at risk the speed differential would need to be taken into account and kept as low as possible.

A critical overview of the current traffic rules could be very useful to edit or add rules and definitions that are specially made for the pedestrian. This approach has occurred or is in the process of occurring in some European countries. This process is called "Code de la rue" (Street code) and is particularly relevant to urban areas.

6.7.2. A search for equity

Pedestrians are vulnerable road-users. They are exposed to far more risks than they create through their presence in the public space, even in urban areas where we know from mobility data that they are not a minority. This is not equitable. To balance this inequity, a review of practices in some OECD countries proposes two solutions:

Precautionary principle applying to all road-users

All road-users have a responsibility towards the most vulnerable members; a truck driver towards a car driver or cyclist, a cyclist towards a pedestrian, or an adult towards a child. Therefore all road users must take particular care not to cause any harm or to increase the risk towards the most vulnerable road users, especially children, elderly people or persons with impaired mobility. This principle of responsibility could easily be integrated into the national traffic code of the ITF/OECD countries. This precautionary principle has been applied since the introduction of the Code de la rue in Belgium (2004) and France (2008) and is also foreseen in the Vienna Convention on Road Traffic:

- Drivers are not entitled to expose vulnerable road users, such as cyclists and pedestrians to danger. All drivers must be very careful when encountering these users in public spaces, particularly in built-up areas where they are expected to be situated (Article 7, Belgium).

- Drivers should demonstrate extra care in relation to the most vulnerable road-users such as pedestrians and cyclists and in particular children, elderly people and persons with impaired mobility (Article 7.3 of the Vienna Convention on Road Traffic).

Financial protection in the case of crashes

The risk posed by vulnerable road users themselves is extremely low compared with the risk they are at when exposed to motorised traffic. Therefore, if a pedestrian is injured in a road crash, the pedestrian should be compensated for costs resulting from the crash. Such a law may increase the awareness of driver responsibility and the risks associated with using a vehicle.

Some OECD countries already include such financial protection for crashes involving pedestrians.

- The "Loi Badinter" or Badinter Act was introduced in France under the Civil Code on July 5, 1985. It excludes liability from the indemnification process and provides an almost absolute obligation to indemnify for non-driver victims of a road crash. Therefore, in almost all cases, pedestrians are automatically compensated except where the cause of the crash was the inexcusable fault of the pedestrian. In such cases, compensation for the pedestrian can be limited or excluded.

- Since the mid 1980's liability in the Netherlands has been based on a reversed burden of proof. Children below the age of 14 years are not liable at all, except in the case of gross negligence. This is also true for the disabled people and older adults. In other cases there is a maximum of 50% liability. The reasoning is that driving a car increases the danger and risk posed to vulnerable road users.

6.7.3. Enacting rules to improve the comfort and safety of pedestrians

The national traffic codes are trying to reduce the number of dangerous situations on the road for vehicles, and should also try to implement similar rules for pedestrians. It is useful to look at in-depth analyses of pedestrian crashes to develop rules that reduce dangerous situations for pedestrians, and to develop standards or norms applying to street design.

Traffic rules to help drivers avoid dangerous situations

In some situations, pedestrians can be at risk due to the inappropriate actions of drivers. The traffic rules should highlight such situations in order to try to prevent them.

Some typical pedestrian crash types (Brenac and Yerpez, 1997, Dupriez and Houdmont, 2009) can be identified through in-depth analyses of crashes.

The two main types of driver problems are detection and anticipation when a pedestrian leaves or enters the footpath. A third crash type is one where the pedestrian is walking along the street, and a fourth type involves situations where injuries to pedestrians are "collateral damage". Modification of traffic rules should occur to help prevent these crash types from occurring.

Avoid pedestrians walking on the road

The footpath, when existing, should be accessible at any time and pedestrians should be able to walk on it for all of their trips. Parked cars or obstacles on the footpath, however, divert them towards walking on the road. This is difficult for some pedestrians due to their greater age and their physical limitations; therefore the footpath should be protected legally through the traffic rules against improper use, such as parking. The minimum width of a footpath is 1.5 metres, which allows two pedestrians to walk side by side. It also provides space for a person to walk beside a wheel chair. The footpath should also be kept clear of all obstacles.

Protecting pedestrians who need to walk in the carriageway

Sometimes, in areas without traffic-calming, there is no footpath and no other place to walk except on the road. Although this situation should be avoided as far as possible, it must be dealt with in the traffic rules. In addition, the speed differential between road user groups should be reduced so that when a pedestrian is encountered on the street, drivers should adapt their speed to maintain a safe distance between the pedestrian and their vehicle. If this is not possible the driver should travel at walking speed.

Traffic rules to help pedestrians avoid dangerous situations

Pedestrians are responsible for their own safety. Responsible pedestrian behaviours include; taking care when crossing the street, taking the shortest and most predictable routes, and crossing when the traffic signals permit. However, even when pedestrians take all precautions, human error is inevitable and pedestrians like drivers, require a forgiving environment.

Traffic rules specific to pedestrians crossing

There are four main factors that contribute to pedestrian crashes. These factors include: the visibility and conspicuity of the pedestrian, the length of the crossing, the predictability of pedestrian behaviour on the crossing and the moderation of vehicle travel speed (Brenac and Yerpez, 1997). These four factors can be integrated into the traffic rules or the rules and standards applicable to street design, which include:

- Ensure visibility of pedestrians wanting to cross.
- Minimise the crossing distance for pedestrians.
- Take into account the needs and wishes of pedestrians.
- Ensure moderation of vehicle speed in the area surrounding a pedestrian crossing.

6.7.4. Conclusions

Pedestrians are exposed to far more risks than they create through their presence in the public space and therefore, this inequity should be balanced through legislation. Implementation of the precautionary principle as well as offering financial protection to pedestrians could be one way to improve the current situation. It is important to undertake a critical review of the existing national traffic codes, to add, edit or rewrite rules that do not consider the safety of pedestrians or that cause too many constraints on them (or other vulnerable users). The traffic rules and standards applied by authorities should ensure visibility, predictability and the moderation of vehicle speed wherever pedestrians and vehicles use the same road, and especially where drivers approach a pedestrian crossing.

6.8. New technologies to encourage and facilitate pedestrian mobility

Innovative technologies have the potential to reduce the number and severity of pedestrian casualties when used correctly and also to facilitate the mobility of pedestrians.

6.8.1. Innovations to improve safety

Through innovative vehicle design and technology, novel active and passive safety features are being widely developed and employed to support the safety of vulnerable road users. It is expected that

these innovations in design and technology will play a key role in decreasing the number of pedestrian-vehicle conflicts, as well as reduce the severity of pedestrian injuries in the future.

Vehicle design to mitigate the consequences of a collision

The initial impact location in most pedestrian-vehicle conflicts occurs at the front-end of the vehicle; hence the shape and structure of the front-end are important determining factors in the type and severity of injuries sustained by pedestrians. Consequently, innovative designs that are aimed at changing the frontal structure and geometry of the vehicle will assist in reducing serious pedestrian injuries and fatalities.

Research on improving car bonnets by reducing their rigidity is another area of innovative vehicle design that has been aimed at reducing pedestrian injury and fatality (Simms and Wood, 2009). As adult pedestrians often received injuries from rigid components at the base of the windscreen, new structures provided in that area will help to absorb impact energy and reduce pedestrian injuries and fatalities (Simms and Wood, 2009). Bonnet airbags function in conjunction with pop-up bonnets. Upon impact with a pedestrian, the bonnet will raise providing clearance to the engine whilst an airbag is deployed simultaneously at the base of the windscreen (see figure 6.21). The airbag subsequently provides a cushion for the impact, which aims to minimise the severity of head injuries (Simms and Wood, 2009).

Leading research in this area is currently being carried out in Australia, Europe, Japan and the US, utilising advanced modelling and simulation of head and leg impacts to develop and improve test procedures and pedestrian protection standards for new vehicles. In 2003, on the basis of the report from the European Experimental Vehicle Committee (EEVC, 1998[4]), Europe voted a new directive to protect pedestrians and other vulnerable road users in case of collision with a motorised vehicle. Four subsystem tests were defined in order to test the level of aggressiveness for each new car model: on the bumpers (for impacts on legs), on the leading edge (for the hip) and on the lower and upper part of the bonnet (for the head – children and adults). Nevertheless, tools and methods for assessing each of these sub-systems need continual improvements to fit better with real conditions of pedestrian-vehicle crashes (Chalandon *et al*., 2007; Mizuno, 1998).

In addition, specific consumer tests on pedestrian protection were introduced in 1999, according to the "NCAP"[5] testing procedures. Based on EEVC (1998[6]), a new "four star" grading was established for the more "pedestrian friendly" vehicles. These procedures are currently used in Europe (EuroNcap) and in Australia (ANcap). In this domain, public policy should organise regulations and control with the goal of obtaining a strong reduction in injuries resulting from pedestrian crashes. In 2002, the European Transport Safety Council (ETSC, 2002) estimated that if all cars on the roads of the EU today passed the four EEVC tests, 2 000 lives and 17 000 injuries could be prevented each year. This would represent an economic saving of EUR 3.7 billion.

Figure 6.21. **Innovative vehicle design: Bonnet airbag system**

Source: EuroNCap.

Crash avoidance system

Intelligent driver-assist systems are an increasingly practical example of sensor technologies designed to alert a driver toward dangers posed by collisions with vehicles and other stationary objects. The Volvo model S60, introduced in 2010, is the first vehicle with technology capable of tracking moving pedestrians within a particular radius. When a pedestrian is detected, the vehicle will automatically stop.

Infrared lighting is another innovative technology being employed to help drivers see pedestrians at night.

Facilitating street crossing

A reportedly successful innovation for signalised pedestrian facilities is an optical detection system known as "Puffin" (Pedestrian User Friendly Intelligent) in Britain and Australia, and "Pussycats" (Pedestrian Urban Safety System and Comfort at Traffic Signals) in France and the Netherlands. Puffin crossings differ from the standard pelican crossings in that the lights informing the pedestrians are on the near side of the road, rather than on the opposite side. This type of design provides two advantages: 1) it allows the pedestrian to monitor passing traffic while waiting for the signal to cross, and 2) it may assist visually impaired pedestrians who may have difficulty seeing the signal from across the carriageway. The system also utilises sensors which detect the presence of pedestrians waiting at the crossing and as they are crossing the road, and ensures that the signals for vehicles remain red until the pedestrians have finished crossing (within practical limits) (Puffin Good Practice Guide, 2006).

6.8.2. Innovations to facilitate pedestrian mobility

As well as innovative vehicle designs, other types of innovative designs include those that help educate the public, provide development of road safety infrastructure, as well as offering various alternatives to transport.

GIS applications are being developed to provide route information for pedestrians, including mapping routes that allow for safe, convenient and secure walking. Pedestrians will be able to complete

route searches that accommodate their needs. Transmission of information about user location and transit schedules can be provided, as well as mapping to help pedestrians find their way.

6.8.3. Implementation issues

Automated in-vehicle systems and technologies provide the driver with valuable support, but integrating new technology and automation into driver decision-making is not without risks. In fact, it may lead to unwanted effects on driver performance and behaviour that outweigh the intended safety benefits. It takes time for such useful systems to be tested, and to penetrate the market and where appropriate be mandated into vehicle design by legislation.

GIS applications require local government to take leadership and co-ordinate the initiatives so that information is regularly maintained, updated and made available.

6.9. Summary

Promoting walking in urban areas requires a multidisciplinary approach and effective co-ordination in the implementation of the various measures to ensure the best results. The individual sets of measures described in this chapter need to be tested through a system-based approach – described in chapter 7 – while carefully assessing the benefits and costs of each measure. Several cities in ITF/OECD countries have been very successful in giving a more prominent role to pedestrians in the urban space, with tangible, positive impacts on the overall quality of life for all citizens.

NOTE

1. See: www.newurbanism.org/, www.smartgrowth.org, www.transitorienteddevelopment.org or http://transitorienteddevelopment.dot.ca.gov/
2. Strategy setting and participation (sharing interest) are two pillars of many planning approaches.
3. Geneva has developed pedestrian city map for all pedestrians and especially for children : www.ville-geneve.ch/fileadmin/public/publications/mobilite/petit-plan-pietons-champel-plan-2005-ville-geneve.pdf
4. www.eevc.org/publicdocs/WG17_Improved_test_methods_updated_sept_2002.pdf
5. EuroNCAP www.euroncap.com
6. www.eevc.org/publicdocs/WG17_Improved_test_methods_updated_sept_2002.pdf

ISBN 978-92-821-0364-7
Pedestrian Safety, Urban Space and Health

CHAPTER 7. NEED FOR A WALKING STRATEGY: ROLE OF GOVERNMENTS AND STAKEHOLDERS

National governments and transport and health ministers can do much to support and encourage walking. This chapter calls for a national walking strategy, backed by a clear vision and political support, with a systematic approach to understand pedestrian quality needs.

7.1. Understanding pedestrian quality needs

Walking and sojourning are everyday activities, which everyone undertakes. They are so familiar that it is often assumed that there is no need to acquire knowledge about walking issues, and that government organisations are adequately equipped to deal with them. Based on current studies, however, it appears that, in most cases, improvements in knowledge and its application on the part of the relevant organisations are necessary to achieve real improvements:

- The most basic precondition for improved support of walking and sojourning is awareness of deficits in the system that really matter. Factual knowledge of the system and what users on foot require of it must be acquired, disseminated and managed. It is critical that providers and their staff know what the issues are and that they have access to knowledge held by other stakeholders.

- Awareness itself is not enough to produce change. The authority must be willing to take action. There must be agreement on the content of the issue, on targets and on the strategy that is to be implemented.

- Organisations need to have the authority and opportunities, the tools, the skills and the necessary support to take action. Having these is far from self evident. They need to be acquired.

- Measures have to be truly and adequately implemented in a similar way to large projects concerning vehicles. In practice, there are still many obstacles to be overcome before the strategies that have been agreed upon can be implemented fully.

- Implemented measures need to be evaluated, so that we can learn from our successes and failures. If a measure works, its effectiveness needs to be disseminated so that it can be replicated. If it does not work, it needs to be remedied or no longer used.

A systems approach provides a complete package. The aim is to plan and provide an optimal, and as far as possible, flawless system, where pedestrians can move and sojourn freely and safely. This implies that adequate knowledge is acquired about how to develop and implement the change process taking into consideration the pedestrians' needs, wishes and behaviour. Intervention principles include:

- The change process should be based on a coherent vision on what the future of walking and sojourning in the public space must be. Such a vision serves as a reference standard for the evaluation of plans. The vision should be built on knowledge of the pedestrians' needs and abilities, now and in the future, as well as the interests and priorities of stakeholders.

- Knowledge about pedestrian behaviour is fundamental for the development of strategies to improve opportunities for walking and sojourning. Behaviour is brought about by needs, wishes, opportunities and abilities (Steg and Vlek, 2008). Needs and wishes give purpose and direction to behaviour; abilities define how well pedestrians can perform walking tasks; opportunities define whether or not walking will occur.

- Knowledge about pedestrian behaviour on the various activity levels is needed to develop suitable interventions: where to go (strategic level), how to move (tactical level), how to actually walk, sojourn, cross the street and react to conditions (operational level).

Knowledge should be acquired regarding intervention strategies that produce the best results in the most efficient way. The *Cascade of interventions* principle implies that the authority carefully deals with the logical sequence of decisions (where to go, route choice, reaction to conditions, taking the next step) in concrete situations and applies this knowledge towards the development of intervention strategies.

7.2. Developing a walking strategy

In Chapter 2 walking was described as being overlooked in both the formation of policy as well as in the decision-making process. Due to increasing trends in urbanisation and motorisation, it is evident that, without support, walking as a mode of transport and sojourning as a part of social life may well dissipate in many cities.

Administrations can play a significant and proactive role in redirecting this trend, alongside Non-government Organisations (NGOs) and interested citizens whose engagement is important in order to secure their co-ownership of the envisaged policies and measures affecting their city and ways of life. The results of the survey conducted for this report (ITF/OECD, 2008a) helped to unveil some myths regarding how administrations currently view walking and how institutional frameworks could better support actions for walking.

1. Walking seems to have been obliterated by some administrations which fail to provide leadership and support. This may occur for a number of reasons including: a belief that multiple organisations are involved in promoting walking, a failure to regard walking as a high priority area, or a failure to consider the implications of walking in urban development models.

With the expansion of cities and increasing levels of motorisation, walking as a key mode of transport has declined significantly. There are several reasons for the decline in walking and for the neglect of walking by public administrators and governmental institutions. Some of these reasons are listed below:

- First, it is tempting to view walking as a local matter only. After all, walking trips are relatively short, usually up to one kilometre (15-20 minutes), and the supporting infrastructure (footpaths, pavements and pedestrian crossings) are usually built by local administrations. Current knowledge points to the importance of an over-arching vision, consisting of clear policies and targets, with tailored communication, supportive research and technical advice to effectively promote walking.

- A second factor (also stated in chapter 2) is that walking appears to have suffered the same fate as many things that are taken for granted and forgotten. The humble status of walking is conceivably linked to its many benefits. Walking does not require large infrastructure investments. Walking congestion does not present as a problem but rather results in a positive phenomenon that feeds urban life. Walking does not consume fossil fuels nor create gas emissions. It is universal and inclusive. Last but not least, walking costs almost nothing and, therefore, there can be little commercial interest in promoting it.

- A third reason is that, not surprisingly, most transport, environment and health administrations have tended to focus on more perceived urgent priorities, leaving a leadership vacuum in terms of promoting walking. Moreover, as many organisations could have a stake in walking, it is not apparent where the leadership in this field should come from. At the same time, private sector involvement is difficult to achieve in the apparent absence of a profit stream.

- This leads to the fourth factor: the relationship between urban models and transport. Over the past fifty years, economic and urban models have pointed increasingly to infrastructure that supports the growth of personal and motorised transport. Developing countries are now experiencing similar if not more acute pressures – to catch up as quickly as possible with the developed world to gain a share of the "economic pie". As a result of these models, cities are increasingly facing the problems of restricted mobility and congestion. Governments are under pressure to find solutions that will often result in new infrastructure that further promotes car-based transport, increasing the risk to and the neglect of pedestrians.

2. Walking policies could yield very positive effects for the sustainability of urban systems, public health or social inclusion. There are a number of reasons for placing walking higher on the political agenda.

The true importance of walking has been reviewed in chapters 1 and 2. The shortcomings of current urban design are not just about denying options for pedestrians, but also impact adversely on sustainability of urban systems; and national energy and environmental options. It is well established that cities developed around cars consume more energy (Newman and Kenworthy, 1989) and have a greater impact on the environment, contributing to climate change (OECD, 2010, 53-60). Coupling land use planning with careful mobility policies that favour pedestrians is an important contributor in the fight against climate change. It helps to diminish total distance travelled per person and to enhance the use of carbon-free modes of transport (e.g. rail transport based on clean energy), which assist with public transport viability. Results from these concrete policies can already be seen. Cities around the world are developing sound pedestrian and public transport policies as key components of their sustainability plans (Cervero, 1989).

Examples include Copenhagen in Denmark, which has a low motorisation rate compared to similar places as a result of a spatial strategy developed after the second world war; and Curitiba, in Brazil, which has also guided its spatial development along its structural Bus Rapid Transit (BRT) system. It has also had a specific Pedestrian Master Plan since 1998 and has recently approved one of the newest "streetcar" systems (i.e. trams) in the country, thereby underlining the influential role of walking in coordinating land use and mobility policies.

Moreover, it has been established that promoting walking can improve the social or economic vitality of a city, as well as the health of society. Effective walking policies that encourage regular walking reduce health problems for a very meaningful percentage of the population, especially elderly people. It should also be noted that land use planning is the key to helping promote pedestrian safety and accessibility – particularly for those with impaired mobility. "Design for all" or "universal design" is an important component of urban transport planning.

Finally, a very beneficial and remarkable contribution of walking activity lies in its potential to promote social inclusion. As the "International Charter for Walking" states, witnessing pedestrians on streets is a key indicator of a healthy, efficient, socially inclusive and sustainable community.

No other transport mode, not even cycling, can claim to have this effect on communities through informal social links (Jacobs, 1961) and the natural surveillance of others (NCPC, 1997). Conversely, in sprawling urban environments, the evidence suggests that, "certain features of sprawl can lead towards greater social stratification and less social capital" (Frumkin, 2001). Problems surrounding the liveability of cities are growing in some countries such as the United States, where cars and car-oriented cities have been fuelled for decades. As a result, problems of social isolation and social homogeneity are appearing. Walking can then become the lynchpin for promoting more sustainable, healthier and socially cohesive environments. The impact of promoting walking is far-reaching and can contribute to the success of many other social policies (Tonucci, 1996).

Evidence from recent research shows that public administrations at the national/regional level can do a lot to support and encourage walking.

A comprehensive approach is imperative to prepare and launch actions. Evidence from the report indicated that reactive approaches that were used in the past led to ineffective solutions, while a system based approach, has the flexibility to generate supportive policies.

Complementary policies are needed for the successful promotion of walking, to such an extent that they have to be seen as "pre-conditional" policies. Their key areas will vary according to the requirements of each country, but they could include:

- Spatial Planning.
- Transport system and mobility.
- Safety.
- Environment.
- Health.
- Education and Communication.

A specific institutional and policy framework for pedestrians is also needed. This could include a National Policy or Plan for Pedestrians, governed by a national / regional administrative body. This set up would depend on each country's administrative culture, for example in Australia a governmental staff member may hold a portfolio on Pedestrians. A Research Programme or a Knowledge Centre (e.g., a National Pedestrian Observatory) could be another key instrument to homogenise these policies.

Of course the involvement of local administrative bodies is crucial, since they must have input to these policies. Finally, the role of other personnel and NGOs, has to be supported by administrations.

In the framework of sustainability policies, walking promotion should be considered a general cross-cutting strategy, while walking growth in cities can be an indicator of urban sustainability.

Box 7.1. **Case study: Swiss policy on Walking**

In Switzerland, the national policy on walking, which was instigated by a popular vote, agreed to the adoption of a new Article 88 in the Federal Constitution in 1978, giving the Federal Government jurisdiction over rural footpaths. Based on this constitutional article, in 1987, the "Federal Act on Footpaths and Hiking Trails" and the "Ordinance on Footpath and Hiking Trails" were adopted. The "Human Powered Mobility" Branch of the Federal Roads Office is responsible for their implementation.

In 2003, the Federal Government commissioned the Roads Office of the Federal Department of the Environment, Transport, Energy and Communications to develop a "Plan Directeur de la Locomotion Douce" (Soft Mobility Master Plan), where "locomotion douce" is defined as "human powered mobility". The Federal Administration is to implement the plan to develop human powered mobility by 2011, with actions required across a broad range of domains, including urban and regional planning, infrastructure, cities and agglomerations, information systems, mobility, education and public relations, research and development, statistics and evaluation, competencies and financing.

In 2006, a Federal Act to establish The Infrastructure Fund for Agglomeration, Traffic, Motorways and Main Roads in Mountain Areas of Fringing Regions was adopted to channel the federal financing of infrastructure. To be financed by the infrastructure fund, a project has to comply with certain criteria, among which improving human powered mobility plays an important role. The Federal Office for Spatial Development and the Roads Federal Office are lead agencies in managing and monitoring implementation of the plan and related funding applications.

In summary, Switzerland has introduced a number of important legislative measures to set in place a policy to encourage walking and a funding mechanism to assist in its implementation.

Box 7.2. **Case Study: US Policy on Walking**

In 1991, the US Congress initiated a national policy on walking and cycling, through two actions:

- Approval of the Intermodal Surface Transportation Efficiency Act (ISTEA), recognising for the first time in federal transport law the growing importance of pedestrian and bicycle trips in a well-balanced intermodal transportation system; additional legislative change followed to further accommodate non-motorised modes:
  - The Transportation Equity Act for the 21st Century in 1998, that introduced the potential to use part of the federal road funds to promote, create or maintain walking and pedestrian facilities (Section 217 of the Federal Code, "Bicycle transportation and pedestrian walkways").
  - The *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU)[1] of 2005, containing several programmes to promote non-motorised facilities and projects that attract federal funding via the Roads Trust Fund; programmes include:
    - the "Recreational Trails Program" (Section 1109, with a provision of USD 60 million in 2005, 70 million in 2006, 75 million in 2007, 80 million in 2008 and 85 million in 2009;
    - the "Safe Routes to School Program"[2] (Section 1104), with provision of USD 54 million in 2005, 100 million in 2006, 125 million in 2007, 150 million in 2008 and 183 million in 2009;
    - the "Non Motorized Transportation Pilot Program" (Section 1807) to develop network facilities in four communities Columbia (Missouri), Marin County (California), Minneapolis-Saint Paul (Minnesota) and Sheboygan County (Wisconsin) with a USD 25 million budget for each year, 2005-2009.

The SAFETEA-LU, 2005, requires each state to have a Cycling and Walking Coordinator (Federal Code section 217) to promote non-motorised trips, as a condition to receive federal funds for programmes addressing congestion, mitigation, surface transport and the like.

- Commissioning the Department of Transportation to develop a strategy to increase bicycling and walking while improving their safety and, in 1991, providing USD 1 million in funding to complete a National Bicycling and Walking Study3. This study was published in 1994 and updated in 1999, in 2004 and in 2009. The Study entailed four specific tasks:
  - determine the level of bicycle and walking mobility and the reasons why higher mobility levels are not being achieved;
  - develop a plan for increased mobility with improved safety and to identify the resources needed;
  - determine the full costs and benefits of promoting bicycling and walking in urban and suburban areas;
  - review and evaluate the success of promotions programmes globally to determine their applicability within the U.S.

To develop the non-motorised programmes, the U.S. Department of Transportation maintains a continuous monitoring function of progress by means of the "Bicycle and Pedestrian Program"[4] managed by the Federal Highway Administration", through its "Office of Human and Natural Environment".

3. The successful promotion of pedestrian mobility depends not only on the establishment of a clear vision, a national strategy, etc., but also on giving effect to a set of "pre-conditional" policies that affect several ministries (e.g. spatial planning, transport system and mobility, safety, etc.)

Presented below are some of the "pre-conditional" policies that could be developed:

- It is increasingly urgent for all ITF/OECD countries to start considering *urban planning and design* as key elements to encourage walking – a lack of attention to this will inevitably build dependence on the automobile to the detriment of pedestrian mobility. Urban planning policies can effectively promote "proximity", that is, poly-functional neighbourhoods within walking distance, as well as pedestrian safe and friendly environments.

- The pedestrian approach could be useful if used as a new departure point for *transport planning*, especially if addressed to reducing motorised daily mobility and when used to enhance public transport feasibility. To give credence to walking as a legitimate mode of transport, a greater focus is needed on pedestrian infrastructure design, quality and financing, ideally to a similar level as other transport modes. Similarly, pedestrian planning instruments (data, modelling, strategies, plans and design guidelines) need to be further developed, and integrated within similar urban mobility elements, such as mobility plans.

- To improve significantly *traffic safety* of pedestrians, there is a need to progress "best-practice" models in design, construction, maintenance, regulation, enforcement and speed management. Planning for effective road safety programmes will require an appropriate funding source. Coordination between national and local administration is urgently required, as is the dissemination of best-practice models, training programmes and monitoring procedures to enable effective programmes to be implemented to achieve ambitious reductions in pedestrian deaths and serious injuries in traffic.

- There is a need to develop programmes that reflect the relationship between pedestrian activity and improved *environmental* outcomes:

  - Environmental, energy ministries and national energy efficiency agencies must recognise the role of promoting walking in their national strategies and regulations;

  - Councils developing environmental programmes, such as Local Agenda 21, should strive to integrate pedestrian promotional opportunities in their composition.

- *Health* departments and ministries need to incorporate the encouragement of mobility programmes in their health promotion strategies and programmes.

- The role of *education and communication* needs to be strengthened and broadened – key targets include urban planning and transport professionals, relevant tertiary education faculties, specific groups including pre-schools, schools and older persons associations and the broader community. In addition, careers need to be created within transport, land use planning, environment and health.

- Ministries responsible for *public education* need to promote a new image for walking – one that espouses its many benefits and helps to persuade people to try walking. Health administrations, environment and transport ministries, public transport authorities and private entities can play a major role in communicating this image and the advantages of walking.

4. A specific pedestrian policy, backed by a systems-based approach to understand and define pedestrians' quality needs and preferences, is useful to complement the valuable initiatives taken by local authorities

The best examples of pedestrian promotion come from countries that have a proper, specific pedestrian policy. The following recommendations relate to the development of a national policy and supporting administrative arrangements conducive to effective implementation at the regional and local levels:

- In general, it is imperative to prepare a *national strategy or plan to encourage walking* to establish a clear framework for providing support for other sectorial or local initiatives. While the background and content can vary substantially between countries, walking clearly needs urgent support and a sound and common framework seems essential to trigger this.
- A *process* needs to be put in place to develop a national pedestrian strategy and oversee its implementation. There is no single answer, with the mechanism selected depending on national circumstances and institutional arrangements. In most cases, and in order to ensure the strong involvement of all relevant departments, a *coordinating role* across departments will be preferable to assigning a leading role to just one. Mechanisms to conduct a coordinating role include establishment of a national committee for coordination, an inter-ministerial coordinator (e.g. a "*Pedestrian Champion*") or a National Pedestrian Observatory.
- National pedestrian plans need to provide *guidance for local administrations*. Specifically, the content of local pedestrian plans needs to be defined, as do their relationships with other local plans (e.g., sustainable mobility plans, local road safety plans and Local Agenda 21). The need for professional expertise at the local level should be underlined, as should the best fit of pedestrian issues in local administrative structures. Furthermore, guidelines for local pedestrian plans should address the roles of public participation and financial support.
- Since pedestrians are not perceived by the public as a "class" or as a "lobby" group in their own right, there is a need to provide financial support for *non-government organisations* that represent pedestrian interests and a "place at the table" arranged for them where key issues surrounding pedestrian strategies and programmes are scoped and decided.
- Finally, there is a need to assess the feasibility and benefits of creating a *Pedestrian Knowledge Centre* or *National Pedestrian Observatory* to produce and gather relevant new knowledge on effective promotion of walking. Cultures around walking can largely vary from one country to another; so general knowledge might need to be "customised". The Observatory could also be responsible for producing and applying new knowledge to design and disseminate best-practice guidelines, norms and standards to assist local authorities to achieve effective change.

NOTES

1. www.fhwa.dot.gv/safetealu/
2. safety.fhwa.dot.gov/saferoutes/
3. www.fhwa.dot.gov/environment/bikeped/study/index.htm
4. www.fhwa.dot.gov/environment/bikeped/index.htm

ISBN 978-92-821-0364-7
Pedestrian Safety, Urban Space and Health

CHAPTER 8. CONCLUSIONS AND RECOMMENDATIONS

Walking has great potential to contribute to high-level government agendas for more sustainable development and should therefore take a central position in urban transport policies. Ensuring that walking is an attractive alternative and complement to motorised transport is a core response to the challenges of climate change, fossil fuel dependence, pollution, maintaining mobility for an ageing population, health, and managing the explosion in motorisation expected in low- and middle-income countries. Because trends established today will determine the future of cities for many decades, action is needed now for the sustainable cities of tomorrow.

Conclusions

1. Walking is the most fundamental form of mobility. It is inexpensive, emission-free, uses human power rather than fossil fuel, offers important health benefits, is equally accessible for all – except those with substantially impaired mobility – regardless of income, and for many citizens is a source of great pleasure. Yet walking presents challenges to society's least robust individuals.

Almost everyone is a pedestrian. Walking is the original and most natural mode of transport and the most important for maintaining good health.

Physical inactivity is a leading risk factor for health. Walking daily for as little as 30 minutes contributes to preventing the onset of numerous diseases linked to a lack of physical activity. The World Health Organisation has demonstrated that the overall benefits of walking outweigh any disadvantages associated with crash risk and exposure to pollution.

People with impaired mobility, using wheelchairs or mobility scooters, have at least similar requirements to pedestrians for an environment that facilitates accessibility.

The Charter for pedestrians' rights, adopted by the European Parliament in 1988 -- states that pedestrians have the right to live in a healthy environment and to enjoy freely the amenities offered by public areas, under conditions that adequately safeguard their physical and psychological well-being.

2. The vitality of a city is closely linked to people being out and about on foot for many purposes. Beyond walking for access to goods and services, these other activities in the urban space are collectively termed "sojourning". Walking and sojourning are at the heart of urban life and contribute to liveable, attractive, prosperous and sustainable cities.

Cities are places to live, connect and socialise. Urban space is for sojourning as well as moving around. Walking is fundamental to human existence and the quality of life.

Because walking connects people, it has an essential role in the liveability of cities, sociability, learning, and developing one's own personal independence and identity. Pedestrians generally make the most efficient use of scarce space in cities. Pedestrian areas and the intermingling of people bring vitality to cities and economic benefits to retailers.

3. Walking is, however, the neglected transport mode and, despite being at the start and end of all trips, is rarely captured in government statistics on mobility and is often neglected in planning and policy development.

The simplest, most sustainable and cheapest means of locomotion has been largely taken for granted – despite the fact that all trips begin or end on foot. Walking is a necessary complement of public transport. However, motorised traffic has generally received priority, exposing pedestrians to crash risks, inconvenience, pollutant emissions and noise. The entire urban environment, including the road transport system, should be designed taking better in consideration the needs of pedestrians.

Traditionally, street and urban design have not focused adequately on the needs of pedestrians. Fortunately, in an acceleration of a trend that had by the 1960s already been set by some pioneering cities and towns, the past practice of overlooking pedestrians' needs in favour of the car is now being reversed in many cities.

Decision-makers rely on mobility statistics, including data on personal travel behaviour, to formulate strategic transport policies and to improve the safety and efficiency of transport systems. However, published data rarely include walking, resulting in its exclusion from analysis and policy discourse.

Despite some well known difficulties in measuring walking, it is an important activity, representing as much as 50% of trips in urban areas. More comprehensive information on pedestrian mobility and safety would help better understand the role of walking in modern life and the causes and consequences of pedestrian injuries, including falls. Comprehensive data collection and analysis on all modes, including walking, are needed to plan and design for optimum mobility. Such analyses should focus on the efficiency, capacity, safety and flexibility of the transport system, to meet the current and future needs of all citizens, including those who are least able.

4. Public institutions representing specifically the interests of pedestrians – including the socially disadvantaged members of society who rely heavily on walking – are rare.

A large proportion of the pedestrian population comprises children and people with age or mobility-related impairments. These groups are not well placed or equipped for making their needs known to decision makers, and often lack support from lobby groups active in the transport sector. As a result, the most vulnerable groups of pedestrians are inadequately represented in urban policy-making. Indeed, no lead agencies for pedestrians at government level could be identified in the survey undertaken for this study.

Walking is not simply a local matter. National governments and transport and health ministers have a responsibility to support and encourage walking through leadership and by providing the necessary legal, administrative and technical frameworks.

Responsibilities for accommodating the needs of pedestrians and promoting walking are spread across a wide range of organisations and ministries, resulting in no clear institutional responsibility at either local or national levels for agencies to incorporate walking into their priorities. Central government needs to address the lack of incentives that results from fragmentation.

5. Walking and public transport are interdependent elements of sustainable urban mobility. Walking is facilitated by a well-connected network with pedestrian-friendly infrastructure and well-designed urban space.

Walking is an integral part of travel on public transport; it is more convenient over shorter distances and highly complementary to other transport modes. By strengthening public transport services, including accessibility and security, pedestrians are more motivated to use public transport in preference to private vehicles, thus contributing to a reduction in the number of motorised vehicles in city centres.

Pedestrians should be provided with a well-connected network of footways designed to minimise the effects of geographical, topographical, and physical barriers to pedestrian mobility. This network crucially needs to provide easy access to public transport facilities. By making decisions from the beginning that are favourable to walking, infrastructure costs will be lower and affordability higher than if costly redesign is needed to rectify basic problems, as what takes ten years to build can take 100 years to replace.

6. Pedestrians are amongst the road users most vulnerable to traffic injury. It has become highly challenging, especially for older and young people, to cope with the complex, sometimes hostile, traffic conditions that characterise today's cities and towns.

Pedestrians do not pose a significant risk to other road users, yet are exposed to life-threatening risks from them. However, they have been overlooked in the development of current traffic codes which have been focused on facilitating the flow of motorised traffic.

Insecurity, whether real or perceived, has a major impact on the decision to walk, especially in relation to children and elderly people. Of particular concern is an observed decline in walking among children, in part motivated by their parents' perceptions that walking is a high-risk activity.

At any given time, around 30% of pedestrians have impaired mobility (because they are overloaded, or have temporary or permanent health impairments). Because of the ageing of the population in many countries around the world, public authorities must prepare for a future where a growing number of highly vulnerable people will be even more dependent on walking.

7. Pedestrians suffer severe trauma from falls in public spaces and in traffic collisions while crossing streets. The magnitude of the consequences of falls is known to be underestimated. Older people have an elevated risk of severe injury and death from both falls and traffic collisions.

It is estimated that more than 20 000 pedestrian fatalities occur annually in OECD member countries, where pedestrian deaths range from 8 to 37% of all road fatalities. Worldwide, the number of pedestrians killed every year on the road exceeds 400 000. In all countries, senior pedestrians (over 65 years of age) are the most at risk. In OECD countries, the 65+ age group represents 13-20% of the population but they comprise more than 50% of pedestrian fatalities.

A large but under-estimated, and sometimes ignored, share of pedestrian injuries involves pedestrians falling in public spaces, accounting for up to 75% of all pedestrian injuries.

These injuries are partly due to an inadequate environment, poor maintenance of facilities and visual conditions. This problem will increase with ageing of the population, especially because of the increased frailty of older people.

8. Lowering motorised traffic speeds reduces the frequency and severity of crashes, especially those involving pedestrians. Reducing speed also contributes to smoother traffic flow, and enhances in many ways the liveability and sustainability of cities.

Pedestrian safety and the survival rate from collisions with vehicles are directly linked to the speed of motorised traffic. The risk of death or serious injury to a pedestrian rises rapidly at impact speeds above 30 km/h. Travel speeds of 30 km/h can reduce the risk of fatal injury to a pedestrian by over 80% compared to travel speeds at 50 km/h. Speeds above 30 km/h are too dangerous in mixed traffic zones and cities should not permit speeds of more than 50 km/h on any road designed also to be used by pedestrians.

The large majority of pedestrian injuries or fatalities occur in urban areas and, according to police reports, 70-80% of those in traffic collisions occur while crossing the road, including between 33% and 50% at pedestrian crossings. These findings highlight the importance of very careful planning in the design of pedestrian crossings. Pavements and crossings have to be planned for optimal functionality, providing a homogenous, predictable and forgiving environment, with safe placement of street furniture, signs, lampposts, to allow for a maximum visibility between pedestrians and drivers.

9. Motorisation has contributed to urban sprawl, and cities have evolved to accommodate car use, with many negative impacts on life and social cohesion. Changes are required now to manage the preponderant role of motorised traffic in industrialised countries. This is also urgent in low- and middle-income countries, which are now moving rapidly towards much higher levels of motorisation.

Cities are becoming increasingly dependent upon motor-vehicle transport as they expand in ways that contribute to urban sprawl. Planning and design features are required to reduce motor-vehicle use and promote alternative transport modes.

The needs of pedestrians should be considered when planning urban environments so that people can easily walk or travel by public transport to and from their chosen destinations. In addition, city planners should aim to develop pedestrian-friendly environments, including footways that are conducive to walking.

Recommendations

National governments and transport and health ministers can do much to support and encourage walking, even when it is considered to be mainly a local policy issue. A clear vision and political support at national level, backed by a systematic approach to understanding and defining infrastructure quality for pedestrians, is an important complement to, and support for, initiatives taken by local authorities. To achieve sustainable mobility, governments are invited in particular to consider the following recommendations:

1. Integrate mobility management and urban planning and take better account of the needs of pedestrians from the earliest stages of urban development projects and transport investments, with the object of creating seamless, high-quality networks for pedestrian activity.

2. Establish clear administrative responsibilities among relevant government departments at all levels for co-ordinating walking programmes and initiatives. The purpose of such arrangements is to stimulate and support actions in government and private sector organisations in an integrated way. This might take the form of a national committee or an interministerial co-ordinator supported by a national pedestrian observatory.

3. Improve knowledge about walking to adequately inform government policy development in relation to this fundamental aspect of mobility. This requires a standardized methodology for measuring, reporting and monitoring pedestrian mobility and injuries (from traffic crashes and falls). Standardization would help to make the measurement of growth in walking and sojourning a core indicator of urban sustainability and liveability. Efforts should also be directed at the development of international comparisons of mobility and safety statistics to agreed definitions. At a national level, such information could be collected by a national pedestrian observatory.

4. Incorporate public transport services as an integrated part of the development of new urban areas and the regeneration of existing areas, through planning guidance and financial support for public services. This can support a long-term shift towards higher-density, mixed-use, walking and transit-oriented urban form and a reduction in urban sprawl.

5. Encourage the responsible authorities to give higher priority and more space to non-motorised traffic and public transport in city centres. This includes a number of key actions: providing easy, safe, well-maintained and secure pedestrian access to public transport and to all city centre destinations; development of car-free areas; parking policies to discourage over-use of cars in city centres; and regulations to prevent parking on pavements and crossings, which undermines the quality of walking and, in severe cases, renders it impracticable.

6. Develop national pedestrian planning guidance for local administrations. Plans should be required to give consideration to the impact of projects on pedestrians, and cyclists, as part of project appraisals and environmental impact assessments. Plans should also consider the development and setting of targets for future levels of walking, as well as addressing needs for financial support. Public participation through, for example, pedestrian associations should be solicited in developing urban transport plans. Safety should receive specific attention in national planning guidance, with recommendations for implementation at the local authority level.

7. Encourage employers to implement a broad range of incentives for employees to include active transport in commuting trips. Government agencies should demonstrate leadership in this area.

8. Adopt a safe system approach for the design of the walking environment so that it is organised in such a way that specific risk groups are not exposed to avoidable risks.

9. Implement traffic-calming policies and generalise 30 km/h zones in city centres, residential areas and other high pedestrian activity areas. This should be based on a functional classification of urban spaces, streets and road networks, supported by appropriate infrastructure design criteria to create low-risk and amenable urban environments for non-motorised road users. To be fully effective, best-practice education, communication and enforcement programmes are needed. The development of intelligent speed adaptation systems is also recommended.

10. Encourage the introduction of high-quality education programmes in schools and local community centres, to teach safe road user behaviour and promote the benefits of walking through a range of effective forms of communication. Adult retraining initiatives are also recommended. School mobility plans should be developed aiming to produce a safe and supportive environment in which children can walk to and from school.

11. Conduct a critical review of current traffic codes to strengthen the legal and financial protection of pedestrians in case of a crash, and give higher priority to more vulnerable road users in order to provide safer, more equitable conditions among all road users.

12. Develop a research strategy to understand better mobility trends in a changing society. This should include evaluating the effectiveness of measures to reduce dependence on private car travel, achieve higher-density urban forms, protect the environment, improve health and achieve more efficient and sustainable use of energy.

In conclusion, it is the firm view of the contributors to this report that a shift in culture and in professional practices towards a more "walkable" society will deliver many highly-prized benefits to society, in both the short-term and the long-term futures. Safer, more vibrant, appealing and sustainable places to live, work and visit will result.

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ACKNOWLEDGEMENTS AND LIST OF PARTICIPANTS

This report is the result of a three-year co-operative effort by an international group of experts representing 19 countries as well as the World Health Organization.

The Working Group was chaired by Mr. Thanos Vlastos and the work was co-ordinated by the Secretariat of the Research Centre. The report was subject to expert review before publication. The report was formally approved by the Joint Transport Research Committee at its April 2011 session.

The Secretariat is very appreciative of all the time and effort the contributors dedicated to this report.

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The report was reviewed by Mr. Richard Allsop, University College, London. The Working Group and the Secretariat are very grateful for his comments and suggestions to improve the quality of this final publication.

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(75 2011 01 1 P) ISBN 978-92-821-0364-7 – No. 60171 2012

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(75 2011 01 1 P1)
ISBN 978-92-821-0364-7